

## DIVISION VIII

### STREETSCAPE SPECIFICATIONS

#### PART 800 – DECORATIVE LIGHTING

##### 800.1 GENERAL

###### 800.1.1 Summary:

A) This Section includes specific requirements for lighting and control for street and sidewalk lights to be installed in the City of Tulsa.

B) Section Includes:

- 1) Exterior Lighting Poles for support of luminaires, poles, and accessories.
- 2) Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
- 3) Luminaire supports.
- 4) Lighting control equipment.
- 5) Standard details are provided primarily to illustrate style and appearance of light fixtures. Performance of the lights is detailed in the specification in regard to lumen output, light color temperature, efficacy and testing requirements. All lights and poles provided shall be identical (within noted tolerances) in appearance to fixtures and poles specified in the standard details. Before approval for purchase, current test data as specified in this document is to be provided to the City of Tulsa, produced by an independent, UL Certified test lab.

C) Related Documents and Requirements:

- 1) Drawings and general provisions of the Contract, including General, Supplementary Conditions and City of Tulsa Special Conditions, apply to this Section.
- 2) City of Tulsa standard details.

###### 800.1.2 Definitions:

A) The following terms are used within the text of this Section:

- 1) BUG: Backlight, Uplight, and Glare.
- 2) CCT: Correlated Color Temperature.

- 3) CRI: Color Rendering Index.
  - 4) EPA: Equivalent Projected Area. This is important to verify wind loads if a new light is submitted.
  - 5) Fixture: See “Luminaire”.
  - 6) IPP: International Protection or Ingress Protection Rating.
  - 7) Lumen: Measured output of lamp and luminaire, or both.
  - 8) Luminaire: Complete lighting unit, including lamp, reflector, and housing.
  - 9) Pole: Luminaire-supporting structure.
  - 10) LED Module: LED assembly including circuit board, LEDs, and electronic components that plug into the fixture and produce light.
  - 11) IES: Illumination Engineering Society.
  - 12) NRTL: National Recognized Testing Laboratory.
  - 13) NIST: National Institute of Standards and Technology.
  - 14) PMMA: Poly (methyl methacrylate).
  - 15) IESNA: Illuminating Engineering Society of North America.
  - 16) ISTMT: In-situ Temperature Measurement Testing.
  - 17) UL: Underwriters Laboratories.
- B) The following items are included in the decorative lighting specifications and all equipment referenced is to be in compliance with this document.
- 1) All light fixtures, light poles, and pole bases associated with street lighting including those on street right-of ways and sidewalks.
  - 2) All underground conduit and wire or above ground electrical service for powering lights and receptacles associated with the light poles.
  - 3) All lighting controllers, contactors, photocells, and other components associated with the referenced lighting equipment.

- 4) Electrical Service provided by AEP-PSO for powering street lighting and associated receptacles.

800.1.3 Action Submittals:

- A) Product Data (Poles): For each pole, accessory, and luminaire-supporting device, arranged as indicated.
  - 1) Include data on construction details, profiles, EPA, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
  - 2) Include finishes for lighting poles and luminaire-supporting devices.
  - 3) Anchor bolts.
- B) Project Data (Luminaires): For each type of luminaire.
  - 1) Arrange in order of luminaire designation.
  - 2) Include data on features, accessories, and finishes. Include data on performance specification items identified in this document.
  - 3) Include physical description and dimensions of luminaire.
  - 4) For LEDs, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
  - 5) Before approval for purchase, provide for review IES LM-79, LM80 and TM21 test results. Data to be provided from an independent UL Certified laboratory.
  - 6) Provide means of attaching luminaires to supports and indication that the attachment is suitable for components involved and is consistent with detail drawings.

800.1.4 Closeout Submittals:

Operation and Maintenance Data:

- A) For luminaires include an operation and maintenance manual.

800.1.5 Maintenance Material Submittals:

- A) Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1) Poles: Furnish one spare pole to owner for every twenty poles installed. Furnish at least one pole of each type.

- 2) LED Modules: One for every ten of each type and rating installed. Furnish at least one of each type.
- 3) Lens Covers and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
- 4) Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.
- 5) Internal House Side Shield for acorn style luminaires: Furnish one spare house shield to owner for every five luminaires installed. Furnish at least one of each type.

800.1.6 Quality Assurance:

A) Luminaire Photometric Data Testing Laboratory Qualifications:

- 1) Provided by an independent UL Certified testing agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 for Energy Efficient Lighting Products and complying with applicable IES testing standards.

B) Provide luminaires from a single manufacturer for each luminaire type.

C) Each luminaire type shall be binned within a four-step MacAdam Ellipse to ensure color consistency among luminaires or use other processes to ensure light color is as specified by CCT and CRI values.

D) Installer Qualifications: An authorized representative who is a licensed electrician and is trained and approved by manufacturer is to be responsible for construction of the lighting system.

E) Manufacturer Qualifications:

- 1) Supplier of poles and LED fixtures must have documentation that they have been in the business of manufacturing poles and LED fixtures for at least five years.
- 2) It shall be the duty of the Director to investigate and examine the qualifications of all manufacturers of poles and LED fixtures, and consider the following:
  - a) Financial responsibility: An audited or reviewed financial statement from a Certified Public Accountant indicating a current asset-to-debt ratio of not less than 1.5 shall be provided upon request from the City. The City also reserves the right to request any additional documentation of the manufacturer's financial resources and condition.

- b) The character, quality and availability of the manufacturer's products and experienced personnel.
- c) The performance record of the manufacturer's products on other contracts for public or private improvements.
- d) The nature and extent of commitments involving the manufacturer's equipment and personnel.
- e) Reputation for reliability and integrity.
- f) Recommendation of other entities concerning the use of manufacturer's products and services.
- g) Any other facts which would materially affect the ability of the manufacturer to properly, adequately, expeditiously, and satisfactorily provide poles and LED fixtures and fulfill all warranty requirements, as necessary.

800.1.7 Delivery, Storage, and Handling:

- A) Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping. Retain factory-applied pole wrappings on poles until right before pole installation.
- B) Store poles on decay-resistant skids at least 12" above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C) Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

800.1.8 Warranty:

- A) Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in performance, materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period.
  - 1) Warranty Period for Luminaires: Seven years from date of Substantial Completion.
  - 2) Warranty Period for Metal Corrosion: Seven years from date of Substantial Completion.
  - 3) Warranty Period for Color Retention: Seven years from date of Substantial Completion.

- 4) Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within seven years from date of Substantial Completion.
  - 5) Warranty Period for Entire System: Seven years from date of Substantial Completion.
- B) Warranty to include all parts and labor as required to bring failed products back into compliance with the lighting system as originally specified.
  - C) Contractor to identify a local source for providing the warranty repair work. If necessary, to expedite repairs the owner may furnish spare parts to the warranty provider, with the understanding these parts shall be replaced at the earliest date possible.
  - D) City of Tulsa and the vendor are required to examine parts and mutually agree to when to declare damage to any fixture is the result of an electrical surge or lightning strike or other act not covered by the warranty.

## 800.2 MATERIALS

### 800.2.1 Lighting Poles Types:

- A) Foundation Design per latest AASHTO Standards for Structural Supports.
- B) Structural Characteristics: Comply with AASHTO LTS-4-M.
  - 1) Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated below.
    - a) Wind Load: Pressure of wind on pole and luminaire and banners and banner arms, calculated and applied as stated in AASHTO LTS-4-M.
    - b) Basic wind speed for calculating wind load for poles is 90 mph.
- C) Basis of design-Acorn Pole: Subject to compliance with requirements, provide the following:
  - 1) Tapered fiberglass composite core fluted pole.
  - 2) Nominal Height: 12'.
    - a) Wall thickness: 0.125".
    - b) Base: 20" diameter.

- 3) Anchor bolts: Per manufacturer standards and City of Tulsa Standard 804.
  - 4) Finish and Color: Powder Coated Black.
  - 5) Accessories:
    - a) Duplex Receptacle GFCI type, 120V AC, 15A in a weatherproof assembly. Comply with requirements in Section on "Wiring Devices". Mount as indicated on Detail.
    - b) See City of Tulsa Standard 800.
    - c) Banner Arms: Manufacturer's standard to match pole type. Two 30" banners per pole.
- D) Basis of Design Product: "Blue Dome" Pole. Subject to compliance with requirements, provide the following:
- 1) Pole:
    - a) Aluminum or steel.
    - b) Nominal Height: 25.5'.
    - c) Base: 16.5" diameter.
  - 2) Anchor Bolts: Per manufacturer's standards and City of Tulsa Standard 804.
  - 3) Finish & Color: Powder Coated, black.
  - 4) Accessories:
    - a) Duplex Receptacle GFCI type, 120V AC, 15A in a weatherproof assembly. Comply with requirements in Section on "Wiring Devices". Mount as indicated on Detail.
    - b) See City of Tulsa Standard 801.
    - c) Banner Arms: Manufacturer's standard to match pole type. Two 30" banners per pole.
- E) Basis of Design – "Ball Field" Pole (Existing Poles in Brady and Greenwood Districts)
- 1) Pole:
    - a) Aluminum or steel.

- b) Nominal Height: 18' for 4" pole and 25' for 5" pole.
  - c) Base: 18' pole has 16" base, 25' pole has 18" diameter base.
- 2) Anchor Bolts: Per manufacturer's standards and City of Tulsa Standard 804.
  - 3) Finish & Color: Powder Coated, black.
  - 4) Accessories:
    - a) Duplex Receptacle GFCI type, 120V AC, 15A in a weatherproof assembly. Comply with requirements in Section on "Wiring Devices". Mount as indicated on Detail.
    - b) See City of Tulsa Standard 802.
    - c) Banner Arms: Manufacturer's standard to match pole type. Two 30" banners per pole.

800.2.2 Performance Requirements (Luminaires):

- A) Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an independent UL certified testing agency, and marked for intended location and application.
- B) NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

800.2.3 Luminaire Types:

- A) Basis of Design-Acorn Light: Subject to compliance with requirements. Provide the following:
  - 1) Luminaire:
    - a) Diameter: 17.00",  $\pm 1$ ".
    - b) Height: 39.5",  $\pm 1$ ".
    - c) Lamp: LED modules.
  - 2) Optical System: IES Type V distribution, IP66 rated.
    - a) Flat lens, optical grade PMMA acrylic refractor or,
    - b) Clear, tempered, shock-resistant glass or,



- c) Prismatic globe, or
  - d) Approved equal.
- 3) Voltage: 120V to 277V.
- 4) Mounting & Configuration: Pole top mount.
- 5) Finish & Color: Powder Coated Black.
- 6) Lumens: Minimum 7600.
- 7) EPA: 2.17.
- 8) Luminaire Efficacy Rating (LM/W): Minimum 96.
- 9) BUG rating: B3-U3-G2
- 10)CRI = 70
- 11)CCT = 4,000K
- 12)System (LED + Driver) Rated Life: Minimum 100,000 hours.
- 13)Accessories:
- a) Duplex receptacle GFCI type, 120V AC, 15A in weatherproof assembly. Comply with requirements in section on "Wiring Devices". Mount as indicated on detail.
  - b) Provide fixture with "Dark Sky" compatible top shield to prevent spill light going upward.
  - c) Fixture to have factory provided "house shields" that can be installed in the globe to prevent light from spilling into adjacent residences or businesses, where this creates a problem.
  - d) See City of Tulsa Standard No. 800.
- B) Basis of Design Product: Blue Dome Light Fixture. Subject to compliance with requirements, provide the following, or equal:
- 1) Luminaire:
- a) Diameter: 27.5", ±1".

- b) Height: 23.25", ±1".
    - c) Lamp: LED modules
  - 2) Optical System: IES Type III distribution, IP66 rated.
    - a) Flat lens, optical grade PMMA acrylic refractor, or
    - b) Clear, tempered, shock-resistant glass.
  - 3) Voltage: 120V – 277V.
  - 4) Finish & Color: Powder Coated, black.
  - 5) Lumens: Minimum 9600.
  - 6) Luminaire Efficacy Rating (LM/W): Minimum 96.
  - 7) BUG rating: B3-U0-G2.
  - 8) CRI = 70.
  - 9) CCT = 4,000K.
  - 10) System (LED + Driver) Rated Life: Minimum 100,000 hours.
- C) Basis of Design Product: Ball Field Style Light Fixture.
  - 1) Luminaire:
    - a) Diameter: ±1".
      - 1. 18" on 18' pole.
      - 2. 26" on 25' pole.
    - b) Height: ±1".
      - 1. 13" on 18' pole.
      - 2. 19" on 25' pole.
    - c) Lamp: LED modules.
  - 2) Optical System: IES Type III distribution, IP66 rated.

- a) Flat lens, optical grade PMMA acrylic refractor, or
  - b) Clear, tempered, shock-resistant glass.
- 3) Voltage: 120V – 277V.
  - 4) Finish & Color: Powder Coated, black.
  - 5) Lumens: Minimum 7200 on 18' pole and minimum 9200 on 25' pole.
  - 6) Luminaire Efficacy Rating (LM/W): Minimum 96.
  - 7) BUG rating: B3-U0-G2.
  - 8) CRI = 80.
  - 9) CCT = 4,000K.
  - 10) System (LED + Driver) Rated Life: Minimum 100,000 hours.

#### 800.2.4 Special LED Lighting Requirements:

##### A) The following requirements are made on all proposed LED light Fixtures:

- 1) Fixtures must be comprised of modular components that are field replaceable, including glass lenses (where applicable), LED drivers and LED modules.
- 2) Power supply shall have a minimum power factor of .90 and a total harmonic distortion (THD) of 20% or less at full input power and voltage. Line transient protection shall be 20 kv or greater for both common mode and differential mode, per IEEE C.6241-2-2002 Class A operation. Power supply shall meet consumer emissions limits as described in FCC 47 CFR Part 15/18. TVSS shall have visible indication of failure and shall be field replaceable. The power supply shall have a Class A sound rating per ANSI Standard C63.4.
- 3) Luminaire to operate at temperature limits and have heat sinks and passive thermal management hardware that does not require fans or liquids. Thermal management systems to limit current when excessive temperatures are sensed. Thermal management system shall maintain LED temperature equivalent to the manufacturers rated specifications.

#### 800.2.5 Infrastructure Standards:

##### A) Conduit:

- 1) All buried conduit to be schedule 40 PVC. Wall thickness to be per ASME Standards B36.10M and B36.19M. All exposed conduit to be Rigid Galvanized Steel.
- 2) Conduit for AEP-PSO service feeders to lighting controllers to be minimum 3" PVC or HDPE.
- 3) Where boring is required, use minimum 3" HDPE.

B) Wire:

- 1) Wire to be installed in conduit for lighting.
- 2) Wire to be sized for ampacity of connected lighting and derated per NEC for multiple circuits, and voltage drop.
- 3) Minimum wire size is #12 for lighting and grounding circuits.

C) Pull Boxes:

- 1) Street Lighting pull boxes to be concrete or Prescolite (combination of plastic and fiberglass) or approved equal flush mounted boxes with lids.
- 2) Pull box lids to be permanently engraved with "LIGHTING".

D) Pole Bases:

- 1) All light fixtures shall be installed on cast-in-place concrete pole bases, as shown on the standard Standards 804 and 805.
- 2) Where special conditions are encountered, modified pole details shall be provided.
- 3) All pole bases to have an 8' copper clad ground rod installed adjacent to them and be bonded to the support steel using minimum #6 stranded wire. Connection is to be made via Cadweld.
- 4) Concrete testing of material for pole bases is to be per the latest ODOT Specifications.

800.2.6 Mounting Hardware:

- A) Exterior hardware shall be stainless steel.
- B) General Finish Requirements:

- 1) Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- 2) Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

## 800.3 EXECUTION

### 800.3.1 Examination:

- A) Examine areas and conditions, with Installer present, for compliance with pole manufacturer requirements for installation tolerances and other conditions affecting performance of the Work.
- B) Examine poles, luminaire-mounting devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.
- C) Examine rough-in for foundation and conduit to verify actual locations of installation.
- D) Examine rough-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- E) Proceed with installation only after unsatisfactory conditions have been corrected.
- F) Check architectural finishes and verify that luminaires are provided with proper trim, finishes, supports, and miscellaneous accessories regardless of catalog numbers prefixes or suffixes shown in fixture schedule.
- G) Verify all circuits in the lighting controller are permanently labeled and a circuit description is included in the panel lid. Confirm timer settings are correct.

### 800.3.2 Pole Installation:

- A) Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
- B) Orient access door away from curb.
- C) Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on Drawings.
  - 1) Fire Hydrants and Storm Drainage Piping: 60".
  - 2) Water, Gas, Electric, Communication, and Sewer Lines: 5'.

3) Trees: 15' from tree trunk.

4) From back of curb: 1'6".

D) Concrete Pole Foundations:

1) Cast in place, with anchor bolts to match pole base flange. Structural steel complying with ASTM A36/A36M and hot-dip galvanized according to ASTM A123/A123M and with top plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork as specified in latest ODOT specification.

2) Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements as specified in latest ODOT specification.

E) Foundation-Mounted Poles: Mount poles with leveling nuts and tighten top nuts to torque level recommended by pole manufacturer.

1) Grout void between pole base and foundation. Use non-shrink or expanding concrete grout firmly packed to fill space.

2) Install base covers unless otherwise indicated.

3) Use a short piece of 1/2" diameter PVC pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

F) The City of Tulsa field inspector shall inspect pole bases before they are poured.

G) Raise and set poles using web fabric slings (not chain or cable).

H) Where pole receptacles are used, verify proper function of receptacles with a portable receptacle tester.

800.3.3 Luminaire Installation:

A) Comply with NEC.

B) Use fastening methods and materials as approved by manufacturer.

C) Supports:

1) Sized and rated for luminaire weight.

2) Able to maintain luminaire position after cleaning and re-lamping.

- 3) Support luminaires without causing deflection of finished surface.
- 4) Luminaire-mounting devices shall be capable of supporting a horizontal force of 100% of luminaire weight and a vertical force of 400% of luminaire weight.
- D) Install luminaires level, plumb, and square with finished grade unless otherwise indicated.
- E) Coordinate layout and installation of luminaires with other construction.
- F) Verify proper operation of all luminaires and repair/replace any non-working material.
- G) Adjust luminaires that require field adjustment or aiming.

800.3.4 Corrosive Prevention:

- A) Aluminum: do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B) Steel Conduit: Comply with City of Tulsa Electric Code. In concrete foundations, wrap conduit with 0.010" thick, pipe-wrapping plastic tape applied with a 50% overlap.

800.3.5 Grounding:

- A) Ground metal poles and support structures according to City of Tulsa Electric Code.
  - 1) Install grounding electrode for each pole unless otherwise indicated.
  - 2) Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- B) Ground nonmetal poles and support structures according to the City of Tulsa Electric Code on "Grounding and Bonding for Electrical Systems".
  - 1) Install grounding electrode for each pole.
  - 2) Install grounding conductor and conductor protector.
  - 3) Ground metallic components of pole accessories and foundations.

800.3.6 Field Quality Control:

- A) Inspect each installed fixture for damage. Replace damaged fixtures and components with new.

B) Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

C) Verify operation of photoelectric controls.

D) Illumination Tests:

1) Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s).

a) IESNA LM-50 – “Photometric Measurements of Roadway Lighting Installations”.

b) IESNA LM-64 – “Photometric Measurements of Parking Areas”.

c) IESNA LM-72 – “Directional Positioning of Photometric Data”.

800.4 PAYMENT

800.4.1 Method of Measurement:

The City of Tulsa Inspector and the Project Architect or Engineer will review Pay Applications submitted by the Contractor and shall approve payment based on the quantity of lights that are properly and completely installed according to the drawings including footings, poles, fixtures and touch-up.

800.4.2 Basis of Payment:

Payment will be made for each site furnishing pay item at the contract unit price per specified pay unit:

<u>PAY ITEM</u>	<u>PAY UNIT</u>
STREETLIGHT	EACH

800.5 Design Criteria:

800.5.1 In order to facilitate a uniform look for the City of Tulsa the following standards are to be met in regard to street lighting:

A) Lighting Requirements:

1) For LED lights, contractor must submit the following test information performed by a UL certified lab:

a) LM-79 Fixture Test: This test is documentation of the fixture performed in a lab. Minimum acceptable efficacy for the fixture is to be 96 lumens/watt.



- b) Manufacturer to provide an ISTMT Thermal measurement test showing operation of the fixture in question under temperature, while current and light output are monitored. A test temperature of 25° C is required. This is a test of the submitted fixture under temperature, with documented performance values.
  - c) Independent 24-hour 40° C thermal testing shall be performed. Thermal measurements shall not exceed LED and power supply rated maximum values.
- 2) Provide TM-21 data: TM-21 is the IES-recommended method for projecting lumen degradation of an LED package, array or module based on data collected according to LM-80.
  - 3) Lighting Correlated Color Temperature shall be 4,000 K nominal. Independent UL testing to confirm lighting color temperature of the selected fixture.
  - 4) Minimum foot-candle illumination of 1.0 on sidewalk areas with a maximum average to minimum ratio of 3:1. Refer to IESNA standards or AASHTO Roadway Lighting Design Guide for other applications.

B) Lighting Controller and Light Pole Circuiting:

- 1) Contractor to feed lighting controller below grade, from AEP-PSO power pedestal or service pole.
- 2) Power conduit for AEP-PSO service feed to be minimum of 3" diameter.
- 3) No power for traffic control or other loads shall be fed from the lighting controller or associated conduits, with the exception of irrigation power and pole receptacles.
- 4) Provide controller per Standard No. 803. Feed only decorative lights and receptacles for the controller.
- 5) Traffic control equipment and AEP-PSO provided lights are not to be fed from lighting controller.
- 6) Receptacles on poles to be switched on with decorative lights.
- 7) Lighting controller is to be in a stand-alone NEMA 4X hinged stainless steel box. Box dimensions are to be approximately 30" W x 40" H x 24" D and to be mounted on a 4' x 4' x 0.5' thick concrete base with conduits entering from the bottom. Box to be bolted to concrete foundation with four 3/4" stainless steel bolts, length as required with 4" embedment. Use Hilti HIT-RE 500-SD epoxy or approved equal. Seal joint between cabinet and concrete pad with Dow Corning 795 Silicone Building Sealant with Limestone color or approved equal.

- 8) Lighting controller to have AEP-PSO approved meter installed on it. Meter is to be a minimum of 18" above grade.
- 9) Contractor to obtain permit and circuit for decorative street lighting in the name of the responsible party. Decorative lights and associated receptacles shall be metered.
- 10) Coordinate with AEP-PSO for electrical service for controller. Minimum service size is 240/120V 60A, single phase. Where needed, three phase panels are allowed. Size actual controller for connected load plus 20% additional load.
- 11) Astronomic timer must have at least 48 hours of internal backup to keep programmed times in the event of power loss.
- 12) Confirm exact location of lighting controller with owner before final installation.
- 13) All pole or fixture receptacles are to be GFCI rated in-use receptacles and be 120V single phase.
- 14) When pole mounted receptacles are used, the pole circuits and the receptacle circuits should match the same groupings.
- 15) All lights should have the same operating voltage.

C) Performance Requirements (Poles):

- 1) Structural Characteristics: Comply with AASHTO LTS-6-M.
- 2) Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.
- 3) Ice Load: Load of 3 lbs./sq. ft. (145 Pa), applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.
- 4) Minimum Design Life: 25 years.

## **PART 810 – BRICK UNIT PAVERS**

### 810.1 GENERAL

#### 810.1.1 Summary:

##### A) Section Includes:

- 1) Brick pavers set in sand or mortar setting beds.
- 2) Cast-in-place concrete edge restraints.

##### B) Related Sections:

- 1) Section: ODOT 303 – Aggregate Base
- 2) Section: ODOT 325 – Separator Fabric for Bases

#### 810.1.2 References:

##### American Society of Testing Materials (ASTM):

- A) C902 Standard Specification for Pedestrian and Light Traffic Paving Brick.
- B) C1272 Standard Specification for Heavy Vehicular Paving Brick.
- C) C136 Method for Sieve Analysis for Fine and Coarse Aggregate.
- D) C67 Method of Sampling and Testing Brick and Structural Clay Tile.
- E) C33 Specification for Concrete Aggregates.
- F) C144-89 Standard Specification for Aggregate for Masonry Mortar.

#### 810.1.3 Submittals:

##### A) Product Data and Specifications from Manufacturers:

- 1) Brick Paver.
- 2) Bedding Sand.
- 3) Polymeric Joint Sand.
- 4) Masonry Adhesive.

- B) Adhesion and Compatibility Test Reports: From latex-additive manufacturer for mortar and grout containing latex additives.
- C) Sand Equivalency test results according to AASHTO T 176.
- D) Sieve Analyses: For aggregate setting-bed materials, according to ASTM C136.
- E) Samples for Initial Selection for the following:
  - 1) Each type of unit paver indicated.
  - 2) Polymeric Joint Sand.
- F) Samples for Verification:
  - 1) Full-size units of each type of unit paver indicated on drawings. Six units each.

810.1.4 Quality Assurance:

- A) Installer Experience: Installation shall be by an installer with at least two years of experience and who has installed at least 200,000 sq. ft. of sand set pavers in commercial projects.
- B) Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.
- C) Mockups: Construct mockups of full-size sections of brick paver pavement to demonstrate typical joints, surface finish, texture, color, and standard of workmanship. Include 2 sq. ft. of brick on mortar.
  - 1) Build mockups to be 6' x 6' in a location as directed by Owner's Representative.
    - a) Mockups shall include all joint types, including joints with caulk.
    - b) Provide one mockup for each type of paving pattern indicated on the plans.
    - c) Contractor shall provide up to two mockups for each type of paving as base bid for the project.
  - 2) Notify Owner's Representative seven days in advance of dates and times when mockups will be constructed.
  - 3) Obtain Owner's Representative's approval of mockups before starting construction.

- 4) Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.
- 5) Demolish and remove approved mockups from the site when directed by Owner's Representative.
- 6) Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D) Preinstallation Conference: Conduct conference at Project site.

#### 810.1.5 Delivery, Storage, and Handling

- A) Deliver, store, and handle all paving materials in accordance with the manufacturer's recommendations.
- B) Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.
- C) Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D) Store aggregates where grading and other required characteristics can be maintained, and contamination avoided.
- E) Store liquids in tightly closed containers protected from freezing.

#### 810.1.6 Project Conditions:

- A) Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.
- B) Weather Limitations for Mortar and Grout:
  - 1) Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
  - 2) Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100° F and higher.

### 810.2 PRODUCTS

#### 810.2.1 Brick Pavers:

A) Manufacturer: Below or approved equal.

- 1) The Belden Brick Company, Crestline Brick Pavers  
PO Box 20910  
Canton, OH 77401-0910  
330.451.2013
- 2) Endicott Clay Products Co.  
PO Box 17  
Fairbury, NE 68352  
402.729.3323
- 3) Pine Hall Brick  
2701 Shorefair Drive  
Winston-Salem, NC 27105  
800.334.8689
- 4) Glen-Gery Brick, Extruded (repressed chamfer)  
PO Box 7001  
Wyomissing, PA 19610  
610.374.4011

B) Brick Pavers: Light-traffic paving brick; ASTM C902-09 Class SX Type I, Application PS. With a Minimum Coefficient of Friction at 0.70. Provide brick without frogs or cores in surfaces exposed to view in the completed Work.

C) Efflorescence: Brick shall be rated "not effloresced" when tested according to ASTM C67.

#### 810.2.2 Aggregate Base Materials:

A) Graded Aggregate for Base: Oklahoma Department of Transportation, Type "A" aggregate base according to Section 703.01 Aggregate for Aggregate Base, Oklahoma Department of Transportation Standard Specifications for Highway Construction, with the following exceptions:

- 1) 8% maximum passing the No. 200 sieve.

B) Sand for Setting Bed: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C33 for fine aggregate with the following exceptions:

- 1) 1% maximum passing the No. 200 sieve.
- 2) Sand equivalent of not less than 25.

- C) Polymeric Sand for Joints: Fine, sharp, washed, natural sand per ASTM C144 mixed with Ethylene-vinyl acetate or acrylic additive in dry, redispersible form; prepackaged. Equal to:
  - 1) Manufacturer: Techniseal.
  - 2) Product: Techniseal HP.
  - 3) Color: Granite Gray.
  - 4) 1% maximum passing the No. 200 sieve.
- D) Herbicide: Commercial chemical for weed control, registered with the EPA. Provide in granular, liquid, or wettable powder form.

810.2.3 Mortar Setting-Bed Materials:

- A) Portland Cement: ASTM C150, Type I or Type II.
- B) Hydrated Lime: ASTM C207, Type S.
- C) Sand: ASTM C144.
- D) Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed Portland cement and aggregate mortar bed, and not containing a retarder.
  - 1) See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers. Retain one of first two subparagraphs and list of manufacturers below. See Division 1 Section "Product Requirements".
  - 2) Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a) Custom Building Products.
    - b) Laticrete International, Inc.
    - c) MAPEI Corporation.
- E) Water: Potable.
  - 1) Polymer Type: Ethylene-vinyl acetate or acrylic additive in dry, redispersible form; prepackaged with other dry ingredients.

#### 810.2.4 Mortar and Ground Mixes:

- A) General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times, and other procedures needed to produce setting-bed and joint materials of uniform quality and with optimum performance characteristics. Discard mortars and grout if they have reached their initial set before being used.
- B) Mortar-Bed Bond Coat: Mix neat cement and latex additive to a creamy consistency.
- C) Portland Cement-Lime Setting-Bed Mortar: Type M complying with ASTM C270, Proportion Specification.
- D) Latex-Modified, Portland Cement Setting-Bed Mortar: Proportion and mix Portland cement, sand, and latex additive for setting bed to comply with written instructions of latex-additive manufacturer and as necessary to produce stiff mixture with a moist surface when bed is ready to receive pavers.
- E) Latex-Modified, Portland Cement Bond Coat: Proportion and mix Portland cement, aggregate, and liquid latex for bond coat to comply with written instructions of liquid-latex manufacturer.
- F) Masonry Adhesives: Concrete or Masonry Adhesives: Moisture Cure Urethane Glue for use with masonry and concrete.
  - 1) 'HP-Pro' by Techniseal, or
  - 2) Approved equal.

#### 810.2.5 Edge Restraints:

- A) Where not otherwise retained, provide edge restraints installed around the perimeter of all interlocking concrete paving unit areas as follows:
  - 1) Custom concrete edge restraint as shown in the details.
  - 2) 1/4" x 4" steel edging as manufactured by Joseph T. Ryerson & Son, Inc, Chicago, Illinois or Collier Metal Specialties, Inc., Garland Texas, or
  - 3) Approved equal.

#### 810.2.6 Geotextiles:

- A) Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50%; complying with AASHTO M 288 and the following, measured per test methods referenced:



- 1) Survivability: Class 2; AASHTO M 288.
- 2) Grab Tensile Strength: 247 lbf (1100 N); ASTM D4632.
- 3) Sewn Seam Strength: 222 lbf (990 N); ASTM D4632.
- 4) Tear Strength: 90 lbf (400 N); ASTM D4533.
- 5) Puncture Strength: 90 lbf (400 N); ASTM D4833.
- 6) Apparent Opening Size: 300 to 600  $\mu\text{m}$ ; ASTM D4751.
- 7) Permittivity: 0.02 per second, minimum; ASTM D4491.
- 8) UV Stability: 50% after 500 hours' exposure; ASTM D4355.

## 810.3 EXECUTION

### 810.3.1 Examination:

#### A) Acceptance of Site and Verification of Conditions:

- 1) All units shall be sound and free of defects that would interfere with the proper placing of unit or impair the strength or permanence of the construction.
- 2) Minor cracks incidental to the usual methods of manufacture, or chipping resulting from customary methods of handling in shipment and delivery, shall not be deemed grounds for rejection.
- 3) Contractor shall inspect, accept, and certify in writing to the paver installation contractor that site conditions meet specifications for the following items prior to installation of interlocking concrete pavers.
  - a) Verify that subgrade preparation, compacted density and elevations conform to specified requirements.
  - b) Verify that geotextiles, if applicable, have been placed according to drawings and specifications.
  - c) Verify that aggregate or concrete base materials, thickness, compacted density, surface tolerances and elevations conform to specified requirements.
  - d) Higher density or compaction to ASTM D1557 may be necessary for areas subject to continual vehicular traffic. Stabilization of the subgrade and/or base material may be necessary with weak or saturated subgrade soils.

- e) Provide written density test results for soil subgrade, and aggregate base materials to the CITY.
  - f) Verify location, type, and elevations of edge restraints, concrete collars around utility structures, and drainage inlets.
- 4) Do not proceed with installation of bedding sand and pavers until sub-grade soil and base conditions are corrected by the Contractor.
- B) Where pavers are to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.

#### 810.3.2 Preparation:

- A) Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.
- B) Verify base is dry, certified by Contractor as meeting material, installation, and grade specifications.
- C) Verify that base and geotextile is ready to support sand, edge restraints, pavers, and imposed loads.
- D) Edge Restraint Preparation:
  - 1) Install edge restraints per the drawings and manufacturer's recommendations at the indicated elevations.
  - 2) Mount directly to finished base. Do not install on bedding sand.
  - 3) The minimum distance from the outside edge of the base to the spikes shall be equal to the thickness of the base.
- E) Proof-roll prepared subgrade according to requirements of ODOT subgrade method B to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive base course for unit pavers.

#### 810.3.3 Installation, General:

- A) Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.

- B) Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
- C) Cut clay pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer or split cuts will be rejected.
- D) Handle protective-coated brick pavers to prevent coated surfaces from contacting backs or edges of other units. If, despite these precautions, coating does contact bonding surfaces of brick, remove coating from bonding surfaces before setting brick.
- E) Joint Pattern:
  - 1) As indicated on drawings for pedestrian applications.
- F) Joint filler before setting pavers. Sealant materials and installation are specified in Division 7 Section "Joint Sealants".
- G) Provide edge restraints as indicated. Install edge restraints before placing unit pavers.
  - 1) Install job-built concrete edge restraints or bands indicated on the drawings.
  - 2) Where pavers set in mortar bed are indicated as edge restraints for pavers set in aggregate setting bed, install pavers set in mortar and allow mortar to cure before placing aggregate setting bed and remainder of pavers. Cut off mortar bed at a steep angle so it will not interfere with aggregate setting bed.

#### 810.3.4 Aggregate Setting-Bed Applications:

- A) Compact soil subgrade uniformly to at least 95% of ASTM D698 laboratory density.
- B) Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- C) Place aggregate base, compact by tamping with plate vibrator, and screed to depth indicated.
- D) Place aggregate base, compact to 98% of ASTM D1557 (modified proctor) maximum laboratory density, and screed to depth indicated.
- E) Place sand setting bed and screed to a thickness of 1", taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.

- F) Treat setting bed with herbicide to inhibit growth of grass and weeds.
- G) Set pavers with a minimum joint width of 1/16" and a maximum of 1/8" being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Cut and arrange pavers so no pavers are smaller than 1/3 paver, and no joints are greater than 1/8". Exceptions will be made where pavers abut utility lids and curb radius. Fill gaps between units that exceed 3/8" insert dimension with pieces cut to fit from full-size unit pavers.
- H) Set pavers with a minimum joint width of 1/16" and a maximum of 1/8" being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed 3/8" insert dimension with pieces cut to fit from full-size unit pavers.
- 1) When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.
- I) Compaction of Pavers: Vibrate pavers only under Manufacturer's Approval or recommended written installation instructions, into sand setting bed with a low-amplitude plate vibrator capable of a 3,500-lbf to 5,000-lbf (16-kN to 22-kN) compaction force at 80 to 90 Hz. Use vibrator with neoprene mat on face of plate or other means as needed to prevent cracking and chipping of pavers. Perform at least three passes across paving with vibrator.
- 1) Place plywood protection plating over brick pavers prior to vibrating pavers into place. Operate compaction device on plywood to seat pavers.
  - 2) Compact pavers when there is sufficient surface to accommodate operation of vibrator, leaving at least 36" (900 mm) of uncompacted pavers adjacent to temporary edges.
  - 3) Before ending each day's work, compact installed concrete pavers except for 36" (900 mm) width of uncompacted pavers adjacent to temporary edges (laying faces).
  - 4) As work progresses to perimeter of installation, compact installed pavers that are adjacent to permanent edges unless they are within 36" of laying face.
  - 5) Before ending each day's work and when rain interrupts work, cover pavers that have not been compacted and cover setting bed on which pavers have not been placed with non-staining plastic sheets to protect them from rain.
- J) Polymeric Joint Sand: Spread dry joint sand and fill joints immediately after vibrating pavers into leveling course. Protect pavers with plywood and vibrate pavers to force

sand into joints. Repeat process as necessary to completely fill the joints and remove the excess sand.

- 1) Placement and hydration of polymeric joint sand shall be performed in accordance with the joint sand manufacturer's written instructions.
- K) Do not allow traffic on installed pavers until sand has been swept and vibrated into joints and joint sand has cured.
- L) Repeat joint-filling process as may be required for joints that are not completely filled.

#### 810.3.5 Mortar Setting-Bed Applications:

- A) Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.
- B) Apply mortar-bed bond coat over surface of concrete subbase about 15 minutes before placing mortar bed. Limit area of bond coat to avoid its drying out before placing setting bed. Do not exceed 1/16" thickness for bond coat.
- C) Apply mortar bed over bond coat; spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.
- D) Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Before placing pavers, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.
- E) Wet brick pavers before laying if the initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.
- F) Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform 1/16" thick bond coat to mortar bed or to back of each paver with a flat trowel.
  - 1) Joints are to match dry set pavers on sand setting bed and joints are to receive polymeric joint sand.
- G) Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.

#### 810.3.6 Masonry Adhesive:

A) Prepare surface and apply glue per the manufactures written instructions.

810.3.7 Field Quality Control:

A) Tolerances: do not exceed 1/16" unit-to-unit offset from flush (lippage) or 1/8" in 24" and 1/4" in 10' from level, or indicated slope, for finished surface of paving.

B) Pavers installed in heavy vehicular areas:

1) Pavement surface shall be set 1/8" to 1/4" (3 to 6 mm) above drainage gratings.

2) Pavement surface shall be set 1/8" above concrete edge restraints.

810.3.8 Maintenance for Refilling Joint Sand and Paver Settlement:

A) Refilling of Joints: One month after initial installation of pavers and at completion of project contractor shall sweep additional sand into the joints as needed and as directed by Engineer.

B) Paver Settlement: One month after initial installation of pavers and at completion of project contractor shall check surface of pavers for settlement and re-set pavers as needed and as directed by Engineer.

810.3.9 Repairing and Cleaning:

A) Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

B) Cleaning: Remove excess joint sand from exposed paver surfaces; wash and scrub clean.

810.3.10 Protection:

After work in this section is complete, the Contractor shall be responsible for protecting work from damage due to subsequent construction activity on the site.

810.4 PAYMENT

810.4.1 Method of Measurement:

The City of Tulsa Inspector and the Project Architect or Engineer will review Pay Applications submitted by the Contractor and shall approve payment based on the quantity of brick unit pavers that are properly and completely installed including aggregate base materials, mortar setting bed materials, mortar and grout mixes, masonry adhesives, edge restraints and geotextiles.

810.4.2 Basis of Payment:

Payment will be made for each square foot of installed brick unit pavers at the contract unit price per specified pay unit:

PAY ITEM  
BRICK UNIT PAVERS

PAY UNIT  
PER SQUARE FOOT

## **PART 811 – INTERLOCKING CONCRETE PAVERS**

### 811.1 GENERAL

#### 811.1.1 Summary:

##### A) Section Includes:

- 1) Interlocking Concrete Paver Units (manually installed).
- 2) Bedding and Joint Sand.
- 3) Edge Restraints.

##### B) Related Sections:

- 1) Section: ODOT 303 – Aggregate Base
- 2) Section: ODOT 325 – Separator Fabric for Bases

#### 811.1.2 References:

##### A) American Society for Testing and Materials (ASTM):

- 1) ASTM C33, Standard Specification for Concrete Aggregates.
- 2) ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- 3) ASTM C140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
- 4) ASTM C144, Standard Specification for Aggregate for Masonry Mortar.
- 5) ASTM C936, Standard Specification for Solid Concrete Interlocking Paving Units.
- 6) ASTM C979, Pigments for Integrally Colored Concrete.
- 7) ASTM D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,000 ft-lbf/ft<sup>3</sup>).
- 8) ASTM D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup>).
- 9) ASTM D2940, Specification for Graded Aggregate Material for Bases or Sub-bases for Highways or Airports.



### 811.1.3 Submittals:

- A) Manufacturer's drawings and details: Indicate perimeter conditions, relationship to adjoining materials and assemblies, expansion and control joints, concrete paver layout, patterns, color arrangement, installation and setting details.
- B) Sieve analysis per ASTM C136 for grading of bedding and joint sand.
- C) Concrete pavers:
  - 1) Four representative full-size samples of each paver type, thickness, color, finish that indicates the range of color variation and texture expected in the finished installation. Color(s) selected by Owner and approved by the City of Tulsa from manufacturer's available colors.
  - 2) Accepted samples become the standard of acceptance for the work.
  - 3) Test results from an independent testing laboratory for compliance of paving unit requirements to ASTM C936.
  - 4) Manufacturer's certification of concrete pavers by ICPI as having met applicable ASTM standards.
  - 5) Manufacturer's catalog product data, installation instructions, and material safety data sheets for the safe handling of the specified materials and products.
- D) Paver Installation Contractor:
  - 1) A copy of Contractor's current certificate from the Interlocking Concrete Pavement Institute Level I Concrete Paver Installer Certification program.
  - 2) Job references from projects of a similar size and complexity. Provide Owner/Client/General Contractor names and phone numbers.

### 811.1.4 Quality Assurance:

- A) Paving Contractor Qualifications:
  - 1) Utilize an installer with at least one year of experience having successfully completed concrete paver installation similar in design, material, and extent indicated on this project.
  - 2) Utilize an installer holding a current certificate from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program and shall be fully aware and follow their recommendations and specifications.

- B) Manufacturer: Company specializing in the manufacture of concrete interlocking pavers for a minimum of three years.
- C) Installation Contractor shall conform to all local, state/provincial licensing and bonding requirements.
- D) Contractor shall be certified by the Interlocking Concrete Pavement Institute and shall be fully aware and follow their recommendations and specifications.
- E) Regulatory Requirements and Approvals: As required by the City of Tulsa for work within the Right of Way.
- F) Mockups:
  - 1) Install a 6' x 6' paver area.
  - 2) Use this area to determine surcharge of the bedding sand layer, joint sizes, lines, laying pattern(s), color(s), and texture of the job.
  - 3) Evaluate the need for protective pads when compacting paving units with architectural finishes.
  - 4) This area will be used as the standard by which the work will be judged.
  - 5) Subject to acceptance by owner, mockup may be retained as part of finished work.
  - 6) If mockup is not retained, remove, and properly dispose of mockup.

811.1.5 Delivery, Storage, and Handling:

- A) General: Comply with Division
  - 1) Product Requirement Section.
- B) Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers packaging with identification labels intact.
  - 1) Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving.
  - 2) Deliver concrete pavers to the site in steel banded, plastic banded, or plastic wrapped packaging capable of transfer by forklift or clamp lift.
  - 3) Unload pavers at job site in such a manner that no damage occurs to the product.

- C) Storage and Protection: Store materials protected such that they are kept free from mud, dirt, and other foreign materials. Store concrete paver cleaners and sealers per manufacturer's instructions.

811.1.6 Project/Site Conditions:

A) Environmental Requirements:

- 1) Do not install sand or pavers during heavy rain or snowfall.
- 2) Do not install sand and pavers over frozen base materials.
- 3) Do not install frozen sand or saturated sand.
- 4) Do not install concrete pavers on frozen or saturated sand.

811.2 PRODUCTS

811.2.1 Interlocking Concrete Pavers:

A) Manufacturer:

- 1) Concrete pavers shall be equal to those supplied by Pavestone Company,
  - a) D/FW, TX: 817.481.5802
  - b) Houston, TX: 281.391.7283
  - c) Kansas City, MO: 816.524.7283
  - d) San Antonio/Austin, TX: 512.558.7283
  - e) Dallas Service Center: 972.404.0400
  - f) Cape Girardeau, MO: 573.264.1500 or
- 2) Hanover Prest-Paving Company  
240 Bender Road  
Hanover, PA 17331  
800.426.4212, or
- 3) Belgard Pavers from Bonner Springs, Kansas.

B) Interlocking Concrete Paver Units, including the following:

- 1) Paver Type: Equal to Holland Stone

- a) Material Standard: Comply with material standards set forth in ASTM C936.
- b) Color and finish: As selected by the Owner and approved by the City of Tulsa.
- c) Color Pigment Material Standard: Comply with ASTM C979.
- d) Size in Pedestrian Areas: Nominal 3.875" x 7.875" x 2.36" (60 mm) thick, or as approved by the City of Tulsa.
- e) Size in Vehicular Areas: 3.875" x 7.875" x 3.16" (80 mm) thick, or as approved by the City of Tulsa. For driveway and access use only – not for street use.
- f) Average Compressive Strength: 8,000 psi with no individual unit under 7,200 psi.
- g) Average Water Absorption (ASTM C140): 5% with no unit greater than 7%.
- h) Freeze/Thaw Resistance (ASTM C67): Resistant to 50 freeze-thaw cycles with no greater than 1% loss of material.
- i) Minimum average cube compressive strength of 7,250 psi for laboratory cured specimens or 5,800 psi for unconditioned field samples.
- j) Resistance to 28 freeze-thaw cycles while immersed in a 3% saline solution with no greater mass lost than 225 g/m<sup>2</sup> of surface area after 28 years, or 500 g/m<sup>2</sup> after 49 cycles.

#### 811.2.2 Aggregate Base Materials:

##### A) Provide bedding and joint sand as follows:

- 1) Clean, non-plastic, free from deleterious or foreign matter, symmetrically shaped, natural, or manufactured from crushed rock.
- 2) Do not use stone dust.
- 3) Do not use limestone screenings or sand for the bedding that does not conform to the grading requirements of ASTM C33.
- 4) Do not use mason sand, or sand conforming to ASTM C144 for the bedding sand.
- 5) Where concrete pavers are subject to vehicular traffic, utilize sands that are as hard as practically available.

- 6) Sieve according to ASTM C136.
- 7) Bedding Sand Material Requirements: Conform to the grading requirements of ASTM C33 with modifications as shown in Table 1.
- 8) Joint Sand Material Requirements: Conform to the grading requirements of ASTM C144 as shown with modifications in Table 2 or meet the requirements for bedding sand in Table 1.

Table 1  
Grading Requirements for Bedding Sand

ASTM C33		CSA A23.1 FA1	
<u>Sieve Size</u>	<u>Percent Passing</u>	<u>Sieve Size</u>	<u>Percent Passing</u>
3/8" (9.5 mm)	100	10 mm	100
No. 4 (4.75 mm)	95 to 100	5 mm	95 to 100
No. 8 (2.36 mm)	80 to 100	2.5 mm	80 to 100
No. 16 (1.18 mm)	50 to 85	1.24 mm	50 to 90
No. 30 (0.600 mm)	25 to 60	0.630 mm	25 to 65
No. 50 (0.300 mm)	10 to 30	0.315 mm	10 to 35
No. 100 (0.150 mm)	2 to 10	0.160 mm	2 to 10
No. 200 (0.075 mm)	1	0.075 mm	1

B) Polymeric Sand for Joints: Fine, sharp, washed, natural sand per ASTM C144 mixed with Ethylene-vinyl acetate or acrylic additive in dry, redispersible form; prepackaged. Equal to:

- 1) Manufacturer: Techniseal.
- 2) Product: Techniseal HP.
- 3) Color: Granite Gray.
- 4) 1% maximum passing the No. 200 sieve.

Table 2  
Grading Requirements for Joint Sand

<u>Sieve Size</u>	ASTM C144	ASTM C144	CSA A179	CSA A179
	Natural	Sand	Manufactured	Sand
	<u>Percent Passing</u>	<u>Percent Passing</u>	<u>Percent Passing</u>	<u>Percent Passing</u>
No. 4 (4.75 mm)	100	100	5 mm	100
No. 8 (2.36 mm)	95 to 100	95 to 100	2.5 mm	90 to 100
No. 16 (1.18 mm)	70 to 100	70 to 100	1.25 mm	85 to 100
No. 30 (0.600 mm)	40 to 75	40 to 100	0.630 mm	65 to 95
No. 50 (0.300 mm)	10 to 35	20 to 40	0.315 mm	15 to 80
No. 100 (0.150 mm)	2 to 15	10 to 25	0.160 mm	0 to 35

No. 200 (0.075 mm)      0 to 1      0 to 10      0.075 mm      0 to 1

### 811.2.3 Edge Restraints:

A) Where not otherwise retained, provide edge restraints installed around the perimeter of all interlocking concrete paving unit areas as follows:

- 1) Custom concrete edge restraint as shown in the details.
- 2) 1/4" x 4" steel edging as manufactured by:  
Joseph T. Ryerson & Son, Inc.  
Chicago, Illinois  
or  
Collier Metal Specialties, Inc.  
Garland Texas.
- 3) Other if approved by the City of Tulsa.

### 811.2.4 Geotextiles:

A) Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50%; complying with AASHTO M 288 and the following, measured per test methods referenced:

- 1) Survivability: Class 2; AASHTO M 288.
- 2) Grab Tensile Strength: 247 lbf; ASTM D4632.
- 3) Sewn Seam Strength: 222 lbf; ASTM D4632.
- 4) Tear Strength: 90 lbf; ASTM D4533.
- 5) Puncture Strength: 90 lbf; ASTM D4833.
- 6) Apparent Opening Size: 300 to 600  $\mu$ m; ASTM D4751.
- 7) Permittivity: 0.02 per second, minimum; ASTM D4491.
- 8) UV Stability: 50% after 500 hours' exposure; ASTM D4355.

## 811.3 EXECUTION

### 811.3.1 Examination:

A) Acceptance of Site and Verification of Conditions:

- 1) All units shall be sound and free of defects that would interfere with the proper placing of unit or impair the strength or permanence of the construction.
- 2) Minor cracks incidental to the usual methods of manufacture, or chipping resulting from customary methods of handling in shipment and delivery, shall not be deemed grounds for rejection.
- 3) Contractor shall inspect, accept, and certify in writing to the paver installation contractor that site conditions meet specifications for the following items prior to installation of interlocking concrete pavers.
  - a) Verify that subgrade preparation, compacted density and elevations conform to specified requirements.
  - b) Verify that geotextiles, if applicable, have been placed according to drawings and specifications.
  - c) Verify that aggregate or concrete base materials, thickness, compacted density, surface tolerances and elevations conform to specified requirements.
  - d) Higher density or compaction to ASTM D1557 may be necessary for areas subject to continual vehicular traffic. Stabilization of the subgrade and/or base material may be necessary with weak or saturated subgrade soils.
  - e) Provide written density test results for soil subgrade, and aggregate base materials to the CITY.
  - f) Verify location, type, and elevations of edge restraints, concrete collars around utility structures, and drainage inlets.
- 4) Where pavers are to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.

#### 811.3.2 Preparation:

- A) Verify base is dry, certified by Contractor as meeting material, installation, and grade specifications.
- B) Verify that base and geotextile is ready to support sand, edge restraints and pavers, and imposed loads.
- C) Edge Restraint Preparation:

- 1) Install edge restraints per the drawings and manufacturer's recommendations at the indicated elevations.
- 2) Mount directly to finished base. Do not install on bedding sand.
- 3) The minimum distance from the outside edge of the base to the spikes shall be equal to the thickness of the base.

#### 811.3.3 Installation:

- A) Spread bedding sand evenly over the base course and screed rails, using the rails to produce a nominal 1" (25 mm) thickness, allowing for specified variation in the base surface.
  - 1) Do not disturb screeded sand.
  - 2) Screeded area shall not substantially exceed that which is covered by pavers in one day.
  - 3) Do not use bedding sand to fill depressions in the base surface.
- B) Ensure that pavers are free of foreign materials before installation.
- C) Lay pavers in pattern(s) shown on drawings. Make horizontal adjustments to laid pavers as required.
- D) Provide joints between pavers 1/16" (2 mm) wide.
- E) Joint (bond) lines shall not deviate more than  $\pm 1/2"$  (12 mm) over 50' (15 m) from string lines.
- F) Fill gaps at the edges of the paved area with cut pavers or edge units. Cut and arrange pavers so no pavers are smaller than 1/3 paver, and no joints are greater than 1/8". Exceptions will be made where pavers abut utility lids and curb radius.
- G) Cut pavers to be placed along the edge with a masonry saw.
- H) Adjust bond pattern at pavement edges such that cutting of edge pavers is minimized. All cut pavers exposed to vehicular tires shall be no smaller than one-third of a whole paver.
- I) Keep skid steer and forklift equipment off newly laid pavers that have not received initial compaction and joint sand.
- J) Use a low-amplitude plate compactor capable of at least minimum of 3,000 lbf for 60 mm pavers, and 5,000 lbf for 80 mm pavers, at a frequency of 75 to 100 hHz to



vibrate the pavers into the sand. Remove any cracked or damaged pavers and replace with new units.

- K) Simultaneously spread, sweep, and compact dry joint sand into joints continuously until full. This will require at least four to six passes with a plate compactor. Do not compact within 3' (900 mm) of unrestrained edges of paving units.
- L) All work within 3' (900 mm) of the laying face must be left fully compacted with sand-filled joints at the end of each day or compacted upon acceptance of the work. Cover the laying face or any incomplete areas with plastic sheets overnight if not closed with cut and compacted pavers with joint sand to prevent exposed bedding sand from becoming saturated from rainfall.
- M) Remove excess sand from surface when installation is complete.
- N) Allow excess joint sand to remain on surface to protect pavers from damage from other trades. Remove excess sand when directed by Architect.
- O) Surface shall be broom clean after removal of excess joint sand.
- P) Re-sanding of the paver joints as necessary shall be accomplished by the Contractor for a period of 90 days after completion of the work.

#### 811.3.4 Field Quality Control:

- A) The final surface tolerance from grade elevations shall not deviate more than  $\pm 3/8$ " (10 mm) over 10' (3 m). Use a straightedge, flexible straightedge or transit depending on surface slope and contours.
- B) Check final surface elevations for conformance to drawings.
- C) The surface elevation of pavers shall be 1/8" to 3/8" (3 to 10 mm) above adjacent drainage inlets, concrete collars, or channels.
- D) Lippage: No greater than 1/8" (3 mm) difference in height between adjacent pavers.

#### 811.3.5 Repairing and Cleaning:

- A) Remove and replace pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.
- B) Clean concrete pavers in accordance with the manufacturer's written recommendations.

811.3.6 Protection:

A) After work in this section is complete, the General Contractor shall be responsible for protecting work from damage due to subsequent construction activity on the site.

811.4 PAYMENT

811.4.1 Method of Measurement:

The City of Tulsa Inspector and the Project Architect or Engineer will review Pay Applications submitted by the Contractor and shall approve payment based on the quantity of concrete pavers that are properly and completely installed including aggregate base materials, edge restraints and geotextiles.

811.4.2 Basis of Payment

Payment will be made for each square foot of installed brick unit pavers at the contract unit price per specified pay unit:

<u>PAY ITEM</u>	<u>PAY UNIT</u>
CONCRETE PAVERS	PER SQUARE FOOT

## **PART 812 – STAMPED CONCRETE FINISHING**

### 812.1 GENERAL

#### 812.1.1 Summary:

##### A) Section Includes:

- 1) Integrally colored and color-hardened Portland cement concrete paving with imprinted pattern and stain/sealer treatments.

##### B) Related Documents:

- 1) Section 7 9000 – Joint Sealants: Sealant for joints.

#### 812.1.2 References:

##### A) American Concrete Institute (ACI)

- 1) ACI 305R – Hot Weather Concreting.
- 2) ACI 306R – Cold Weather Concreting.
- 3) ACI 308 – Standard Practice for Curing Concrete.
- 4) ACI 309 – Standard Practice for Consolidation of Concrete.
- 5) ACI 347 – Guide to Formwork for Concrete.
- 6) ACI 503 – Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive.

##### B) American Society for Testing and Materials (ASTM)

- 1) ASTM C33 – Standard Specifications for Concrete Aggregates.
- 2) ASTM C150 – Standard Specifications for Portland Cement.
- 3) ASTM C260 – Standard Specifications for Air-Entraining Admixtures for Concrete.
- 4) ASTM C309 – Standard Specifications for Liquid Membrane Forming Compounds for Curing Concrete.
- 5) ASTM C494 – Standard Specifications for Chemical Admixtures for Concrete.

#### 812.1.3 Submittals:

A) Product Data: Manufacturer's data sheets on each product to be used, including:

- 1) Preparation instructions and recommendations.
- 2) Storage and handling requirements and recommendations.
- 3) Installation methods.

B) Testing:

- 1) Submit proposed mix design for each class of concrete for review prior to commencement of work.
- 2) Testing firm will take cylinders and perform slump and air entrainment tests in accordance with ACI 301.
- 3) Four concrete test cylinders will be taken for each class of concrete placed each day.
- 4) One slump test will be taken for each set of test cylinders taken.

812.1.4 Quality Assurance:

A) Installer Qualifications:

- 1) The Installer shall provide a qualified foreman or supervisor who has a minimum of three years of experience with imprinted and textured concrete, and who has successfully completed at least five imprinted concrete installations of high quality and similar in scope to that required.
- 2) The concrete is cast in place, on the job site, by trained and experienced workmen who shall be employed by a firm that is a licensed and certified Imprint Licensed Contractor by a reputable national colored concrete company.
- 3) Perform work in accordance with ACI 301, 302, 303.
- 4) Obtain materials from same source throughout.
- 5) Conform to applicable codes and regulations for paving work performed within the public right of way.

B) Ready-Mixed Supplier Qualifications:

- 1) Supplier of ready-mixed concrete products shall comply with ASTM C94 requirements for production facilities and equipment. Supplier shall be certified

according to NCRMA's "Certification of Ready Mixed Concrete Production Facilities Quality Control Manuals".

C) Testing Agency Qualifications:

- 1) An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 to conduct the testing indicated, as documented according to ASTM E548.

D) Mockup:

- 1) Provide field samples of surface colors textures and patterns specified for architect approval prior to beginning work, 48" x 48" in size illustrating paving finishes.
  - a) Finish areas designated by Architect.
  - b) Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect
  - c) Finish mockup area as required to produce acceptable work.

812.1.5 Delivery, Storage, and Handling:

- A) Store products in manufacturer's unopened packaging until ready for installation.
- B) Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

812.1.6 Project Conditions:

- A) Do not place pavement when base surface or ambient temperature is less than 40° F (4° C) or if base surface is wet or frozen.
- B) Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

812.1.7 Warranty:

- A) All materials equal to that manufactured by The Bomanite Company and warranted to be of uniform quality within manufacturing tolerances.

812.2 PRODUCTS

812.2.1 Manufacturers:

A) Acceptable Manufacturers:

- 1) The Bomanite Company  
8789 Auburn Folsom Rd #108  
Granite Bay, CA 95746  
Tel: 303.369.1115  
Fax: 303.291.0282  
Email: info@bomanite.com  
Web: www.bomanite.com
- 2) Patterned Concrete Industries, Ltd.  
800.252.4619  
www.patternedconcrete.com

812.2.2 System:

A) Supporting Structure:

- 1) Mix Design:
  - a) Mix and deliver concrete in accordance with ASTM C94, Alternate 2. Refer to Drawings for concrete strength requirements.
  - b) Use accelerating admixtures containing no calcium chloride in cold weather only when approved by testing laboratory. Use of admixtures will not relax cold weather placement requirements.
  - c) Use set retarding admixtures during hot weather only when approved by testing laboratory.
  - d) Add air entraining agent to concrete mix for concrete work exposed to exterior, in amounts of 4% to 7% of total concrete volume or as otherwise recommended by testing laboratory.
  - e) Add coloring admixture where scheduled in quantities recommended by coloring admixture manufacturer to achieve selected color.
  - f) Maintain water cement ratio to produce a minimum of 3" to maximum of 5" slump.
  - g) Use of calcium chloride is strictly prohibited.
- 2) Subgrade:
  - a) Refer to drawings for scope of subgrade preparation.

B) Color:

1) Integral Color: to be selected from Manufacturer's standard color chart.

a) Integral Coloring Admixture: Integral Color, synthetic oxide pigment, meeting ASTM C979 and C494.

1. Type A cement dispersing/water reducing.

2. Type D set retarding/water reducing.

3. Color to be equal to Interstar Ready Mix Color Chart – Egyptian Red (two bags)

2) Color Hardener:

a) Bomanite Color Hardener: The concrete shall be colored with Color Hardener. Color to be selected from Manufacturer's standard color chart.

C) Tools Selection:

1) Imprinting Tools:

a) Mat type imprinting tools for texturing freshly placed concrete, in pattern/texture as selected by Architect or as scheduled.

b) Imprinting tools for specialty projects shall become property of the City of Tulsa after the project.

2) Bomanite Patterns:

a) Herringbone Brick 4" x 8" pavers.

3) Textures and Patterns:

a) Designs as scheduled. Refer to Drawings. Up to two patterns to be selected.

D) Release Agent Selection:

1) Powdered Release Agent. Up to two colors to be selected.

a) PermaPro Gunsmoke Release Agent or equal.

b) Liquid Release Agent. Clear color.

c) Bomanite Liquid Release or equal.

E) Secondary Antique or Coloration:

1) Topical Stain:

- a) Colors to be selected from Manufacturer's standard color chart.
- b) Equal to Bomanite Topical Stain.

2) Chemical Stain:

- a) Colors to be selected from Manufacturer's standard color chart.
- b) Equal to Bomanite Chemical Stain.

F) Cure Agent:

1) Membrane Color Cure:

- a) Color(s) as scheduled. Refer to Drawings.
  - 1. Curing Compound: Meeting ASTM C309, water-based emulsion.
  - 2. Silicate Cure & Densifier:
    - i. The concrete shall receive a cure treatment of Bomanite Con Shield or equal.

G) Sealing and Finish Coatings:

- 1) Equal to Color Wax by The Bomanite Company.
- 2) HydroLock by The Bomanite Company or equal.
- 3) VOC II by The Bomanite Company or equal.

812.2.3 Related Materials

A) Cement:

- 1) ASTM C150, Type 1, Portland cement, gray color.

B) Fine and Coarse Aggregates:

- 1) ASTM C33.

C) Water:



1) Clean and not detrimental to concrete.

D) Form Material:

1) Conform to ACI 301. If using metal, material shall be free from deformities. If using wood, use construction grade lumber, sound and free of warp, minimum 2" (51 mm) nominal thickness, except where short radii of curves require thinner forms.

E) Contraction Joint Devices:

1) Galvanized sheet metal, keyed profile.

F) Tie Wire:

1) Annealed steel, minimum 16 gage size.

G) Dowels:

1) ASTM A615, Grade 40, plain steel, uncoated finish.

H) Form Release Agent:

1) As acceptable to concrete colorant manufacturer, non-staining, dissipative type.

I) Vapor Retarding Membrane:

1) 10 mil (.2540 mm) reinforced polyethylene.

J) Air-Entraining Admixture:

1) ASTM C206. Air Entrained Concrete shall be used wherever concrete is exposed to the freezing weather. Proportions of entrained air, as determined by ASTM C233, and C260, shall be as follows:

a) Aggregate: 3/8" maximum size aggregate 6% to 8% entrained air.

b) Aggregate: 3/4" maximum size aggregate 5% to 7% entrained air.

K) Joint Fillers:

1) Asphaltic Joint Filler:

a) Asphalt impregnated fiberboard, ASTM D1751, 1/2" (12 mm) thick.

2) Non-Asphaltic Joint Fillers:

a) ASTM D1752, Type I

L) Sealants:

- 1) Two-part polyurethane sealants, of grade as required to suit application, meeting ASTM C920, in manufacturer's custom colors.
  - a) Urethane, SL grade, as specified in Section 7 9000.
  - b) Urethane, SL-TB grade as specified in Section 7 9000.

M) Bonding Agent:

- 1) ASTM C1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene rubber.

N) Epoxy-Bonding Adhesive:

- 1) ASTM C881, two component epoxy resin, capable of humid curing and bonding to damp surface, of class and grade to suit requirements if required, and as follows: Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

812.3 EXECUTION

812.3.1 Inspection:

- A) Verify compacted subgrade is ready to support paving and imposed loads, free of frost, smooth and properly compacted.
- B) Verify gradients and elevations of base are correct, and proper drainage has been provided so water does not stand in the area to receive paving.
- C) Beginning of installation means acceptance of existing conditions.

812.3.2 Preparation:

- A) If vapor retarding membrane is not used, moisten base to minimize absorption of water from fresh concrete.
- B) Notify Architect and testing laboratory, minimum 24 hours prior to commencement of concreting operations.

812.3.3 Forming:

- A) Construct and remove forms in accordance with ACI 347.

- B) Place and secure forms to correct location, dimension, and profile. Adequately brace to withstand loads applied during concrete placement.
- C) Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- D) Place joint fillers vertical in position, in straight lines. Secure to formwork during concrete placement.

#### 812.3.4 Inserts and Accessories:

- A) Make provisions for installation of inserts, accessories, anchors, and sleeves.
- B) Place vapor retarder continuously over subgrade. Overlap joints a minimum of 12" (305 mm) and seal with a joint tape of same permeance as sheeting material.

#### 812.3.5 Joints:

- A) Intentional stoppage of concrete placing shall be at planned location of either an expansion joint or contraction joint.
- B) When stoppage occurs at an expansion joint, install joint assembly with a bulkhead of sufficient section drilled to accommodate required dowels. Provide expansion joints at maximum 50' (15 m) on center each way (OCEW) at pedestrian paving. Align joints with stamped concrete pattern.
- C) When stoppage occurs at a contraction joint, install sheet metal joint assembly of sufficient section to prevent deflection, shaped to concrete section.
- D) Stoppage at Unintentional Location:
  - 1) Immediately upon unintended stoppage of concrete placing, place available concrete to a line and install bulkhead perpendicular to surface of pavement and at required elevation. Place and finish concrete to this bulkhead. Remove and dispose of concrete remaining on subgrade ahead of bulkhead.
  - 2) When placing of concrete is resumed before concrete has set to extent that concrete will stand on removal of bulkhead, new concrete shall be rodded with the first; otherwise, carefully preserve joint face.
  - 3) Provide a joint seal space at edges created by a construction joint of this type shall have a joint seal space as detailed on Drawings.
- E) Provide sawed contraction joints in pedestrian paving spaced 10' OCEW spacing. Align joints with stamped concrete pattern.

- 1) Saw joints after completion of finishing operations as soon as concrete has hardened to extent necessary to prevent revealing of joint or damage to adjacent concrete surfaces.
  - 2) Saw joints same day that concrete is placed except that sawing of joints in concrete placed late in day may be delayed until morning of following day.
  - 3) In any event, saw joints within 18 hours after placing concrete. Use a power-driven concrete saw made especially for sawing concrete and maintain in good operating condition.
  - 4) Saw cut shall be to a depth equal to 1/4 of slab thickness, minimum 1" (25 mm) depth.
  - 5) Align joints in vehicular paving with joints in adjacent pedestrian paving.
  - 6) Cut joints through curbs at right angles to back of curb.
- F) Place joint filler between paving components and building or other appurtenances.
- G) Provide scored joints in sidewalks and plazas to a depth of 1/4 the slab thickness, and at intervals as indicated, but in no case spaced greater than width of walk.

#### 812.3.6 Placing Concrete:

- A) Place concrete in accordance with ACI 301, 302, and 304. Deposit concrete so that specified slab thickness will be obtained after vibrating and finishing operations. Minimize handling to prevent segregation. Consolidate concrete by suitable means to prevent formation of voids or honeycombs. Exercise care to prevent disturbance of forms and damage to vapor retarder. Place concrete to lines and levels shown, properly sloped to drain as designed.
- 1) Hot Weather Placement: ACI 305.
  - 2) Cold Weather Placement: ACI 306.
  - 3) Ensure inserts, embedded parts, and formed joints are not disturbed during concrete placement.
  - 4) Place concrete continuously between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
- B) After consolidating and screeding, float concrete to gradients indicated. Use a straight edge to level and test surface in longitudinal direction to required grade. Finish edges to provide a smooth dense surface with 1/8" (3 mm) radius.

- C) Apply Color Hardener prior to application of pattern. Apply at rate recommended by manufacturer, evenly to the surface of the fresh concrete by the dry-shake method. Applied in two or more shakes, floated after each shake, and troweled only after the final floating.
- D) While concrete is still in its plastic state, apply the tool/texture pattern to the surface of the concrete. Properly tamp tools into the surface to achieve the required texture, with uniformity of pattern and depth of stamping. Utilize bond breaker to keep tools from sticking to fresh concrete.
  - 1) Release material shall be applied to the troweled surface prior to imprinting.
- E) Place curing compound on exposed concrete surfaces immediately after finishing.
- F) Apply in accordance with manufacturer's instructions.
- G) Apply secondary stain treatment per approved mock-up or as scheduled to achieve design.
- H) Apply finish sealer per approved mock-up or as specified to achieve design required.

812.3.7 Field Quality Control:

- A) Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

812.3.8 Protection:

- A) Immediately after placement, protect concrete from premature drying, excessive hot or cold temperatures, and mechanical injury.

812.3.9 Method of Measurement:

Stamped Concrete Paving. The quantity to be measured for under this item shall be for each logo installed at the location and of the type shown on the Plans or in the Proposal, completed and accepted, measured in place.

812.3.10 Basis of Payment:

Accepted quantities of stamped concrete paving, measured as provided above, will be paid for at the contract unit price INSTALLED:

STAMPED CONCRETE ROUTE 66 LOGO (16" x 16").....EACH

STAMPED CONCRETE PAVING (DECORATIVE BAND).....SQUARE FOOT

STAMPED CONCRETE PAVING..... SQUARE YARD

Payment shall be full compensation for furnishing ALL materials, equipment, labor, excavation, and incidentals to complete the work as specified including concrete footing construction.

## **PART 820 – STREETSCAPE AMENITIES**

### 820.1 GENERAL

#### 820.1.1 Summary:

##### A) Section includes:

- 1) Fabricate and install benches, trash receptacles, bollards, bike racks, tree wells, and parking lot screens in accordance with the requirements set forth in this section.

##### B) Additional work included in this section:

- 1) Field measuring for weld plates, sleeves and insert locations.
- 2) Field measuring.
- 3) Anchors or inserts and footings.
- 4) Touch-up of powder coated materials.

#### 820.1.2 References:

##### A) American Concrete Institute (ACI)

- 1) ACI 347 Recommended Practice for Concrete Formwork.

##### B) American Society for Testing and Materials (ASTM)

- 1) A53 Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless.
- 2) A123 Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
- 3) A269 Specification for Seamless and Welded Austenitic Stainless-Steel Tubing for General Service.
- 4) A312 Specification for Seamless and Welded Austenitic Stainless-Steel Pipe.

##### C) Powder Coating Properties (ASTM)

- 1) D523-89: 80-90 Gloss at 60°.
- 2) D3363-92a: Pencil hardness 2H.
- 3) D2794-93: Dir / Rev Impact, Gardner, Up to 160 in./lbs.

- 4) D522-93a: Flexibility, Mandrel, 1/4" diameter no fracture.
- D) Americans With Disabilities Act Accessibility Guidelines (ADAAG), and Public Right of Ways Accessibility Guidelines (PROWAG)
- E) Green Globes System
- F) International Code Council (ICC)
  - 1) International Building Code (IBC).
  - 2) International Residential Code (IRC).
- G) National Association of Architectural Metal Manufacturers (NAAMM) and National Ornamental and Miscellaneous Metals Association (NOMMA)
  - 1) Metal Finishes Manual
- H) National Association of Home Builders (NAHB)
  - 1) Model Green Home Building Guidelines.
- I) Institute of Building Sciences
  - 1) Metric Guide for Federal Construction.
  - 2) U.S. Green Building Council.
  - 3) The Leadership in Energy and Environmental Design (LEED) Green Building Rating System™.

820.1.3 Quality Assurance:

A) Fabricator Qualifications:

- 1) A firm experienced in manufacturing site furnishings similar to those required for this project and with a record of successful in-service performance.
- 2) Furnish references listing projects of similar size and scope.

B) Installer Qualifications:

- 1) An experienced installer who has completed installation of bicycle parking racks, trash receptacles, and benches, similar in material, design, and extent to that indicated for this project and whose work has resulted in construction with a record of successful in-service performance.



C) Source Limitations:

- 1) Obtain each color, finish, shape, and type of furnishing from a single source with resources to provide components of consistent quality in appearance and physical properties.

D) Product Options:

- 1) Drawings indicate general size, shape, and dimensional requirements of furnishings, but are not intended to limit specific site furnishings to one manufacturer unless specifically stated. Submitted products should meet the general design intent and appearance of the detailed product.

E) Regulatory Requirements:

- 1) Components and installation are to be in accordance with state and local code authorities.

F) Certifications:

- 1) Furnish certification that all components and fittings are furnished by the same manufacturer or approved by the primary component manufacturer.

820.1.4 Submittals:

A) Submit shop drawings and product data that:

- 1) Show sections and plans of site, dimensions, and assembly of components.
- 2) Show all field connections.
- 3) Provide setting diagrams for installation of anchors, location of pockets, and weld plates for attachment of rails to structure.
- 4) Indicate all required field measurements.
- 5) Submit six sets of hard copies, and one digital copy of PDF and CAD files for approval.

B) Indicate component details, materials, finishes, connection and joining methods, and the relationship to adjoining work.

C) Submit manufacturer's installation instructions.

D) Submit recommended methods for repairing damage to the powder coat, or other finishes of the site furnishings.

E) Substitutions:

- 1) Any changes in specified material must meet requirements of the General Conditions "or equal" clause.
- 2) Changes in architectural details to fabricator's standard procedures will be allowed when appearance and strength are not affected.

F) State any alternatives that affect the work and/or bid price of this section, such as a change in material or a change to contractor's standard details.

820.1.5 Delivery, Storage, and Handling

A) Deliver materials to the job site in good condition and properly protected against damage to finished surfaces.

B) Storage on site:

- 1) Store material in a location and in a manner to avoid damage. Stacking shall be done in a way, which will prevent bending.
- 2) Store material in a clean, dry location away from uncured concrete and masonry. Cover with waterproof paper, tarpaulin, or polyethylene sheeting in a manner that will permit circulation of air inside the covering.
- 3) Keep handling on site to a minimum. Exercise particular care to avoid damage to finishes of material.

820.1.6 Examination of Conditions:

A) Contractor should visit the site and be fully aware of the location and orientation of all site furnishings. Unless otherwise stated in the drawings, benches and trash receptacles may be mounted directly on existing concrete sidewalks. Below grade footings should be poured to allow the proposed paving to be placed with the correct finished grade, and at the proper thickness.

820.1.7 Warranty:

A) Furnishings are to carry a minimum one-year manufacturer's limited warranty against defects in materials and workmanship. The one-year warranty shall be extended to cover the time period one-year from the date of final acceptance of the project.

820.2 PRODUCTS

820.2.1 Acceptable Manufacturers:

A) Bike Rack and components shall be equal to those manufactured or supplied by:

- 1) Inverted U Bike Parking Rack:  
SiteScapes, Inc.  
P.O. Box 22326  
Lincoln, NE 68542  
888.331.9464  
[www.sitescapeonline.com](http://www.sitescapeonline.com)
- 2) Dumor Bike Rack Model 83:  
ACS Playground Adventures  
8501 Mantle Avenue  
Oklahoma City, OK 73132  
405.721.3506  
[www.acsplay.com](http://www.acsplay.com)
- 3) 'U' Bike Rack:  
Madrax, a division of Graber Manufacturing, Inc.  
1080 Uniek Drive  
Waunakee, WI 53597  
608.849.1080  
[www.madrax.com](http://www.madrax.com)
- 4) Loop Bikerail Kit Embedded:  
The Wagner Companies  
P.O. Box 423  
Butler, WI 53007  
Tel: 888.243.6914  
Fax: 414.214.0550  
[www.wagnercompanies.com](http://www.wagnercompanies.com)  
[info@mailwagner.com](mailto:info@mailwagner.com)

B) Benches shall be equal to those manufactured or supplied by:

- 1) Dumor Bench Model 119:  
ACS Playground Adventures  
8501 Mantle Avenue  
Oklahoma City, OK 73132  
405.721.3506  
[www.acsplay.com](http://www.acsplay.com)
- 2) Plaza Series, Model PL-5 Bench with Center Frame:  
FairWeather Site Furnishings  
1540 Leader International Drive  
Port Orchard, WA 98367  
800.323.1798

- 3) Victor Stanley CBF-12 Bench:  
Victor Stanley  
P.O. Drawer 330  
Dunkirk, MD 20754  
800.368.2573  
[www.victorstanley.com](http://www.victorstanley.com)

C) Trash Receptacle shall be equal to those manufactured or supplied by:

- 1) Dumor Trash Receptacle Model 119:  
ACS Playground Adventures  
8501 Mantle Avenue  
Oklahoma City, OK 73132  
405.721.3506  
[www.acsplay.com](http://www.acsplay.com)
- 2) Litter Receptacle S-42:  
Victor Stanley  
P.O. Drawer 330  
Dunkirk, MD 20754  
800.368.2573  
[www.victorstanley.com](http://www.victorstanley.com)
- 3) Model URT-FBS-36-F-P-LD-LF:  
Creative Pipe, Inc.  
P.O. Box 2458  
Rancho Mirage, CA 92270-1087  
800.644.8467  
[www.creativepipe.com](http://www.creativepipe.com)

D) Bollards shall be equal to those manufactured or supplied by:

- 1) Model B4-5 Bench with Center Frame:  
FairWeather Site Furnishings  
1540 Leader International Drive  
Port Orchard, WA 98367  
800.323.1798
- 2) Model matching details provided:  
Creative Pipe, Inc.  
P.O. Box 2458  
Rancho Mirage, CA 92270-1087  
800.644.8467  
[www.creativepipe.com](http://www.creativepipe.com)

E) Tree Grates with Expandable Tree Openings shall be equal to those manufactured or supplied by:

- 1) Model 8655 Tree Grate Set:  
East Jordan Ironworks  
270 Redwing Road  
Ardmore, OK 73401  
580.389.5010  
customersupport@ejco.com
- 2) Model 6018/20-1:  
Ironsmith  
41701 Corporate Way #3  
Palm Desert, CA 92260  
800.338.4766  
www.ironsmith.cc
- 3) Metropolitan Collection Tree Grate R-8707:  
Neenah Foundry  
2121 Brooks Avenue  
Neenah, WI 54956  
800.558.5075  
www.nfco.com

#### 820.2.2 Materials and Finishes:

##### A) Steel:

- 1) Pipe: ASTM A53.
- 2) All steel to be powder coated in the factory.
- 3) Colors of all site furnishings to be approved in writing by the City of Tulsa prior to placing order.

##### B) Stainless Steel: Type 304

- 1) Pipe: ASTM A269 and A312.

#### 820.2.3 Site Furnishings

##### A) Material shall conform to and be finished in accordance with 2.2.

##### B) Bicycle Rack:

- 1) Fabricate from powder coated steel 2" (2.375" OD).
- 2) Capacity: Two bicycles.
- 3) Mount: Embedded.

4) Color: As approved by the City of Tulsa.

C) Benches, Trash Receptacles, and Bollards:

1) Fabricate from powder-coated steel.

2) Cast elements on benches to be either wrought iron or aluminum.

3) Color: As approved by the City of Tulsa.

820.2.4 Fasteners:

A) All mechanical fasteners used in the assembly shall be manufactured from stainless steel.

B) Cement: Hydraulic, ASTM C595, factory prepared with accelerator.

820.2.5 Fabrication:

A) Cut material square and remove burrs from all exposed edges, with no chamfer.

B) Make exposed joints butt tight and flush.

C) For posts set in concrete, furnish matching sleeves or inserts not less than 5" long.

D) Verify dimensions on site prior to shop fabrication.

820.2.6 Protective Coatings:

A) Following fabrication, site furnishings should be cleaned and treated with a corrosion preventative under-coating.

B) All furnishings are to be coated with a TGIC exterior rated powder in the color approved by the Architect and the City of Tulsa. All parts should be finished to an average of 8 to 10 mil thickness and fully cured to the manufacturer's specifications.

820.3 EXECUTION

820.3.1 Examination:

A) Coordinate installation of footings and attachment bolts with the installation of paving.

B) Supply items to be cast in concrete or embedded in masonry.

820.3.2 Installation:

- A) Install in accordance with shop drawings and manufacturer’s instructions at locations indicated on the drawings.
- B) Erect work square and level, and free from distortion or defects detrimental to appearance or performance.
- C) Expansion joints shall be provided as needed to allow for thermal expansion or contraction.

820.3.3 Repair and Cleaning:

- A) As installation is completed, wash thoroughly using clean water and soap, rinse with clean water.
- B) Do not use acid solution, steel wool, or other harsh abrasives.
- C) If stain remains after washing, remove finish and restore in accordance with *NAAMM/NOMMA Metal Finishes Manual*.
- D) Remove stained or otherwise defective work and replace with material that meets specification requirements.
- E) Repair damaged finish as directed by City of Tulsa.
- F) Replace defective or damaged components as directed by City of Tulsa.

820.3.4 Protection:

- A) After work of this section is complete, contractor shall be responsible for protecting site furnishings from damage from subsequent construction activity on the site.

820.3.5 Method of Measurement:

The City of Tulsa Inspector and the Project Architect or Engineer will review Pay Applications submitted by the Contractor and shall approve payment based on the quantity of site furnishings that are properly and completely installed including footings, attachment and touch-up.

820.4.2 Basis of Payment:

Payment will be made for each site furnishing pay item at the contract unit price per specified pay unit:

<u>PAY ITEM</u>	<u>PAY UNIT</u>
BIKE RACK	EACH
BENCH	EACH

TRASH RECEPTACLE	EACH
TREE GRATES	EACH
PARKING LOT SCREENING FENCE	PER LINEAL FOOT



## PART 830 – STRUCTURAL SOIL

### 830.1 GENERAL

#### 830.1.1 Summary:

A) The work of this section consists of all Structural Soil work and related items as indicated on the drawings or as specified herein and includes, but is not limited to, the following:

- 1) CU-Soil™ is a proprietary material patented by Cornell University (US Patent #5,849,069) and marketed under the registered trademark, CU-Structural Soil®. Only licensed companies are authorized to produce this material, meeting the specifications described in this text. For a list of licensed CU-Soil™ producers, call AMEREQ, INC. at 800.832.8788.

#### 830.1.2 Related Work:

- A) Section 831 – Trees, Shrubs, and Ground Cover
- B) Section 840 – Underground Sprinkler System

#### 830.1.3 Quality Assurance:

A) Qualifications of installing contractor: The work of this section should be performed by a contracting firm which has a minimum of five years of experience. Proof of this experience shall be submitted as per paragraph, SAMPLES and SUBMITTALS, of this section.

#### 830.1.4 Submittals:

A) At least 30 days prior to ordering materials, the installing contractor shall submit to the Engineer representative samples, certificates, manufacturer's literature, and test results for materials specified below. No materials shall be ordered until the required samples, certificates, manufacturer's literature, producer's current license and test results have been reviewed and approved by the Engineer. The Engineer reserves the right to reject any material that does not meet CU-Structural Soil® specifications. Delivered materials shall closely match the approved samples.

B) Submit soil test analysis reports for sample of clay loam from an independent soil-testing laboratory. The testing laboratory for particle size and chemical analysis may include a public agricultural extension service agency.

- 1) Submit a mechanical analysis of the clay loam sample and particle size analysis including the following gradient of mineral content:

<u>USDA Designation</u>	<u>Size in mm</u>
Gravel	+2 mm

Sand	0.05 – 2 mm
Silt	0.002 – 0.05 mm
Clay	minus 0.002 mm

- C) Sieve analysis shall be performed and compared to USDA Soil Classification System.
- D) Sieve analysis shall be done by a combined hydrometer and wet sieving using sodium hexametaphosphate as a dispersant in compliance with ASTM D422 after destruction of organic matter by hydrogen peroxide.
- E) Submit a chemical analysis, performed in accordance with current AOAC Standards, including the following:
  - 1) pH and buffer pH.
  - 2) Percent organic matter as determined by the loss of ignition of oven dried samples. Test samples shall be oven dried to a constant weight at a temperature of 230° F, ±9°.
  - 3) Analysis for nutrient levels by parts per million.
  - 4) Soluble salt by electrical conductivity of a 1:2 soil/water sample measured in Millimho per cm.
  - 5) Cation Exchange Capacity (CEC).
  - 6) Carbon/Nitrogen Ratio.
- F) At the Engineer's discretion, the sample of CU-Structural Soil® may be tested for the following:
  - 1) Compaction in accordance with ASTM D698/AASHTO T 99 without removing oversize aggregate.
  - 2) California Bearing Ratio in accordance with ASTM D1883 soaked CBR shall equal or exceed a value of 50.
  - 3) Measured dry-weight percentage of stone in the mixture.
  - 4) The approved CU-Structural Soil® sample shall be the standard.
  - 5) Any deviation from the specified crushed stone and clay loam specifications shall be approved by Amereq, Inc.

830.1.5 Delivery, Storage, and Handling:

- A) Delivered CU-Structural Soil® shall be at or near optimum compaction moisture content as determined by AASHTO T 99 (ASTM D698) and should not be placed in frozen, wet, or muddy sites.
- B) Always protect CU-Structural Soil® from exposure to excess water and from erosion. Do not store CU-Soil™ unprotected. Do not allow excess water to enter site prior to compaction. If water is introduced into the CU-Soil™ after grading, allow water to drain to optimum compaction moisture content.
- C) CU-Structural Soil® shall be amended to produce a consist pH within the range of 6.0 to 7.0.

830.1.6 Examination of Conditions:

- A) All areas to receive CU-Structural Soil® shall be inspected by the installing contractor before starting work and all defects such as incorrect grading, compaction, and inadequate drainage shall be reported to the Engineer prior to beginning this work.

830.2 PRODUCTS

830.2.1 Materials:

A) CU-STRUCTURAL SOIL®

- 1) A uniformly blended urban tree mixture of crushed stone, clay loam and Gelscape® Hydrogel Tackifier, as produced by an Amereq-licensed company, mixed in the following proportion:

<u>Material</u>	<u>Unit of Weight</u>
Specified crushed stone	100 units dry weight
Specified clay loam	20 – 25 units (to achieve minimum CBR of 50)
Gelscape® Hydrogel Tackifier	0.035 units dry weight moisture
ASTM D698/AASHTO T 99	Optimum moisture

830.3 EXECUTION

830.3.1 Mixing and Quality Control Testing:

- A) All CU-Structural Soil® mixing shall be performed at the licensed producer’s yard using appropriate soil measuring, mixing, and shredding equipment of sufficient capacity and capability to assure proper quality control and consistent mix ratios. No mixing of CU-Structural Soil® at the project site shall be permitted.
- B) Maintain adequate moisture content during the mixing process. Soils and mix components shall easily shred and break down without clumping. Soil clods shall easily break down into a fine crumbly texture. Soils shall not be overly wet or dry.

The licensed producer shall measure and monitor the amount of soil moisture at the mixing site periodically during the mixing process.

- C) Raw materials shall be mixed off-site, only at the licensed producer's facility, on a flat asphalt or concrete paved surface to avoid soil contamination.
- D) Should the independent laboratory test results of the clay loam reveal a need to amend it, to meet specifications, the amending materials should be added to the clay loam following the rates and recommendations provided by Amereq, Inc.

#### 830.3.2 Underground Utilities and Subsurface Conditions:

- A) The installing contractor shall notify the Engineer of any subsurface conditions which will affect the contractor's ability to install the CU-Structural Soil®.
- B) The installing contractor shall locate and confirm the location of all underground utility lines and structures prior to the start of any excavation.
- C) The installing contractor shall repair any underground utilities or foundations damaged during the progress of this work.

#### 830.3.3 Preparation:

- A) Do not proceed with the installation of the CU-Structural Soil® material until all walls, curb footings and utility work in the area have been installed. For site elements dependent on CU-Structural Soil® for foundation support, postpone installation of such elements until immediately after the installation of CU-Structural Soil®.
- B) Install subsurface drain lines as shown on the plan drawings prior to installation of CU-Structural Soil® material.
- C) Excavate and compact the proposed subgrade to depths, slopes and widths as shown on the drawings. Maintain all required angles of repose of the adjacent materials as shown on the drawings. Do not over excavate compacted subgrades of adjacent pavement or structures.
- D) Confirm that the subgrade is at the proper elevation and compacted as required. Subgrade elevations shall slope parallel to the finished grade and/or toward the subsurface drain lines as shown on the drawings.
- E) Clear the excavation of all construction debris, trash, rubble, and any foreign material. In the event that fuels, oils, concrete washout silts, or other material harmful to plants have been spilled into the subgrade material, excavate the soil sufficiently to remove the harmful material. Fill any over excavation with approved fill and compact to the required subgrade compaction.

- F) Do not proceed with the installation of CU-Structural Soil® until all utility work in the area has been installed. All subsurface drainage systems shall be operational prior to installation of CU-Structural Soil®.
- G) Protect adjacent walls, walks and utilities from damage. Use 1/2" plywood and/or plastic sheeting as directed to cover existing concrete, metal and masonry work and other items as directed during the progress of the work.
  - 1) Clean up all trash and any soil or dirt spilled on any paved surface at the end of each working day.
  - 2) Any damage to the paving or architectural work caused by the installing contractor shall be repaired, as directed by the Engineer.
- H) Maintain all silt and sediment control devices required by applicable regulations. Provide adequate methods to assure that trucks and other equipment do not track soil from the site onto adjacent property and the public right of way.

830.3.4 Water:

- A) The installing contractor shall be responsible to furnish his own supply of water (if needed) free of impurities, to the site.

830.3.5 Installation:

- A) Install CU-Structural Soil® in 6" lifts and compact each lift.
- B) Compact all materials to at least 95% Proctor Density from a standard compaction curve AASHTO T 99 (ASTM D698). No compaction shall occur when moisture content exceeds maximum as listed herein. Delay compaction if moisture content exceeds maximum allowable and protect CU-Structural Soil® during delays in compaction with plastic or plywood as directed by the Engineer.
- C) Bring CU-Structural Soil® to finished grades as shown on the drawings. Immediately protect the CU-Structural Soil® from contamination by toxic materials, trash, debris, water containing cement, clay, silt or materials that will alter the particle size distribution of the mix with plastic or plywood as directed by the Engineer.
- D) The Engineer may periodically check the material being delivered, prior to installation for color and texture consistency with the approved sample provided by the installing contractor as part of the submittal for CU-Structural Soil®. If the Engineer determines that the delivered CU-Soil™ varies significantly from the approved samples, the Engineer shall contact the licensed producer.

- E) Engineer shall ensure that the delivered structural soil was produced by the approved CU-Soil™ licensee by inspecting weight tickets showing source of material.
- F) CU-Soil™ should not be stockpiled long-term. Any CU-Soil™ not installed immediately should be protected by a tarp or other waterproof covering.

#### 830.3.6 Fine Grading:

- A) After the initial placement and rough grading of the CU-Structural Soil® but prior to the start of fine grading, the installing contractor shall request review of the rough grading by the Engineer. The installing contractor shall set sufficient grade stakes for checking the finished grades.
- B) Adjust the finish grades to meet field conditions as directed.
  - 1) Provide smooth transitions between slopes of different gradients and direction. Fill all dips with CU-Soil™ and remove any bumps in the overall plane of the slope.
    - a) The tolerance for dips and bumps in CU-Structural Soil® areas shall be a 3” deviation from the plane in 10’. All fine grading shall be inspected and approved by the Engineer prior to the installation of other items to be placed on the CU-Structural Soil®.

#### 830.3.7 Acceptance Standards:

- A) The Engineer will inspect the work upon the request of the installing contractor. Request for inspection shall be received by the Engineer at least ten days before the anticipated date of inspection.

#### 830.3.8 Clean-Up:

- A) Upon completion of the CU-Structural Soil® installation operations, clean areas within the contract limits. Remove all excess fills, soils and mix stockpiles and legally dispose of all waste materials, trash, and debris. Remove all tools and equipment and provide a clean, clear site. Sweep (do not wash) all paving and other exposed surfaces of dirt and mud until the paving has been installed over the CU-Structural Soil® material. Do no washing until finished materials covering CU-Structural Soil® material are in place.

### 830.4 PAYMENT

#### 830.4.1 Method of Measurement:

The Engineer will review Pay Applications submitted by the Contractor and shall approve payment based on the quantity of structural soil that is properly and completely installed according to the drawings, including placing, and compacting.

830.4.2 Basis of Payment:

Payment will be made for each Cubic Yard of installed Structural Soil at the contract unit price per specified pay unit:

<u>PAY ITEM</u>	<u>PAY UNIT</u>
STRUCTURAL SOIL	PER CUBIC YARD

## **PART 831 – TREES, SHRUBS, AND GROUND COVER**

### 831.1 GENERAL

#### 831.1.1 Summary:

- A) Trees, shrubs, vines, and ground cover as applicable.
- B) Topsoil backfill.
- C) Staking and guying.
- D) Maintenance service.

#### 831.1.2 Related Work:

- A) 832 – Sodding.
- B) 833 – Landscape Maintenance.
- C) 840 – Underground Sprinkler System.

#### 831.1.3 References:

- A) Standardized Plant Names, 1942 edition, American Joint Committee on Horticulture Nomenclature.
- B) American Standard for Nursery Stock (ANSI Z60), latest edition, American Association of Nurserymen.
- C) FS O-F-241 – Fertilizer, Mixed, Commercial.

#### 831.1.4 Quality Assurance:

- A) Contractor to locate all utilities and be responsible for all damage to utilities resulting from demolition and planting operations.
- B) Perform work with personnel experienced in the work required of this Section under direction of a skilled foreman.
- C) Submit sources of plant materials. All materials to have name tags attached. Submit invoice with plant names noted if required.
- D) Contractor shall locate all materials and be responsible for conformance with requirements of this Section. All plants not meeting requirements to be rejected.
- E) All trees are to be reviewed by Engineer prior to planting.



- 1) Trees will be reviewed at local growing or nursery site by Engineer or his appointed representative and approved before delivering to the site. Contractor shall schedule review of plant material in such a manner that no single review period will exceed one working day with a maximum of two review periods. Contractor shall be responsible for notification and coordination with all parties prior to scheduling review sessions.
  - 2) Prior to review by Engineer, Contractor shall have pre-selected all trees and identified each with a "locking" tree tag. Additional tree tags will be provided by Contractor for changes at time of visit. Tree tags will have permanent, non-reproducible identifying notation unique to this project.
- F) Submit analysis of topsoil to be imported for backfill. Test performed by accredited soils laboratory.

831.1.5 Delivery, Storage, and Handling:

- A) Move B&B plant materials with solid balls wrapped in burlap. Plants to be lifted only by ball or container.
- B) Deliver plant materials immediately prior to placement. Keep plant materials not immediately installed moist and protect from freezing by covering ball or container with mulch. Any plants not planted within two days of delivery are to be heeled-in in a vertical position, root balls fully encompassed by mulch and a temporary watering system installed.
- C) Reject plants when ball or container of earth surrounding roots has been cracked, broken, or frozen preparatory to or during process of planting.

831.1.6 Warranty:

- A) Warrant all plants to be living, healthy specimens for a period of one year commencing upon Final Acceptance by City. Warranty period shall terminate only if plants have been in full leaf for 30 days at end of warranty period. Termination of warranty period shall be extended as necessary to comply. All materials to be in vigorous condition at end of warranty period.
- B) Immediately remove dead plants and plants not in a vigorous condition and replace as soon as weather conditions permit. Each replacement shall be covered with a one-year warranty commencing at time of planting.
- C) Replacements: Match with adjacent plants of the same species in size and form.

831.1.7 Maintenance Service:

- A) Begin maintenance of plant materials immediately after planting and continue until Final Acceptance by City.
- B) Maintenance shall include measures necessary to establish and maintain plants in a vigorous and healthy growing condition. Include the following:
  - 1) Cultivation and weeding of plant beds and tree pits. When herbicides are used for weed control, apply in accordance with manufacturer's instructions. Remedy damage resulting from use of herbicides.
  - 2) Watering sufficient to maintain optimum moisture level.
  - 3) Pruning, including removal of dead or broken branches.
  - 4) Disease and insect control.
  - 5) Maintaining plants in an upright, plumb position, and repair of settling.
  - 6) Maintenance of wrappings, guys, turnbuckles, and stakes. Adjust turnbuckles or otherwise keep guy wires tight. Repair or replace accessories when required.
- C) Contractor to be responsible for pruning or removing trees that become an obstruction to safe traffic flows or the open view of traffic signalization.

## 831.2 PRODUCTS

### 831.2.1 Materials:

- A) Trees, Shrubs, Vines, and Ground Cover: Species and size identified in plant list. Plant materials shall be true to name, in good health, free of disease and insects, excellent in form and in complete conformance with ANSI Z60. All materials to be nursery grown.
- B) Topsoil: Friable loam, typical of cultivated topsoil locally, containing at least 2% of decayed organic matter (humus) secured from a well-drained, arable site, reasonably free of subsoil, stones, earth clods, sticks, roots, or other objectionable extraneous matter or debris, and containing no toxic materials. Topsoil to have acidity range of 6.0 to 7.0.
- C) Mulch: Shredded cedar, cypress, or hardwood; dyed brown in color. Submit type and source for approval.
- D) Fertilizer: Osmocote 18-6-12 or approved equal.
- E) Compost: "Back to Earth Composted Cotton Burrs", premium compost, course screened, as manufactured by Soil Mender Products, LP, [www.soilmender.com](http://www.soilmender.com).

“Hu-More Plant and Soil Builder” manufactured by Humalfa, Inc., P.O. Box 878, Shattuck, OK 73858, 580.938.2514, or approved equal.

F) Peat Moss: Sphagnum peat moss.

G) Metal Edging: 3/16” x 4” steel landscape edging with steel stakes as manufactured by Col-Met, 3333 Miller Park South, Garland, Texas 75042, 972.494.3900, www.colmet.com, or approved equal.

#### 831.2.2 Accessories:

A) Wrapping Materials: Heavy paper manufactured for tree wrapping purpose.

B) Stakes: Green Metal Fence posts (three per tree) – 6’ height.

C) Hardware (cables, wire, eye bolts, and turnbuckles): Noncorrosive; of sufficient strength to withstand wind pressure.

D) Tie straps: Soft polypropylene material equal to ArborTie, by Deep Root Partners, L.P., 31 Langston St., Suite 4, San Francisco, CA, 94103, 1.800.277.7668, or approved equal.

### 831.3 EXECUTION

#### 831.3.1 Preparation:

A) Locate trees so they do not obstruct safe traffic flow, or the open view of traffic signalization.

B) Verify topsoil is ready to receive the work of this Section. All areas to be planted with shrub or ground cover masses to have minimum 12” depth of topsoil.

C) Remove all weeds and grasses from planting beds. Bermuda grass, if present, to be exterminated by approved means or all soil removed to 6” depth and replaced with topsoil free of Bermuda grass.

D) Stake tree locations and place shrubs, vines, and ground covers for review and final orientation by Owner's Representative prior to installation.

E) Outline bed edges for approval.

F) Prepare topsoil for shrub and ground cover beds, after removing any vegetation with approved procedure by tilling 2” layer (165 CF per 1,000 sq. ft.) of compost into the upper 6” of soil.

#### 831.3.2 Installation:

- A) Excavate for plant materials. Tree pits shall be as indicated in the details. Slope cut edge to 6" depth and bottom of pit to depth required to accommodate tree root ball. Shrub pits shall be 12" greater in diameter than root ball. Topsoil or structural soil from excavation may be retained for backfill if it is friable and free of rock and clods greater than 2" in diameter. Remove all subsoil, rock, and debris from site.
- B) Set trees and other plant materials with top of root ball 2" below adjacent paving, after settlement.
- C) Remove containers from container-grown stock. Set plants in center of pits and backfill with topsoil in 6" layers. Pull away ropes, wires, etc. from the top of the ball.
- D) Remove any soil from the top of the root ball to the level of the root flare.
- E) Final 6" layer of backfill around trees to consist of 1:1 mixture of compost and topsoil.
- F) Thoroughly water soil when the hole is half-full and again when full.
- G) Apply 1/2 lb. fertilizer evenly over cultivated area around each tree and 1 lb. per 100 sq. ft. to shrub and ground cover plantings.
- H) Evenly spread a 3" layer of mulch over tree pits and planting beds.
- I) Prune trees and shrubs after planting to remove dead and broken branches.
- J) 8' diameter circular area around trees to be mulched and free of vegetation. For trees 2" and greater in caliper, area to be 8' in diameter. For trees less than 2" caliper, area to be 6' in diameter. Circle to be centered on tree and true in form.
- K) Wrap trunks of all trees of the Acer and Gleditsia genus.
- L) After planting trees, form a 3' diameter ridge of topsoil around edge of excavation to retain water.

#### 831.3.3 Plant Support:

- A) Brace plants upright in position by staking and guying as detailed. Guys to be secured to tree with loops as detailed.

#### 831.3.4 Finishing:

- A) Install pavers or tree grates as indicated on the plans and details.
- B) Provide edge restraint to maintain the position of the pavers.
- C) Install mulch or gravel as indicated on details.

831.4 PAYMENT

831.4.1 Method of Measurement:

The Engineer will review Pay Applications submitted by the Contractor and shall approve payment based on the quantity of trees and shrubs that is properly and completely installed according to the drawings, including planting, backfilling, and finishing.

831.4.2 Payment will be made for each Tree, and each Shrub at the contract unit price per specified pay unit:

<u>PAY ITEM</u>	<u>PAY UNIT</u>
TREE	PER EACH
SHRUB	PER EACH

## **PART 832 – SODDING**

### 832.1 GENERAL

#### 832.1.1 Summary:

- A) Preparation of planting surface.
- B) Fertilizing.
- C) Sod installation.
- D) Maintenance service.

#### 832.1.2 Related Work:

- A) 831 – Trees, Shrubs, and Ground Cover.
- B) 833 – Landscape Maintenance.
- C) 840 – Underground Sprinkler System.

#### 832.1.3 References:

- A) Standardized Plant Names, 1942 Edition, American Joint Committee on Horticulture Nomenclature.
- B) ASPA (American Sod Producers Association) – Guideline Specifications to Sodding.
- C) FSO-F-241 – Fertilizers, Mixed, Commercial.

#### 832.1.4 Definitions:

- A) Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lamb's Quarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nut Grass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel and Brome Grass.

#### 832.1.5 Quality Assurance:

- A) Sod Producer: Company specializing in sod production and harvesting with a minimum of five years of experience.
- B) Sod: Root development that will support its own weight, without tearing, when suspended vertically by holding the upper two corners.

C) Submit sod certification for grass species and location of sod source.

832.1.6 Regulatory Requirements:

A) Comply with regulatory agencies for fertilizer and herbicide composition.

832.1.7 Tests:

A) Provide soils tests and recommendations for areas to be sodded. Obtain from approved testing agency. Such tests shall be a composite of random samples. Test areas exhibiting different soil types separately. Provide separate tests for each 10,000 sq. ft. of sodded area.

832.1.8 Maintenance Data:

A) Submit recommended maintenance procedures to be followed by City/Owner.

B) Include maintenance instructions, cutting method and maximum grass height, types, application frequency, and recommended coverage of fertilizer.

832.1.9 Delivery, Storage, and Handling:

A) Deliver sod on pallets. Protect exposed roots from dehydration.

B) Do not deliver more sod than can be laid within eight hours for Fescue Sod, or 24 hours for Bermuda Sod.

832.1.10 Coordination:

A) Coordinate the work of this Section with installation of underground sprinkler system and plant material as applicable.

832.1.11 Maintenance Service:

A) Maintain sodded areas immediately after placement until grass is well established, has achieved complete coverage, and exhibits a vigorous growing condition or until Final Acceptance by the City whichever is longer. Maintenance period shall include minimum of two mowings.

832.2 PRODUCTS:

832.2.1 Materials:

A) Sod: Cultivated grass sod, type indicated on Drawings, with strong fibrous root system, free of stones, burned or bare spots, and weeds.

- B) Fertilizer: Type recommended for grass; of proportions necessary to eliminate any deficiencies of topsoil as indicated in soils test or otherwise approved.
- C) Soil Amendments: Lime, Sulphur, or other material recommended by soil test.
- D) Water: Clean, fresh, and free of substances or matter which could inhibit vigorous growth of grass.

832.2.2 Accessories:

- A) None

832.2.3 Harvesting:

- A) Machine cut sod and load on pallets in accordance with ASPA guidelines.
- B) Cut sod with minimum 1/2" and maximum 1" topsoil base.

832.3 EXECUTION

832.3.1 Inspection:

- A) Verify that prepared soil base is ready to receive the work of this Section.
- B) Beginning of installation means acceptance of existing site conditions.

832.3.2 Preparation:

- A) Finish grade areas to be sodded so that the surface is smooth and is approximately 1" below adjoining sidewalks and other paved surfaces.
- B) Remove all weeds and grasses from areas to be sodded. If Bermuda grass is present in areas to receive Fescue sod, to be exterminated by approved means or all soil removed to 6" depth and replaced with topsoil free of Bermuda grass.
- C) Planting surface shall be made friable by approved method of scarification. Prepared surface shall be floated smooth and free of bumps and depressions. Remove stones and foreign matter over 2" in diameter from top 2" of sod bed. Plant immediately, thereafter, provided the bed has remained in a friable condition and has not become muddy or hard. If it has become hard, till to a friable condition again.
- D) Apply fertilizer per soil tests recommendation. Apply fertilizer prior to installation of sod. For fescue sod apply 6-24-24 fertilizer at a rate of 5 lbs. per 1,000 sq. ft. and Milorganite or approved equal at a rate of 5 lbs. per 1,000 sq. ft. Fertilizer application to be done before laying sod.



- E) Apply fertilizer no more than 48 hours before laying sod.
- F) Lightly water to aid the dissipation of fertilizer.
- G) Prior to laying sod, incorporate soil amendments such as lime and Sulphur at rates recommended by soils tests to a 4" depth.
- H) Fescue sod should be laid only when the temperature is below 90° and is expected to remain less than 90° for the following 12 hours.
- I) Fescue sod to be laid only when the wind is less than 10 mph.

#### 832.3.3 Laying Sod:

- A) Moisten prepared surface immediately prior to laying sod.
- B) Remove plastic netting from sod.
- C) Lay sod immediately on delivery to site within 24 hours for Bermuda grass or eight hours for Fescue after harvesting to prevent deterioration.
- D) Lay sod tight with no open joints visible and no overlapping; stagger end joints 12" minimum. Do not stretch or overlap sod pieces.
- E) Finished sodding to be smooth and free of bumps and depression. Surface to be flush with adjoining grass areas if any. Place top elevation of sod approximately 1/2" below adjoining edging, paving, and curbs. Grade planting surface as necessary to accomplish above.
- F) On slopes 4" per foot and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2' on center. Drive pegs flush with soil portion of sod.
- G) Water sodded areas deeply immediately after installation.
- H) After sod and soil have dried sufficiently, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities.

#### 832.3.4 Warranty:

- A) Sodded areas to be vigorously growing at time of final acceptance or if installation occurs during dormancy warranty to extend through first month of following growing season. At conclusion of initial warranty period replace dead or unhealthy sod.
- B) For a period of one year commencing upon the Date of Substantial Completion, re-sod or reseed bare areas until complete coverage is achieved. Repairs to be completed as specified in the Maintenance requirements below.

832.3.5 Maintenance:

- A) Maintain sod until Final Acceptance by the City, or for additional time period as indicated in the Pay Quantity items for the project.
- B) Mow grass at regular intervals to maintain at a maximum height of 3" for Fescue and 2-1/2" for Bermuda grass. Do not cut more than 1/3 of grass blade at any one mowing.
- C) Neatly trim edges and hand clip where necessary.
- D) Immediately remove clippings after mowing and trimming.
- E) Water sufficiently to ensure establishment and maintain vigorous appearance. For a period of one week following Fescue sod installation, each area shall be watered four times daily with spray mist.
- F) Roll and/or topdress surface as needed to remove minor depressions or irregularities.
- G) Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
- H) Immediately replace sod in areas which show deterioration or bare spots. Any areas that have had topsoil washed away shall be filled to match specified grade with topsoil before re-sodding.
- I) Protect sodded areas with warning signs during maintenance period.
- J) Apply approved fertilizer at rate to provide 1-1/2 lbs. of actual Nitrogen per 1,000 sq. ft. every 25 days during growing season.
- K) For the purpose of establishing an acceptable standard, no bare areas will be permitted.

832.4 PAYMENT

832.4.1 Method of Measurement:

The Engineer will review Pay Applications submitted by the Contractor and shall approve payment based on the square foot quantity of each type of solid sod that is properly and completely installed according to the drawings, including placing and maintaining.

832.4.2 Basis of Payment:

Payment will be made for each Tree and each Shrub at the contract unit price per specified pay unit:

<u>PAY ITEM</u>	<u>PAY UNIT</u>
BERMUDA SOD	PER SQUARE FOOT
FESCUE SOD	PER SQUARE FOOT

## **PART 833 – LANDSCAPE MAINTENANCE**

### **833.1 GENERAL**

#### **833.1.1 Summary:**

- A) Work includes furnishing of necessary labor, tools, equipment, materials, supplies, and miscellaneous items required for accomplishing landscape maintenance as specified.
- B) Certain items of work included but not necessarily limited to the following are:
  - 1) Mowing, watering, edging, trimming, weed control, fertilization, trash and debris removal, and repair of lawn areas.
  - 2) Pruning and fertilization and watering of trees and shrubs.
  - 3) Mulching, weed control, cultivation and trash removal from shrub, groundcover, and tree beds and saucers.
- C) For Seasonal Color planting areas, includes furnishing all labor, materials, services, and equipment to plant and maintain seasonal color beds as herein specified except as follows:
  - 1) 1" depth layer of compost to be incorporated into upper 6" of soil profile by tilling. To be performed once annually in between spring and fall plantings.
  - 2) At end of each season, upon approval by owner or representative, spent or dead plants to be removed.
  - 3) Fertilize beds at time of spring planting at rate of 1 lb. of Nitrogen per 100 sq. ft. of bed.

#### **833.1.2 Related Work:**

- A) Section 831 – Trees, Shrubs, and Ground Cover.
- B) Section 832 – Sodding.
- C) Section 840 – Underground Sprinkler System.

#### **833.1.3 Quality Assurance:**

- A) All maintenance operations shall be accomplished as required to maintain standards as herein specified. Frequencies indicated herein are general guidelines and are not intended to restrict accomplishment of work as dictated by existing conditions or contractual agreements.

- B) Maintenance operations shall not be performed when existing weather or ground conditions would adversely affect quality of work or result in damage to grounds.
- C) Contractor shall protect all existing facilities and plant material and repair or replace any damage due to landscape maintenance operations.
- D) It is the Contractor's responsibility to report in writing to the Owner any and all conditions that may exist or occur which detract from the appearance of the landscaping and is beyond the scope of this contract.
- E) Clean up shall occur during and after all maintenance operations and debris shall be disposed of legally off-site.

833.1.4 Submittals:

- A) Submit type and manufacturer's data for fertilizer.

833.2 PRODUCTS

833.2.1 Material:

- A) Fertilizer: Shall be a commercial fertilizer furnished in standard factory sealed containers conforming to specified analysis. The term analysis shall mean the percentages of "total nitrogen", "available phosphoric acid", and "soluble potash".
- B) Water: Shall be furnished by the Contractor and transported to the site, or via irrigation system or hydrants on site, and paid for by Contractor. Contractor shall furnish all other equipment necessary for use of water.

833.3 EXECUTION

833.3.1 Lawn Areas:

- A) Mowing: To be accomplished as growth rate indicates, approximately four times a month; during the growing season, approximately April 1 – November 1. Thirty times per year total.
  - 1) Mow at a height of 2" to 2-1/2". Not more than 1" of the leaf blade shall be removed at one mowing unless otherwise directed by the Owner.
  - 2) Remove visible buildup of grass clippings from lawn areas after each mowing.
  - 3) After each mowing, promptly remove grass clippings from sidewalks, streets, driveways, and gutters. Clippings shall not be allowed to remain on such areas overnight.

- 4) Surface of mowed grass to be even without ridges of irregularities.
  - 5) A mowing cycle shall be completed within two days.
  - 6) In the event of drought conditions which necessitate water curtailment, height of mowing shall be raised to 3" and frequency decreased as approved by the Owner's Representative.
- B) Watering: During the growing season, adjust for amount of rainfall to provide approximately 1-1/2" – 2" of moisture every ten days.
- 1) Newly planted lawn areas should be watered as necessary to keep the upper 2" of soil moist.
  - 2) During lawn dormancy watering shall be accomplished once a month.
- C) Fertilization: Fertilization requirements will be as follows for lawn areas:
- 1) All lawns 1 lb. of actual Nitrogen per 1,000 sq. ft. four to six weeks after planting and thereafter 1 lb. of Nitrogen/1,000 sq. ft. per every six weeks. Test all turf areas for requirements at second growing season.
- D) Edging: All lawns shall be edged where areas meet curbs, sidewalks, or other non-lawn surfaces.
- 1) Shall be accomplished every other mowing, except cut of Site Entries and Ring Road which will be accomplished every fourth mowing.
  - 2) All resulting debris to be removed and disposed of by contractor. No grass clippings or trimmings will be allowed to remain overnight.
- E) Trimming: All grass around trees, shrubs, building, benches, light poles, stairs, mow strips, pavement inserts, etc., that is not cut by mowing shall be trimmed to height of adjacent mowed area.
- F) Trash Removal: All trash and litter shall be removed from lawn areas prior to each mowing.
- G) Pest, Insect, and Disease Control: Apply proper chemicals by certified personnel to control pests, insects, and diseases and to maintain lawns and planting in a healthy condition. Application should be performed at a time that public and tenants will not be in contact or have any real or imagined harm done to them by application and apply only during times of favorable weather.
- H) Repair:
- 1) Repair erosion by top-dressing with topsoil and re-vegetation.

- 2) Maintenance shall include all temporary protection barriers and signs, as necessary.
- 3) Dethatching to occur once per year.

833.3.2 Trees, Shrubs, and Groundcovers:

- A) Watering: Normally, trees and shrubs will not require water in addition to that provided for lawns as hereinbefore specified. Should lawn water be suspended, trees, shrubs and groundcover will be deeply watered as frequently as possible to approach rates set for lawn irrigation.
- B) Weeding and Cultivation:
  - 1) Area around all trees within saucer rim as per planting details should be cultivated and freed of all grass and weed growth. Saucer rim shall be maintained around the cultivated area to hold water. During the growing season, weeds and grass should be removed each time lawn is mowed.
  - 2) Shrub beds and groundcovers should be kept weed-free by weeding to occur each lawn mowing. Weeds may be chemically removed and/or controlled.
- C) Fertilization: Apply evenly within saucer rim. Time of application to be April or May.
  - 1) Trees 2-1/2" caliper and greater: 1 lb.
  - 2) Trees less than 2-1/2" caliper: 1/2 lb.
  - 3) Shrubs: 1 lb./1,000 sq. ft. of bed area.
- D) Pruning:
  - 1) Trees: Prune as necessary to remove broken or dead branches and maintain natural character in accordance with acceptable horticultural standards. Pruning should be accomplished at least once a year.
  - 2) Shrubs:
    - a) Remove broken or dead branches and prune (not shear) as necessary to maintain natural form. Pruning should be accomplished at least once a year.
    - b) Shearing will be permitted for the following species: Buxus, Euonymus Alatus and Kiautschovicus, and Taxus media "Hicksii". Encourage growth to ultimate height of 4' to 5' for Euonymus and Taxus, and 18" for Buxus, by shearing lightly during the first few growing seasons.

3) Cleanup: Remove all debris created by pruning as work proceeds.

E) Trash Removal: All litter and trash in shrub beds and groundcover areas shall be removed each time lawn is mowed.

F) Re-mulching: Shrub beds and groundcover areas shall be mulched as necessary to maintain a 2" mulch depth. This item shall be performed at least every six months if replenishment is necessary.

833.3.3 Seasonal Color:

A) Beds for seasonal color to be maintained as herein specified. Plantings shall be changed twice per year, with the material, and at the times specified herein.

833.3.4 Irrigation System:

A) Maintain irrigation materials and equipment per manufacturer's current recommendations for maximum efficiency.

B) Set, adjust, and clean heads to maintain proper moisture content of soil.

833.3.5 Roads, Walks, and Parking:

A) Clean trash, glass, leaves, and dirt from all planting beds and surrounding areas.

833.4 PAYMENT

833.4.1 Method of Measurement:

A) Payment for maintenance of plant material and sod prior to Final Acceptance by the City shall be included in the unit price bid for the installation of plant material or sod.

B) When an additional maintenance period is required by the bid documents, the Engineer will review Pay Applications submitted by the Contractor and shall approve payment based on the Number of Months that additional maintenance is required and is properly and completely performed.

833.4.2 Basis of Payment:

Payment will be made for each Tree and each Shrub at the contract unit price per specified pay unit:

<u>PAY ITEM</u>	<u>PAY UNIT</u>
LANDSCAPE MAINTENANCE	PER MONTH



## **PART 840 – UNDERGROUND SPRINKLER SYSTEM**

### 840.1 GENERAL

#### 840.1.1 Summary:

- A) Furnishing of materials and installation of a complete automatic sprinkler system providing uniform moisture coverage. The work shall include all materials, equipment and labor required to complete the project as outlined in the project drawings, documents, and this specification.
- B) Install sleeves for irrigation pipe and wires. Coordinate work with City of Tulsa.
- C) Supply and install one 1" water meter and one 1" reduced pressure backflow preventer meeting City of Tulsa Ordinances and Specifications.
- D) Excavation and Backfill.
- E) Installation of irrigation lines (pressurized), automatic control valves, valve boxes, control and common wiring, lateral lines, sprinkler heads, automatic controller(s) and electrical supply to controller, and backflow preventer as shown on the project drawings and irrigation plan.
- F) Tests including system pressure and performance test.

#### 840.1.2 Related Work:

- A) Section 830 – Structural Soil.
- B) Section 831 – Trees, Shrubs, and Ground Cover.

#### 840.1.3 References:

- A) ANSI/ASTM D2564 – Solvent Cements for Polyvinyl Chloride) (PVC) Plastic Pipe and Fittings.
- B) ASTM D2241 – Polyvinyl Chloride) (PVC) Plastic Pipe (SDR-PR).
- C) ASTM – American Society of Testing Materials.
- D) AWWA – American Water Works Association.
- E) NSF – National Sanitary Foundation.
- F) NEC – National Electric Code.

#### 840.1.4 System Description:

- A) Electric solenoid controlled underground irrigation system consisting of PVC plastic pipe and fittings, with fixed spray pop-up heads in a multi-station electric control system, programmed as approved by Engineer.

840.1.5 Submittals:

- A) For planting within the right-of-way, an automatic irrigation system must be provided for plant maintenance unless otherwise approved by the City of Tulsa. The irrigation system may be designed and sealed by a licensed professional authorized to do business in the state of Oklahoma, as a part of the Construction Documentation submittal, or an irrigation design may be submitted as a design/build drawing by the contractor. As part of the Construction Documentation set, the irrigation design be reviewed only for general compliance with the standards set forth in this document, and related details. If a design/build drawing is provided through the submittal process, the design professional will review and approve the drawing. The licensed professional will attest by approving the plan, that to the best of their ability and knowledge, the system is designed to provide complete coverage with minimal overspray. No construction on the irrigation system will be allowed until plans are approved.
- B) The design shall include the piping layout, location and coverage of sprinkler heads, plant and landscaping features, site structures, list of fittings to be used, and control system and wiring diagrams and data, and shall note water pressure at the project site.
- C) Upon award of contract, Contractor shall provide the following:
  - 1) Three copies of manufacturer's product data for each type of sprinkler head, swing joint assemblies, electric control valves, automatic and manual drain valves, isolation valves, air relief valves, pressure regulators, valve boxes, pipe, fittings including tapping tees and saddles, control wire, waterproof wire connectors, backflow preventer, booster pump, irrigation controllers, rain sensors, freeze sensors, and moisture sensors proposed for use.
  - 2) Provide one of each sprinkler head of each type to be used on the project, one electric control valve, one waterproof wire connector, sample of common and control wire, and one of each type of valve box. Accepted samples will be returned to Contractor for use in project.
- D) Determine and submit to Engineer in writing the static water pressure at meter and/or other designated points of connection at least two weeks prior to beginning of installation.
- E) Upon project completion and final review of system by City of Tulsa, Contractor shall provide the following:

- 1) Provide record or “as-built” drawings of completed facilities as installed. Drawings shall be provided to City of Tulsa in:
    - a) Electronic form (CAD),
    - b) In a reproducible form of mylar or vellum and,
    - c) Three copies of the as-built drawing in blueline or blackline form. As-built drawing shall show the measured distance from easily identified, fixed locations to isolation valves, electric control valves, manual drain valves, and wire splices. Two dimensions from fixed point per location are required.
  - 2) Three binders containing manufacturer’s installation, operational and maintenance instructions as well as a parts breakdown and catalog for each piece of equipment installed on the project. As a minimum the binders shall include information for the irrigation controller, booster pump, backflow preventer, pressure regulators, isolation valves, electric control valves, drain valves, air relief valves, all spray and rotary sprinkler heads, and rain, freeze, and moisture sensors.
  - 3) A plastic laminated (sealed) reduced drawing of the irrigation system indicating the areas or zones of the irrigation system controlled by each electric control valve. For clarity, drawing may be divided into two sections and shown on both sides of the laminated sheet. Reduced drawing shall be placed on the inside of the controller door. Drawing shall be approved for clarity by City of Tulsa prior to acceptance of system.
- F) Upon project completion and prior to the certificate of occupancy and/or Final Acceptance, the design professional noted in paragraph 1.5 A., shall review the system and submit a written certification that the automatic irrigation system was installed per the plan, and provides full coverage of the landscaped area with minimal overspray.

840.1.6 Operation and Maintenance Instruction and Demonstration:

- A) Provide a schedule indicating length of time each electric control valve is required to be open to provide determined amount of water.
- B) Provide a recommended schedule for station run times and frequency of watering for the first two weeks, the first two months, and the first twelve months (including all seasonal change requirements) after completion of the installation.
- C) Instruct City of Tulsa's personnel in operation and maintenance of system, including adjusting of sprinkler heads.

840.1.7 Extra Stock:

A) Provide the following extra stock items:

- 1) Two sprinkler heads of each type and size.
- 2) Two valve keys for manual valves.
- 3) Two keys for valve boxes or markers.
- 4) Two adjustment tools for each type sprinkler head and any tool required to remove or disassemble each type head.
- 5) Two couplers keys for each size of quick coupling valve with brass hose swivels.
- 6) Two replacement diaphragms and solenoids for each size and type of valve installed on the project.

840.1.8 Warranty:

- A) Entire sprinkler system will be unconditionally guaranteed against defects in material and workmanship, including repair of settling of backfilled areas below grade and adjusting heads to proper level for a period of one year from final acceptance.
- B) Minor adjustments, any defective electrical controls, valves, sprinkler heads or other working parts will be repaired or replaced without cost to the City of Tulsa for a period of one year from the date of acceptance.
- C) Damage by others during the one year of guarantee period will be City of Tulsa's responsibility.
- D) Warrant sprinkler system to have 100% uniform moisture coverage of areas shown to be irrigated.

840.1.9 System Service:

- A) Inspect system at two and four weeks after Date of Final Acceptance and make necessary adjustments. Drain System in fall following installation and turn on system the following spring, providing complete system inspection and adjustment.

## 840.2 PRODUCTS

840.2.1 Materials – General

- A) The specific materials to be used shall be as designated on the project drawings and this specification. All materials to be incorporated in this work shall be new and of the best quality, meeting the requirements for such materials and for the purpose intended. Since the irrigation lines on the contract drawings are essentially

diagrammatical, the Contractor shall be responsible for computing and supplying the required pipe, fittings, control wires, and electrical accessories according to the contract documents.

B) Acceptable Manufacturers:

- 1) Weather-matic.
- 2) Rain Bird.
- 3) Hunter.
- 4) Toro.
- 5) Approved equal.

840.2.2 Pipe and Fitting Materials:

A) Pressurized Main Line Pipe:

- 1) All 2" and smaller main line pipe shall meet the latest requirements of ASTM D1785 Standard Specification for Schedule 40 Polyvinyl Chloride) PVC pipe with size as shown on the project drawings.
- 2) All main line pipe to be installed in curved sleeves shall be copper, Type L Soft, and shall be the size shown on the project drawings. All transition fittings to PVC shall be copper sweat socket with threaded MIPT or FIPT connections to the PVC main line pipe.

B) Lateral Pipe:

- 1) All lateral pipe, downstream of the control valves, shall be have solvent weld joints and shall meet the latest requirements of ASTM D2241 Standard Specification for Polyvinyl Chloride) (PVC) Plastic Pipe with standard dimension ratio (SDR) of 21 and a Pressure Rating (PR) of 200 psi.

C) Sleeving Pipe:

- 1) The contractor is responsible for the location and placement of all sleeves on the project whether shown on the drawings or not. Sleeves under sidewalks and concrete other than City of Tulsa streets shall be PVC SCH 40 for straight sections and shall be HD Polyethylene for curved sections. Sleeves shall be sized two times the nominal diameter of the largest pipe passing through the sleeve. Minimum sleeve size shall be 2". Sleeves shall be installed at a minimum cover depth of 20" from finish grade. Coordinate horizontal and vertical elevations with utilities and footings. A separate minimum 2" diameter sleeve shall be provided for the control wires to pass through at each crossing.

All sleeves passing under City of Tulsa streets shall be steel or ductile iron pipe and shall meet the requirements of the governing departments of the City of Tulsa.

D) Fittings:

- 1) Main Line Fittings (2" and smaller): All pressurized main line fittings at all points of direction change such as 22.5, 45, tees or 90° turns shall be solvent weld with a minimum of Schedule 40 dimensions and shall meet the requirements of ASTM D2466-78. Schedule 40 fittings shall be Spears Manufacturing or approved equal.

Main Line Installation of Electric Control Valves and Quick Coupling Valves (2" and smaller) onto the main line shall be PVC Schedule 80 solvent welded or threaded fittings and shall meet ASTM D2467 and ASTM D2464, respectively. PVC Schedule 80 fittings and nipples shall be used on all fittings required between the mainline tap and the electric control valve as well as the threaded connection between the electric control valve and the lateral piping. Schedule 80 fittings shall be Spears Manufacturing or approved equal. Contractor shall use manufacturer's recommended sealing compounds and/or Teflon tape according to manufacturer's recommended practice for the specific application.

- 2) Lateral Line Fittings: Solvent welded fittings shall be Schedule 40 dimensions and wall thickness and shall meet the requirements of ASTM D2466 and shall be used on all piping downstream of electric control valves.

E) Solvent Cement: ANSI/ASTM D2564 for PVC pipe and fittings.

- F) All 1/2" inlet spray heads and 3/4" inlet rotary heads shall be connected to the irrigation piping utilizing 1/2" thick walled polyethylene tubing (Rain Bird Model SPX-100 or approved equal) and appropriate insert fittings (Rain Bird Models SBE-050, SBE-075, SBA-050, SBA-075, or approved equal). Sufficient lengths of flexible pipe shall be used to form a sweeping arc to ensure that spray heads are supported properly and allow for vertical adjustment and movement during service.

- G) All 1" inlet quick coupling valves shall be installed on prefabricated, manufactured swing joint assembly rated for 315 psi with pre-lubricated buttress threads and O-ring seals equal to Spears Manufacturing Co. Series 5807-01012 or approved equal.

- H) Swing Joints: Prefabricated, schedule 80 PVC, equal to Spears. Use for ground level pop-up impact driven heads, gear-driven rotary heads, hydrant, and quick-coupler valves.

- I) Drip Irrigation: Pipe and fittings equal to Rain Bird 1/2" Pressure Compensating Emitter Tubing, or Netafin U.S.A. A Drip Operation Indicator Kit equal to #17500 as supplied by Rain Bird or approved equal shall be installed at each drip irrigation

zone or each tree well (where portions of the drip zone is separated from others with solid line).

#### 840.2.3 Sprinkler Heads and Nozzles:

- A) Sizes and types required to provide complete, even coverage with minimum overspray as noted on the drawings.
- B) Shrub/Ground Cover Beds: 12" Pop-up – Rain Bird 1812-PRS with pressure regulator incorporated into stem with necessary 1800-EXT extensions or approved equal.

#### 840.2.4 Valves:

- A) The irrigation system control valves shall be contamination resistant, glass filled high strength nylon body and bonnet, electrical solenoid operated, normally closed, diaphragm globe valves. The valve shall have a 200 psi CWP rating. The valve shall be activated by a 24 V.A.C. solenoid. Flow control stem shall be non-rising. The valve cover shall be secured to the body with stainless steel threaded studs and nuts. Bleeding of water during manual operations shall be either internal or external. Valves shall be as manufactured by Weathermatic, Inc. Model Series 11,000 or approved equal with size as shown.
- B) Irrigation drip zone control valve to be specifically designed commercial applications with medium flow requirements and incorporating a pressure-regulating filter.
- C) Gate valves (isolation shut off valves): 2" and smaller – shall be bronze, threaded, screw-in bonnet with non-rising stem rated for a 125 psi WSP and 200 psi non-shock WOG. The valve shall be of domestic manufacture, shall meet Federal Specifications MSS SP-80 equal to Hammond Model IB645.
- D) Isolation valves for the electric control valves shall be of the ball type, plastic construction, threaded ends, and have a maximum pressure rating of 235 psi at 73° F. The valves shall be equal to Spears Model 2131-0XX size the same as the control valve.
- E) Automatic drain valves: King Technology, Inc. Model 22, 1/2" inlet or approved equal.
- F) Quick coupling valves: Equal to Weathermatic V100RL-NP with "Non-Potable" purple rubber cover and locking cover. Contractor shall supply two model 44K keys with bronze hose swivel adapters, Buckner model 45002 or approved equal. Quick coupling valve shall be prevented from rotation with Leemco Model LS-120 valve stabilizer or approved equal.
- G) Backflow Preventer: Reduced pressure device equal to Wilkens Model 975XL meeting the requirements of the City of Tulsa for irrigation system use. The

backflow preventer shall be installed using Type L copper pipe and shall incorporate two unions for ease of construction. The contractor shall provide freeze protection for the backflow preventer and piping by using thermostatically controlled "heat tape". The backflow preventer shall be placed in a protective cabinet along with the controller.

- H) Backflow Preventer and Controller Protective Cabinet: The backflow preventer and controller shall be installed in an aluminum cabinet. The protective cabinet shall be installed on a concrete base or sidewalk as indicated on Standard Detail 840 – 842. The contractor is responsible for supplying a connection of 120 Volt power to the cabinet for the controller and backflow preventer. Source of 120 Volt power to be from new project circuitry. Submit proposed connection to engineer for approval.

840.2.5 Water Meter:

- A) New, 1" as provided by the City of Tulsa (One Required).

840.2.6 Controller:

- A) Electronic, compatible with valves, multi-station, programmable, in U.L. approved rainproof housing. The controller shall be installed inside the cabinet at the specified location according to the manufacture's recommendations. The contractor is responsible for supply and connection of 120 Volt power to the controller. Source of 120 Volt power to be from new project circuitry. Submit proposed connection to engineer for approval. The controller shall be as manufactured by Rain Bird Sprinkler Mfg. Corp., Glendora, California Model ESP-12LX+ or approved equal.

840.2.7 Valve Boxes and Markers:

- A) For automatic control valves: Equal to Carson Industries Inc. model 1419E-13 with 1419E extensions as required.
- B) For quick coupling valves and isolation gate and ball valves: Equal to Carson Industries Inc. model 910-12 with 8" corrugated plastic pipe for extension.
- C) For main line isolation valves: Carson Industries, Inc. model 910-12 with 8" I.D. corrugated polyethylene pipe, as manufactured by Advanced Drainage Systems, Inc. (ADS) or approved equal, cut to length as required.
- D) For 24 Volt (low voltage) electrical splices: Carson Industries, Inc. model 910-12 with 8" I.D. corrugated polyethylene pipe, as manufactured by Advanced Drainage Systems, Inc. (ADS) or approved equal, cut to length as required.

840.2.8 Wiring:



- A) Wire: All control wiring to be used for connecting the remote-control valves to the controller shall be 14 gauge and all common wiring shall be 14 gauge. The wire shall be Type UF, 600 Volt, single or stranded solid copper wire with PVC insulation and shall bear UL approval for direct underground burial feeder cable.
- B) Splicing Materials: All electrical connections shall be waterproof so that there is no chance for leakage of water and corrosion build-up in the joint. The type of connection to be used shall be 3M DBY direct bury splice kits, King Silicon-Filled Safety Connectors or approved equal.

840.2.9 Environmental Condition Sensors:

- A) Rain Sensor – Equal to Mini-Clik II manufactured by Mini-Clik, Inc.
- B) Freeze Sensor – Equal to Freeze-Clik manufactured by Mini-Clik, Inc.

840.3 EXECUTION

840.3.1 Preparation:

- A) Contractor shall call and notify the local utility location center before any excavation to request the exact location of all utility lines. Contractor is responsible for the protection of all utility lines located on the site.
- B) Design system to provide coverage of turf and planting beds on separate zones. Route piping to avoid plants and structures. All planting beds with sun exposure shall be zoned separately from shaded planting bed areas. All planting beds with shrubs and perennial plantings shall be zoned separately from beds with annual or seasonal planting. Turf rotor heads to be zoned separately from turf spray heads.
- C) Head locations and pipe routing are diagrammatic only and shall be adjusted during installation to compensate for prevailing winds, gradient, and landscaping to ensure proper coverage with minimal overthrow.
- D) Review layout requirements with other affected work. Location of heads to be coordinated with planting bed and lawn edges. Verify location and installation of sleeves (under paving and other improvements) to accommodate system.
- E) Contractor shall ensure that his equipment, materials, tools, excavations, backfills, any obstruction, and in general, the job site, are properly barricaded, posted, and lighted to prevent unnecessary risk to the public, municipal, or construction employees that may encounter the job site.
- F) Protect landscaping and other features remaining as final work.

840.3.2 Irrigation Design:

- A) Spray heads shall be spaced no further than for "Head to Head" coverage based on the sprinkler head performance published by the head manufacturer. Rotary heads (3/4" inlet) shall be spaced no further than 85% of the published radius for the design pressure.
- B) Valves shall be sized according to the flow through the valve as follows:
  - 1) 3-18 GPM – 1" Valve.
  - 2) 28-54 GPM – 1 1/2" Valve
  - 3) 55-80 GPM – 2" Valve
- C) All components of the irrigation system are to be designed and specified to maintain the design pressure and performance at the sprinkler heads with a fluctuation of static water pressure of  $\pm 10\%$ .
- D) Pressurized main line pipe shall have maximum velocity of 5' per second.
- E) Lateral line pipe shall have maximum water velocity of 5' per second.
- F) The maximum pressure differential between the sprinkler head nearest the control valve and the sprinkler head furthest from the control valve shall not exceed 10% of the pressure at the control valve.
- G) Review layout requirements with other affected work. Location of heads to be coordinated with planting bed and lawn edges. Verify location and installation of sleeves (under paving and other improvements) to accommodate system.
- H) Protect landscaping and other features remaining as final work.

#### 840.3.3 Trenching:

- A) Trenches for pipe shall be excavated to a sufficient width and depth to permit proper handling and installation of the pipe and fittings. All manifold, main lines, and lateral lines shall be installed at a minimum cover depth of 18". The minimum cover specifications shall govern regardless of variations in ground surface profile. Trenches shall be graded and sloped to lowest drain points.
- B) All water, sewer, drainage, electrical, and all other utility lines shall be protected where encountered in trenching and, where cut or damaged by Contractor, shall be repaired at the expense of the Contractor and to the satisfaction of the City of Tulsa.
- C) Concrete and asphalt crossings shall be sleeved prior to their installation. No cutting of existing sidewalks or roadways shall be permitted.

#### 840.3.4 Installation:

- A) Contractor is responsible for the placement and installation of all sleeves whether shown on the drawings or not. Install sleeves under paving and other improvements prior to construction. Install where required to accommodate piping at proper depth to prevent damage by other construction activities and to provide specified burial depth for irrigation pipe. Location of sleeves to be recorded and marked.
- B) Arrange and coordinate installation of water meter. Cost paid by Contractor.
- C) Install backflow preventer inside the cabinet at the specified location as approved by the City of Tulsa.
- D) Install pipe, valves, controls, and sprinklers in accordance with manufacturer's instructions. Connect to water and electrical service. All work to be accomplished in accordance with applicable codes.
- E) Provide for thermal movement due to expansion and contraction of the pipe.
- F) Solvent weld pipe and fitting connections shall be made according to ASTM D2855-83 Standard Practice for making solvent-cemented joints with Polyvinyl Chloride (PVC) pipe and fittings. Special care shall be taken to:
  - 1) Cut pipe square, remove burrs and chamfer 2" pipe and larger.
  - 2) Apply uniform coating on all parts with lighter coats on sockets.
  - 3) Avoid pockets of cement left in joints.
  - 4) Use small cans to maintain cement's original viscosity.
  - 5) Make joints immediately and hold to prevent pipe from pushing out.
- G) After piping is installed, before sprinkler heads are installed and backfilling commences, open valves and flush system with full head of water.
- H) Set valve box covers level at finish grade. Rectangular valve boxes to be placed parallel to nearby curbs and walks or other improvements. Valves and valve boxes shall be installed where shown or directed and shall be set plumb. Valve boxes shall be centered on the valves. Where feasible, valves shall be located outside the area of natural walkways or paths and shall be placed in groundcover areas where possible. Earth fill shall be carefully tamped around each valve box. Valve boxes should be supported or blocked such that any surface loads on the valve boxes will not be transmitted below to the pipe or valves. Washed gravel sumps shall be provided below all valve boxes to permit drainage of water away from valves. Minimum depth of gravel sump is 8".

- I) Install at least two automatic drain valves per zone at all low points sections of lateral piping (lines downstream from valves) to ensure complete drainage of system when not in use.
- J) All sprinklers shall be installed on flexible connections or swing joints as specified in Section 2.2 "Pipe and Fitting Materials" and shall be set plumb and level with the final grade.
- K) Install control wiring. Place the excess wire in a 10" expansion coil at each valve to which controls are connected and at 100' intervals. Control wiring may be installed in the same trenches with the irrigation piping. Wiring shall be bundled and taped with electrical tape at 10' intervals the entire length of each run. Wiring shall be installed on the north or east side of the pipes. Wire shall not be taut in the trench and expansion loops shall be provided to prevent the wire from being tensioned by backfilling or other subsequent construction. The side of the trench in which the wires are located shall be free of stones and other hard material which might injure the wire insulation. Backfill material placed against the wires shall be select material especially free from stones or other material with might injure the insulation.
- L) A minimum of 24" of wire for an expansion loop shall be allowed at each valve for contraction of wire or tightening of wire due to back-filling of trenches or possible valve service or replacement.
- M) Splices outside of valve locations are not desirable and are discouraged. However, should splices be necessary, all splices shall be made in a minimum 10" round valve box. All connections at the electric control valves and splice points shall be water-proofed with the system specified in Section 2.8 "Wiring".
- N) All trenches shall be carefully backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand, soft shale, or other approved materials, free from large clods of earth or stone. Rock, broken concrete or pavement, and large boulders shall not be used as backfill material. The backfill shall be thoroughly compacted and evened off with the adjacent soil level. Selected fill dirt or sand shall be used if soil conditions are as discussed above. The fill dirt or sand shall be used in filling 4" above the pipe. The remainder of the backfill shall contain no lumps or rocks larger than 1". The top 6" of backfill shall be free of rocks or gravel particles over 1/2" in diameter, subsoil, or trash. Open trenches or partially backfilled trenches shall be kept to a minimum and effort shall be made to completely backfill that trench opened each day. The Contractor will be responsible for restoration of all settlement for a period of one year from acceptance.
- O) The irrigation controller shall be mounted level and plumb at the specified location shown on the contract drawings according to manufacturer's recommendations. Electrical conduit PVC sweep ells shall be used for the entering and exiting of the 24 Volt control wires into the conduit entering the controller. Controllers shall be connected to the appropriate valves as indicated on the contract drawings.

Electrical power supply to the controller shall be installed according to local electrical codes and shall be provided by Contractor.

P) Rain and freeze sensors shall be installed according to manufacturer's recommendations and shall be installed at locations approved by the design professional.

Q) Clean area and remove all debris and excess materials from site.

#### 840.3.5 Tests:

##### A) Static Pressure Test:

- 1) The entire main line system shall be constructed to successfully withstand, when completed, a full static pressure or 125 psi (whichever is greater) for a period of six hours with no resulting flow or pressure loss.
- 2) The testing for leakage shall be conducted with the observation of the City of Tulsa and all pipe, joints, and appurtenances will be inspected while the system is under test pressure and leaks corrected as directed. The testing shall extend over a period of up to six hours to allow for a complete inspection.

##### B) Performance Test

- 1) Upon completion of the irrigation system including all pressure tests, Contractor shall perform a 48-hour performance test of the complete system to ensure that all components are functioning properly. Contractor shall keep a technically qualified person and necessary crew on the job site during this period of testing.
- 2) The Contractor shall balance and adjust the various components of the system so that overall operation of the system is most efficient. This includes adjustments to pressure regulators, part-circle sprinkler heads, and individual station adjustments on the controllers.
- 3) Repair grades and re-dress mulch in planted areas disturbed by final testing and adjustment.

#### 840.4 PAYMENT

##### 840.4.1 Basis of Payment:

Underground Sprinkler System will be paid for at the contract unit price by lump sum for the system, or as indicated on the Contract Documents and approved by the City of Tulsa.

**SPECIAL – IRRIGATION LUMP SUM (or as otherwise indicated on Contract Documents)**

Such payment shall be full compensation for all equipment, tools, labor, and incidentals necessary to complete the work as specified.

**END OF SECTION**