

# Design and Construction Standards

## Volume 2 Construction Specifications

2015 Edition



Public Works

Planning and Development Services



**OVERLAND PARK**  
KANSAS

**ADOPTION OF  
CONSTRUCTION SPECIFICATIONS  
CITY OF OVERLAND PARK**

**A. Authority**

As set forth in the Overland Park Municipal Code (OPMC) Section 13.10.20.D, the City Engineer is authorized to adopt construction specifications.

**B. Construction Specifications**

The Design and Construction Standards Manual, Volume II – Construction Specifications, 2015 Edition, City of Overland Park, is hereby adopted as the City Engineer’s Standard Specifications.

**C. Future Amendments to the Construction Specifications**

Future amendments to these Construction Specifications may be made by the City Engineer. The process for adoption of such amendments shall include a public notification and comment period, as specified in the OPMC 13.10.20.D. No amendments shall be deemed effective until adopted in conformance with the Code.

**D. Adoption**

The City Engineer hereby adopts these Construction Specifications on this day of May 1, 2015.

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Daniel G. Miller, P.E.  
City Engineer

**CITY OF OVERLAND PARK**

**2015 DESIGN AND CONSTRUCTION STANDARDS MANUAL**

**VOLUME II: CONSTRUCTION SPECIFICATIONS**

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**CITY OF OVERLAND PARK**  
**2015 DESIGN AND CONSTRUCTION STANDARDS MANUAL**  
**VOLUME II: CONSTRUCTION SPECIFICATIONS**

**1 - GENERAL CONDITIONS**

**1.1 DESCRIPTION**

This section contains general information regarding the execution of construction projects within the limits of the City of Overland Park.

**1.1 GENERAL**

**a. Insurance and Surety Requirements.**

(1) Insurance Requirements in General. Unless otherwise specified, when insurance is required, the contractor shall secure and maintain or have maintained throughout the duration of the project, insurance of the type and in at least the amounts specified below to protect against all hazards or risks of loss as hereinafter specified whether such hazards or risks of loss be generated by the contractor or any of his subcontractors, or by anyone directly or indirectly employed by the contractor or his subcontractors. If required by the City Engineer, the contractor shall offer the City evidence of such insurance coverage and all renewals thereof in the form of the certificate of insurance provided by the City.

(2) Worker's Compensation and Employer's Liability. This insurance shall protect the contractor against all claims under applicable state Worker's Compensation laws. The contractor shall also be protected against claims for injury, disease, or death of employees that for any reason may not fall within the provisions of a Worker's Compensation law. The policy shall apply to "all states".

The liability limits shall not be less than the following:

Worker's Compensation:	Statutory
Employer's Liability:	
Bodily Injury by Accident -	\$100,000 each accident
Bodily Injury by Disease -	\$500,000 policy limit
Bodily Injury by Disease -	\$100,000 each employee

(3) General Liability.

General Liability Insurance shall be provided including the following:

- (a) Commercial or Comprehensive General Liability Form;
- (b) Premises and Operations;
- (c) Explosion, Underground & Collapse (certificate must confirm inclusion of "Blasting" coverage, if applicable);
- (d) Products & Completed Operations;
- (e) Broad Form Contractual;
- (f) Broad Form Property Damage;
- (g) Personal Injury;
- (h) Independent Contractors.

Minimum Limits Required:

Bodily Injury and Property Damage, Combined Single Limits:  
\$500,000 each occurrence  
\$500,000 aggregate

(4) Automobile Liability.

Policy shall protect the Contractor against claims for bodily injury and/or property damage arising from the ownership or use of all owned, hired, and/or non-owned vehicles and must include protection for either:

- a. Any Auto or
- b. All Owned Autos (If Any)
- c. Hired Autos
- d. Non-Owned Autos

Limits of liability protection required are the same as the limits for the General Liability section.

(5) Excess Liability.

Policy must include general liability and automobile liability and afford protection at least as broad as the underlying policies.

Bodily Injury and Property Damage, Combined Single Limits:  
\$1,000,000 each occurrence  
\$1,000,000 aggregate

Excess liability requirement may be modified or waived at the City's discretion upon written application to and approval by the City's risk manager. If the requirement is modified or waived, the risk manager shall place on file with the City his or her reasoning for such waiver or modification.

(6) Industry Rating.

Coverage will only be acceptable from an insurance carrier who offers proof that it:

- (a) Is licensed to do business in the state of Kansas;
- (b) Carries a Best's policyholder rating of A or better;
- (c) Carries at least a Class X financial rating; or
- (d) Is a company mutually agreed upon by the City and contractor.

(7) Surety Submission - Amount – Period.

The contractor shall submit cash, a letter of credit or a Performance and Maintenance Bond on all projects before beginning construction. The amount of the surety shall be for the full amount of the project. If surety is given in the form of a bond, it shall remain in effect for a period of two (2) years after the date of completion and acceptance. The contractor may deposit with the City's Director of Finance, Budget and Administration an irrevocable letter of credit from an acceptable financial institution payable to the City, collectible no later than two years from the date of issuance. If surety is given in the form of cash or a letter of credit, all remaining money and any interest accrued thereon shall be returned to the contractor two (2) years after the date of completion and acceptance of the project.

**b. Precedence of Documents.**

For Privately Funded projects, in case of conflict between the Documents, the following order of precedence shall govern, unless appealed to the City and approved:

- First: KDOT Standard Specification except for Division 105.6, if applicable
- Second: Overland Park Municipal Code
- Third: Overland Park Public Works Department's Standard Details
- Fourth: Design and Construction Standards Manual - City of Overland Park, Kansas

- Fifth: Project Plans
- Sixth: Project Standard Details
- Seventh: Project Specifications

Figure dimensions on Plans shall govern over scale dimensions, and detailed drawings shall govern over general drawings. In all cases, where a conflict is cited, the Engineer or the Owner's Representative shall be duly informed. The Engineer will notify the Contractor in writing should the above procedure be deviated from in any particular instance.

If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of the Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or an instructions of an Supplier, the Contractor shall not proceed with the work affected thereby (except in an emergency) until an amendment or supplement to the Contract Documents has been issued by the City or the Owner; provided, however, that the Contractor shall not be liable to City for failure to report any such conflict error, ambiguity, or discrepancy unless the Contractor knew or reasonably should have known thereof.

**c. Approved Plans with Revisions.**

The Contractor shall maintain in a safe place at the site one approved copy with revisions of all drawings, specifications, addenda, written amendments, change orders, work change directives and written interpretations and clarifications in good order and annotated to show changes made during construction.

**d. Site Administration.**

The Contractor shall be responsible for all areas of the site used by him, by other contractors, and all Subcontractors in the performance of the Work. Contractor will exert full control over the actions of all employees and other persons with respect to the use and preservation of property and existing facilities, except such controls as may be specifically reserved to City or others. Contractor has the right to exclude from the site all persons who have no purpose related to the Work or its inspection, and may require all persons on the site (except City's employees) to observe the same regulations as he requires of his employees.

**e. Maintenance.**

During a period of two years from and after the date of the final approval by the City of the work embraced by this contract, the Contractor shall make all needed repairs arising out of defective workmanship or materials, which in the judgment of the City shall become necessary during such period. If within ten (10) days after the mailing of a notice in writing to the Contractor or his agent, the said Contractor shall neglect to make or undertake with due diligence to make the aforesaid repairs, the City is hereby authorized to make such repairs at the Contractor's expense; provided, however, that in case of an emergency where in the judgment of the City delay would cause serious loss, hazard, or damage, repairs may be made without notice being sent to the Contractor; and the Contractor shall pay the cost thereof.

**f. Bonds**

The Contractor shall submit a performance and maintenance bond on all projects before beginning construction. The amount of the bonds shall be for the full amount of the project and shall remain in effect for a period of two years after the date of completion and acceptance.

## **2 - BASIC REQUIREMENTS**

### **2.1 SCOPE**

This Section deals with basic requirements for the construction of all projects within the City of Overland Park.

## **2.2 GENERAL**

### **a. Right of Entry for Inspection.**

Whenever it is necessary to make an inspection to enforce any ordinance or resolution, or whenever there is reasonable cause to believe there exists an ordinance or resolution violation in any building or upon any premises within the jurisdiction of the City, any authorized official of the City may, upon presentation of proper credentials, enter such building or premises at all reasonable times to inspect the same or to perform any duty imposed upon him by ordinance; provided that, except in emergency situations or when consent of the owner and/or occupant to the inspection has been otherwise obtained, he shall give the owner and/or occupant, if they can be located after reasonable effort, twenty-four hours written notice of the authorized official's intention to inspect. The notice transmitted to the owner and/or occupant shall state that the property owner has the right to refuse entry and that in the event such entry is refused, inspection may be made only upon issuance of a search warrant duly authorized by law. In the event the owner and/or occupant refuses entry after such request has been made, the official is hereby empowered to seek assistance from any court of competent jurisdiction in obtaining such entry.

### **b. General Regulations.**

#### **(1) General.**

All public improvement constructed within the City shall be in accordance with the current Standard Details (hereinafter, the "Standard Details") and the minimum design standards and specifications set forth in these specifications. The Standard Details shall be adopted and amended by the City Engineer and shall be on file in the office of the City Engineer. The provisions of the Standard Specifications for State Road and Bridge Construction, Kansas Department of Transportation, current edition (hereinafter "Standard Specifications") are incorporated, except as hereinafter specified.

#### **(2) Approval of Construction.**

Any person or entity proposing to construct any street improvement within the City shall apply to the City Engineer for approval of the location, dimensions, design and construction methods and materials of such street; the application shall be in writing, or plans submitted for approval, and shall contain such information including maps, plats, diagrams, detailed drawings, and specifications as the City Engineer may require. No street shall be constructed within the City without approval of the City Engineer or, in the case of an appeal, without approval of the City Council.

#### **(3) Property Corners and Monumentation.**

It shall be the responsibility of the Contractor to protect all property lot corners and land survey corners and accessories. Should it be necessary to disturb any such monument, whether stake, pin, bar, disk, box, or other, it remains the responsibility of the contractor to reference such markers prior to removal, reset them, and file such relocations or monumentation documents as the law may require. Any such references, removal, replacement and certification of monuments shall be performed by a land surveyor registered in the state of Kansas.

### **c. Cleaning.**

All catch basins, manholes, inlets and outlets and roadway surface shall be thoroughly cleaned of any accumulations of silt, debris or foreign matter of any kind, and shall be free from such accumulations at the time of final inspection.

### **d. Dumping Material on Streets.**

No person shall dump, deposit, wash or spill, or cause to be dumped, deposited, washed or spilled, in or on any street, sidewalk, bike-hike trail, right-of-way, gutter, storm sewer, water course, drainage course or other public utility facility, any leaves, debris, rubbish, snow, or any other material that damages, causes an obstruction to, or interferes with the operation of that facility. It shall also be unlawful for any such person to allow such material to remain in or on such facility. A separate offense shall be deemed committed on each day during or on which a violation occurs or continues.



### 3 - ABBREVIATIONS AND DEFINITIONS

#### 3.1 SCOPE

This section defines the abbreviations and definitions of words and phrases used in the technical specifications.

#### 3.2 GENERAL

##### a. Abbreviations.

References made to the following abbreviations refer to the specifications, standards, or methods of the respective national association. All references to these specifications, standards, or methods shall, in each instance, be understood to refer to the latest issue in effect (including all amendments).

AASHTO	American Association of the State Highway and Transportation Officials
ACI	American Concrete Institute
AI	The Asphalt Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute (Succeeding ASA)
API	American Petroleum Institute
APWA	American Public Works Association
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing Materials
CRSI	Concrete Reinforcing Steel Institute
EPA	Environmental Protection Agency
IBC	International Building Code
KCMMB	Kansas City Metro Materials Board
KDOT	Kansas Department of Transportation
KDHE	Kansas Department of Health and Environment
MUTCD	Manual on Uniform Traffic Control Devices
OSHA	Occupational Safety and Health Act of 1970
OPMC	Overland Park Municipal Code
PIP	Public Improvement Permit
PCA	Portland Cement Association
PCI	Pre-stressed Concrete Institute
PVC	Polyvinyl Chloride
ROW	Right-of-Way

##### b. Definitions.

The following words and phrases whenever used in the ordinances of the City of Overland Park, Kansas, shall be constructed as defined in this section unless from the context a different meaning is intended or unless a different meaning is specifically defined and more particularly directed to the use of such words or phrases:

- (1) "City" means the City of Overland Park, Kansas, or the area within the territorial limits of the City of Overland Park, Kansas, and such territory outside of the City over which the City has jurisdiction or control by virtue of any constitutional or statutory provision;
- (2) "City Engineer" is the professional engineer employed by the City and designated by the City Council as the "City Engineer." In this document, "City Engineer" also refers to the City Engineer's official designated representative.
- (3) "Computation of time" means the time within which an act is to be done. It shall be computed by excluding the first day and including the last day; and if the last day be Sunday or a legal holiday, that day shall be excluded;
- (4) "Council" means the City council of the City of Overland Park, Kansas. "All its members" or "all councilmen" mean the total number of councilmen provided by the general laws of the State of Kansas;
- (5) "County" means the county of Johnson, Kansas;
- (6) "Easement" is an interest in land that entitles its holder to a definite and limited use of land owned by another.
- (7) "Engineer" is the Professional Engineer, registered in the State of Kansas, who is responsible for the design of the improvements.
- (8) "Final Inspection" is the physical inspection by the City Engineer that is conducted after all the work is fully completed and prior to the acceptance of the work by the City as a public improvement.
- (9) "Law" denotes applicable federal law, the Constitution and Statutes of the State of Kansas, the ordinances of the City of Overland Park, and when appropriate, any and all rules and regulations which may be promulgated thereunder;
- (10) "Liquid Limit" is the water content of the soil at the change between the liquid and the plastic states and shall be tested in accordance with ASTM D 4318-05;
- (11) "Month" means a calendar month;
- (12) "Must" and "Shall" is mandatory;
- (13) "Oath" includes an affirmation or declaration in all cases in which, by law, affirmation may be substituted for an oath, and in such cases the words "swear" and "sworn" are equivalent to the words "affirm" and "affirmed";
- (14) "Or" may be read "and" and "and" may be read "or" if the sense requires it;
- (15) "Ordinance" means a law of the City; provided that a temporary or special law, administrative action, order or directive, may be in the form of a resolution;
- (16) "Owner" applied to a building or land includes any part owner, joint owner, tenant in common, joint tenant or tenant by the entirety, of the whole or a part of such building or land;
- (17) "Person" means natural person, joint venture, joint stock company, partnership, association, club, company, corporation, business, trust, organization, or the manager, lessee, agent, servant, officer or employee of any of them;
- (18) "Personal property" includes money, goods, chattels, things in action and evidences of debt;
- (19) "Plasticity Index" is the numerical difference between the liquid limit and the plastic limit;
- (20) "Preceding" and "following" mean next before and next after, respectively;
- (21) "Property" includes real and personal property;
- (22) "Public Improvement Permit" is a permit issued by the City Engineer after the review and approval of designs, plans and specifications that is required prior to commencing any work on or for a public improvement.
- (23) "Real property" includes lands, tenements and hereditary property;
- (24) "Right-of-Way" means the area on, below or above the present and future City streets, alleys, bridges, bikeways, parkways and sidewalks.

- (25) "Sidewalk" means that portion of a street between the curb line and the adjacent property line intended for the use of pedestrians;
- (26) "Standard Specifications" means the "Standard Specifications for State Road and Bridge Construction," Kansas Department of Transportation, current edition.
- (27) "State" means the State of Kansas;
- (28) "Street" includes all streets, highways, avenues, lanes, alleys, courts, places, terraces, squares, curbs, or other public ways in this City which have been or may hereafter be dedicated and open to public use, or such other public property so designated in any law of this State;
- (29) A "street name sign" in these specifications means a complete four-way assembly including mounting brackets, two extruded aluminum blades double faced with reflective sheeting and legend, mounted on a galvanized steel post;
- (30) "Tenant" and "occupant," applied to a building or land, includes any person who occupies whole or a part of such building or land, whether alone or with others;
- (31) Title of Office. Use of the title of officer, employee, board or commission means that officer, employee, department, board or commission of the City;
- (32) "Will" is mandatory; dispositive of intent.
- (33) "Written" includes printed, typewritten, e-mail and photocopy;
- (34) "Year" means a calendar year;

**c. Grammatical Rules.**

The following grammatical rules shall apply in the ordinances of the City of Overland Park, Kansas:

- (1) Gender. Any gender includes the other genders;
- (2) Singular and plural. The singular number includes the plural and the plural includes singular;
- (3) Tenses. Words uses in the present tense include the past and the future tenses and vice versa;
- (4) Use of Words and Phrases. Words and phrases not specifically defined shall be construed according to the context and approved usage of the language;
- (5) All words and phrases shall be construed and understood according to the common and approved usage of the language; but technical words and phrases and such others as may have acquired a peculiar and appropriate meaning in the law shall be construed and understood according to such peculiar and appropriate meaning;
- (6) When an act is required by an ordinance the same being such that it may be done as well by an agent as by the principal, such requirement shall be construed as to include all such acts performed by an authorized agent.

**4 - SHOP DRAWING SUBMITTAL REQUIREMENTS**

**4.1 SCOPE**

For privately funded projects that will be maintained by the City, it is City of Overland Park's policy to require shop drawings for all precast structures and some modular block retaining walls. The City Engineer may require shop drawings on other public infrastructure elements, if applicable. The shop drawings are required for quality assurance, reference during construction and for future reference during repairs, alterations, or other City maintenance activities. Shop drawing submittals shall be in accordance with this Section.

## **4.2 GENERAL**

### **a. Shop Drawing Transmittal.**

All Shop Drawing Submittals shall be accompanied by a transmittal form accurately indicating the materials being transmitted using terminology and notations of these Specifications and Drawings. Any Shop Drawing Submittal not accompanied by such a form, or where all applicable items on the form are not completed, will be returned for resubmittal. Shop Drawings shall be accurate, distinct, and complete, and contain all required information, including clear identification of items, units, and assemblies in relation to the Contract Documents. All inapplicable information shall be marked out or deleted.

(1) Normally, a separate transmittal form shall be used for each specific item or class of material or equipment for which a submittal is required. Submittal of Shop Drawings on various items using a single transmittal form will be permitted only when the items taken together constitute a manufacturer's "package" or are so functionally related that expediency indicates review of the group or package as a whole.

(2) All compliance submittals shall bear the contractor's stamp indicating the submittal has been checked for compliance with the contract documents, date checked and contractor's signature. Before submission of each Shop Drawing the Contractor shall have determined and verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar data, with respect thereto and reviewed or coordinated each Shop Drawing with other Shop Drawings and with the requirements of the Work and the Contract Documents.

## **4.3 SUBMITTALS**

### **a. Shop Drawings**

#### **(1) Precast Concrete Structures**

##### **(a) When Shop Drawings Are Required.**

Shop drawings shall be submitted to Engineering Services for all precast structures to be maintained by the City in the future.

##### **(b) Prior to submittal to the City:**

(1) **Manufacturer's Certification.** Shop drawings are certified by the manufacturer to be in conformance with the project plans and specifications including conformance with all material specifications.

(2) **Developer Engineer's Review.** The manufacturer submits the shop drawings to the developer's engineer who will check the shop drawings for conformance with the project plans and specifications.

(3) **Developer's Engineer Certification.** The developer's engineer will certify that they have reviewed the shop drawings and are in conformance with the approved plans and specifications for the project.

##### **(c) Submittal Deadline.**

Seven or more days before the first installation of a precast structure that requires a submittal, the developer's engineer will submit the reviewed shop drawings, along with the manufacture's certification, to the City of Overland Park, Engineering Services.

##### **(d) City Process.**

The City does not plan to routinely review the shop drawings for privately funded projects, but reserves the right to review the shop drawings and inform the developer's engineer of any necessary changes. If the City has comments on the shop drawings, a response shall be made to the developer's engineer within five working days after the receipt of the shop drawings. In either case, a letter will be mailed to the developer's engineer, authorizing the contractor to proceed with construction.

##### **(e) When P.E. Seal Required.**

If shop drawings are required to be submitted as a result of proposed field modifications of a precast structure, a registered professional engineer shall seal those shop drawings prior to submittal to the City.

(2) Modular Block Retaining Walls

(a) When Shop Drawings Are Required. If requested by Engineering Services, shop drawings shall be submitted for modular block retaining walls greater than four feet in height whether privately or publicly maintained.

(b) Prior to submittal to the City:

(1) Manufacturer's Certification and P.E. Seal. Shop drawings are certified by the manufacturer to be in conformance with the project plans and specifications including conformance with all material specifications. The shop drawings must include appropriate structural analysis (calculations) of the wall and be sealed by a registered professional engineer.

(2) Developer Engineer's or Architect's Review. The manufacturer submits the shop drawings to the developer's engineer and/or architect who will check the shop drawings for conformance with the project plans and specifications.

(3) Developer's Engineer or Architect Certification. The developer's engineer and/or architect will certify that the shop drawings have been reviewed and are in conformance with the approved project plans and specifications.

(c) Submittal Deadline.

As specified by the plan review engineer during construction plan review; the developer's engineer and/or architect will submit the reviewed shop drawings, along with the Manufacturer's certification, to the City of Overland Park, Engineering Services.

(d) City Process.

As specified by the plan review engineer during construction plan review.

(3) Other Submittals

(a) The KCMMB must approve concrete mix designs prior to use in any publicly maintained structure.

**b. Mix Designs**

(1) The City Engineer may require mix designs for materials such as removable flowable fill and asphaltic concrete.

## **5 - CERTIFICATION, TESTING AND INSPECTION SERVICES**

### **5.1 SCOPE**

This section covers the requirements for testing and inspection of the work required and the information that is to be submitted and approved before the City of Overland Park will approve completed work.

### **5.2 GENERAL**

No contractor shall commence construction of any sidewalk, driveway entrance, street, storm sewer, concrete ditch liner or major concrete structure without first calling the City for an inspection.

For all public improvements and work within the right-of-way, the provisions of the Standard Specifications for State Road and Bridge Construction, Kansas Department of Transportation, current edition (hereinafter the "Standard Specifications"), are incorporated, except as hereinafter specified.

### 5.3 CERTIFICATIONS

#### a. Certificates of Compliance.

**b. When requested by the City Engineer, certificates of compliance shall be submitted by the contractor for public construction and by the project engineer for private construction. Certificates of compliance shall cover materials and construction methods used. Certification of materials and equipment.**

(1) When requested by the City Engineer, the contractor shall furnish certifications in accordance with Section 2600 of the KDOT Standard Specifications for the following materials and equipment:

- (a) Underdrain pipe
- (b) Concrete structures components
- (c) Concrete pipe
- (d) Reinforcing steel, plain and epoxy coated
- (e) Paving brick
- (f) Fly-ash
- (g) Fencing
- (h) Grass seed
- (i) Fertilizer
- (j) Landscape tree and shrub stock
- (k) Riprap
- (l) Liquid membrane forming compounds
- (m) Street lighting equipment
- (n) Traffic signal equipment
- (o) Modular retaining wall units
- (p) Geotextile fabrics
- (q) Pavement marking materials
- (r) Permanent signing
- (s) Other items to be incorporated into the work, not specifically indicated herein, but requested by the City Engineer.

(2) The Type of Certification required for each item shall be as per the Standard Specifications, except as approved by the City Engineer.

### 5.4 TESTING

#### a. Tests prior to construction.

(1) When requested by the City Engineer, the contractor shall furnish test results from an approved testing laboratory in accordance with Sampling and Testing Frequency Charts for the City of Overland Park contained at the end of this Section. Tests may be required for any of the following:

- (2) Subgrade properties, including Atterberg limits, soil classification (Unified Soil Classification System), and moisture-density relationship;
- (3) Aggregate for Portland cement concrete, base course, plant mix bituminous intermediate course, or surface course;
- (4) Asphaltic cement properties;
- (5) Portland cement concrete properties.

#### b. Material tests during construction.

(1) Tests of materials being used in construction shall be taken at the frequency established in the "Sampling and Testing Frequency Chart for City of Overland Park", attached at the end of this chapter.

- (2) In construction projects neither financed in whole or part by the City nor administered by the City, the Contractor will select the testing laboratory and pay for all sampling and testing deemed necessary by the City Engineer, subject to approval of the testing laboratory by the City Engineer.
- (3) In the event that any test indicates non-compliance, additional testing will be paid for by the Contractor to determine acceptability of the material or methods.
- (4) The City Engineer shall be provided with documentation of all tests, showing compliance, prior to acceptance of the construction.
- (5) Each test report shall be certified by a qualified person accredited by the American Association of State Highway and Transportation Officials (AASHTO), the American Association for Laboratory Accreditation (A2LA), the American Society of Testing Materials (ASTM), or the Kansas Department of Transportation (KDOT) in the test being performed.
- (6) Test reports shall be prepared in at least three copies and shall be distributed directly by the testing agency to the City Engineer, contractor, and the owner.

## **5.5 INSPECTION**

### **a. Inspection of sidewalk and driveway entrance construction.**

- (1) During the construction of all sidewalks and driveway entrances under the jurisdiction of the City, inspections shall be made by the City Engineer for:
  - (a) Form locations and grades, and subgrade prior to the placement of concrete.
  - (b) Final completion of the sidewalk or driveway entrance, including backfilling, right of way grading, and clean up.
- (2) These approvals will be secured by notifying the City Engineer in ample time, as determined by the current procedures of the City.

### **b. Inspection of street construction.**

- (1) The Contractor shall notify the City Engineer a minimum of 24 hours in advance of placement of any concrete curb and gutter or commencement of any paving operations.
- (2) During the construction of all streets, roads and alleys under the jurisdiction of the City, inspections shall be made by the City Engineer during the following phases of construction:
  - (a) General subgrade preparation for the street.
  - (b) Curb stringline, and final subgrade, for the curb and gutter.
  - (c) Placement of the concrete curb and gutter.
  - (d) Subgrade prior to paving the first lift of asphalt.
  - (e) During the paving operations for the 1<sup>st</sup> lift of asphalt.
  - (f) Condition of the exposed lift of asphalt prior to paving any additional asphalt lifts, including intermediate courses, wedge courses, or surface course.
  - (g) During paving operations for all asphalt intermediate courses, wedge courses, and surface course.
  - (h) Final completion of the project, including backfilling, grading, and clean up.

### **c. Inspection of private drives and parking areas outside of public right of way.**

- (1) These specifications shall apply to new construction and reconstruction of all private drives and parking areas outside of public right of way, except for residential developments located in the A, R-1, R-1A, RE, RP-OE and RP-OS zoning districts.
- (2) During construction of all private drives and parking areas under the jurisdiction of this section, inspections shall be made by the City in accordance with the specification “Parking Drives and Parking Areas Outside of Public Right-of-Way” contained herein.
- (3) Work shall conform to Volume I, Design Standards Table IV “Private Drive and Parking Area Pavement Design and Construction Standards” or a City approved geotechnical report.

**d. Inspection of storm sewer construction.**

The contractor shall notify the City Engineer a minimum of 24 hours in advance of the beginning of any of the following phases of storm sewer construction:

- (1) Delivery of the storm sewer pipe at the job site.
- (2) During the pipe laying operations.
- (3) During construction of curb inlets, area inlets, junction boxes, and/or manholes, prior to placement of concrete; or delivery of the pre-cast structures at the job site.
- (4) During any street repair operations.
- (5) Final completion of the project, including backfilling, grading and clean up.

**e. Inspection of concrete ditch liner and major concrete structure construction.**

The contractor shall notify the City Engineer a minimum of 24 hours in advance of the beginning of any of the following phases of the placement of any concrete for any ditch liner or any major concrete structure:

- (1) Subgrade prior to placing seal course, floor slab, or ditch liner floor, including dewatering.
- (2) Forms, reinforcing steel, and/or welded wire fabric for floor slabs, walls, and /or tops for ditch liners, or major concrete structures, prior to any concrete placement.
- (3) During placement of concrete in floor slabs, ditch liner floors, walls or tops.
- (4) During backfilling operations for ditch liners and major concrete structures.
- (5) Final completion of the project, including grading and cleanup.

**f. Approval.**

- (1) Other inspections may be made as deemed necessary by the City Engineer.
- (2) Approval of the work by the City Engineer shall give the contractor the right to proceed with the succeeding operations, but shall in no way indicate complete approval of prior work if later inspection discloses any deficiency in the prior inspections.
- (3) Any inspection conducted shall not relieve the contractor from any obligation to perform the work in accordance with the approved plans. Any of the work not so constructed shall be removed and replaced according to the plans.



## SAMPLING AND TESTING FREQUENCY CHART

ITEM	CONSTRUCTION OR MATERIAL TYPE	TESTS REQUIRED	TEST METHOD	ACCEPTANCE SAMPLES AND TESTS
<b>1. COMPACTION OF EARTHWORK</b>				
		Field Density Tests	KT-13, KT-51	a 600 sy <sup>2</sup> of prepared subgrade. Not less than 4 per day per equipment spread.
	Structure Backfill	Field Density Tests Moisture Tests	KT-13, KT-51 KT-11, KT-51, or g	a 1 per structure minimum (each side) 600 sy <sup>2</sup> of prepared subgrade. Not less than 4 per day per equipment spread.
	Structure Backfill	Moisture Tests	KT-11, KT-51, or g	1 per structure minimum (each side)
<b>2. SUBGRADE MODIFICATION</b>				
	Aggregates	Plasticity Tests	KT-10	b,c 500 TONS or yd <sup>3</sup>
		Sieve Analysis of Aggregate	KT-2	a 500 TONS or yd <sup>3</sup>
		Material Passing the No.200 Sieve by the Wash Method	KT-3	a 500 TONS or yd <sup>3</sup>
		Sticks in Aggregate	KT-35	e
		Clay Lumps in Aggregate	KT-7	e
		Shale or Shale-like Materials in Aggregate	KT-8	e
		Field Density Tests	KT-13 or KT-41	a,b 1 000 ft
		Moisture Tests	KT-11 or g	e
<b>3. AGGREGATE BASE COURSE</b>				
	Combined Aggregate	Sieve Analysis of Aggregate	KT-2	a 1 000 ft each lift or if total aggregate each 500 TONS
		Plasticity Tests	KT-10	a,c 1 000 ft each lift or if total aggregate each 500 TONS
	Completed Base	Moisture Tests	KT-11 or g	e
		Field Density Tests	KT-13 or KT-41	a 200 ft
		Moisture Tests	KT-11, KT-41 or g	e

### SAMPLING AND TESTING FREQUENCY CHART

ITEM	CONSTRUCTION OR MATERIAL TYPE	TESTS REQUIRED	TEST METHOD	ACCEPTANCE SAMPLES AND TESTS
<b>3A. AGGREGATE BASE COURSE (OP SPECIAL)</b>				
	Combined Aggregate	Sieve Analysis of Aggregate	ASTM C 117-04 ASTM C 136-06	a Preconstruction and when source of material changes
		Soundness, Wear, Absorption and Specific Gravity	Methods stated in the Standard Specifications, Subsection 1117 ASTM D 4318-05	
		Liquid Limit and Plasticity Index	ASTM C 117-04 ASTM C 136-06	h 835 TONS with a minimum of one for each days placement
	Completed Work	Sieve Analysis of Aggregate	ASTM D 4318-05	
		Liquid Limit and Plasticity Index	Test strip roller pattern	h Verification of roller pattern
		Field Density Tests		
<b>4. STABILIZED SHOULDERS (Aggregate, Non-Bituminous)</b>				
	Combined Aggregate	Sieve Analysis of Aggregate	KT-2	a 500 TONS
		Plasticity Tests	KT-10	a,c 500 TONS
	Completed Shoulder	Moisture Tests	KT-11 or g	e
		Field Density Tests	KT-13 or KT-41	b 200 ft or 150 TONS
		Moisture Tests	KT-11, KT-41 or g	b 200 ft or 150 TONS
<b>5. GRANULAR SUBBASE</b>				
	Combined Aggregate	Sieve Analysis of Aggregate	KT-2	a 1 000 ft, 500 TONS, or 500 yd <sup>3</sup>
		Plasticity Tests	KT-10	a 1 000 ft, 500 TONS, or 500 yd <sup>3</sup>
	Completed Work	Moisture Tests	KT-11 or g	e
		Field Density Tests	KT-13 or KT-41	a 200 ft
		Moisture Tests	KT-11, KT-41 or g	a 200 ft
<b>6. SURFACE OR RESURFACING AGGREGATE</b>				
		Sieve Analysis of Aggregate	KT-2	a 500 TONS
		Material Passing the No. 200 Sieve by Wash Method	KT-3	a 500 TONS
		Sticks in Aggregate	KT-35	e
		Soft or Friable Particles in Aggregate	KT-7	e
		Moisture Tests	KT-11 or g	e

## SAMPLING AND TESTING FREQUENCY CHART

ITEM	CONSTRUCTION OR MATERIAL TYPE	TESTS REQUIRED	TEST METHOD	ACCEPTANCE SAMPLES AND TESTS
<b>7. PORTLAND CEMENT CONCRETE STRUCTURES AND MISCELLANEOUS CONSTRUCTION</b>				
		Slump Unit Weight Air Content  Temperature Cylinders	KT-21 KT-20 KT-18, KT-19, or KT-20 ASTM C 1064-05  KT-22	h As needed to control product, minimum 1 set of tests every 50 yd <sup>3</sup> . Select initial sample from first 2 or 3 loads and then on a random basis or as conditions indicate. Perform tests with every set of test cylinders. <u>Bridge Decks</u> Minimum 1 set of seven 6"x12" cylinders and one 4"x8" cylinder per 100 yd <sup>3</sup> or major mix design change <u>Structures</u> Minimum 1 set of 7 per 100 yd <sup>3</sup> <u>Sidewalk and Flatwork</u> Minimum 1 set of 7 per 500 yd <sup>2</sup> <u>Curb and Gutter</u> Minimum 1 set of 7 per 500 lf  All cylinders shall be tested for compressive strength in accordance with ASTM C 39-05 at the following intervals: Two cylinders each at 7 days, 14 days, and 28 days. One cylinder shall be reserved for additional testing, if required.
		Permeability of Concrete	ASTM C 1202-97	<u>Bridge Decks</u> One 4"x8" cylinder shall be tested at 28 days using standard moist curing (2 tests per cylinder). 150 yd <sup>3</sup> for Bridge Decks, Thin Overlays, and Bridge Deck Surfacing
		Density of Fresh Concrete	KT-36	a,b
		KCMMB Test #1	As specified in "Procedure for Analysis of Non-Specified Aggregate within Freshly Mixed Concrete" on file with the City Engineer.	a As needed to control product, beginning of every project and every 150 cubic yards.

## SAMPLING AND TESTING FREQUENCY CHART

ITEM	CONSTRUCTION OR MATERIAL TYPE	TESTS REQUIRED	TEST METHOD	ACCEPTANCE SAMPLES AND TESTS
<b>8. CONCRETE PAVEMENT</b>				
		Slump Unit Weight Air Content	KT-21 KT-20 KT-18, KT-19, or KT-20 ASTM C 1064-05	h As needed to control product, minimum 1 set of tests per each half day and/or per 4 000 yd <sup>2</sup> . Perform tests with every set of test beams.
		Temperature Beams	KT-22 & KT-23	a 1 set of 3 on initial pour. 1 set per week and/or major mix design change.
		Profilograph	KT-46	b Testing by Contractor, results reviewed by City of Overland Park See Std. Spec. Sec. 502.03(k).
		Thickness Cores Density of Fresh Concrete	KT-38	a,b Initially, 1 complete transverse profile, thereafter 5 tests per day.
		KCMMB Test #1	As specified in "Procedure for Analysis of Non-Specified Aggregate within Freshly Mixed Concrete" on file with the City Engineer.	a As needed to control product, beginning of every project and every 150 cubic yards.
<b>9. ASPHALTIC CONCRETE QUALITY ASSURANCE TESTING</b>				
	Bituminous Mixtures	Test showing the information required on table "Superpave Asphaltic Concrete Test (Verified Mix Design)" Mix Cured 4 hours before testing. City Engineer shall receive test results in approximately 7 hours.	Note: Procedure is specified in "Overland Park Technical Specification for Overland Park Superpave Asphaltic Concrete, subparagraph Superpave Asphaltic Concrete Mix Design Method", available in the office of the City Engineer.	a One for two of the contractor test or as directed by the City Engineer.
	Completed Road Work	Resistance to moisture damage <u>Field Density Tests</u>  Cores	AASHTO T283-03  KT-15 Procedure 3 or AASHTO T166	a 1 per year and every 10,000 tons as directed by the City Engineer.  a <u>Surface &amp; Base Courses</u> 1 set of 3-4" cores per 1000 tons placed as directed by the City Engineer.

### SAMPLING AND TESTING FREQUENCY CHART

ITEM	CONSTRUCTION OR MATERIAL TYPE	TESTS REQUIRED	TEST METHOD	ACCEPTANCE SAMPLES AND TESTS
<b>10.</b>	<b>SLURRY SEAL</b>			
		Sieve Analysis of Aggregate	KT-2	a 250 TONS
<b>11.</b>	<b>AGGREGATE FOR CONCRETE</b>			
		Sieve Analysis of Aggregate	KT-2	a 250 TONS
		Material Passing the No. 200 Sieve by the Wash Method	KT-3	a 250 TONS
		Sticks in Aggregate	KT-35	e
		Clay Lumps in Aggregate	KT-7	e
		Shale or Shale-like Materials in Aggregate	KT-8	e
		Unit Weight (light weight aggregate only)	Section 1102(d)(3)	e
<b>12.</b>	<b>PORTLAND CEMENT TREATED BASE</b>			
		Sieve Analysis of Aggregate	KT-2	a 1 in A.M. and 1 in P.M. or each 500 TONS
		Plasticity Tests	KT-10	a,b 1 in A.M. and 1 in P.M. or each 500 TONS
		Moisture Tests	KT-11 or g	,c e Minimum of 1 per day
		Density Standard	KT-12	e Minimum of 1 per day
		Field Density Tests	KT-13 or KT-41	a 1 000 ft/width laid or 2 000 ft/lane
		Field Moisture Tests	KT-11 or KT-41	a 1 000 ft/width laid or 2 000 ft/lane
<b>13.</b>	<b>UNDERDRAIN AGGREGATE</b>			
		Sieve Analysis of Aggregate	KT-2	a 250 TONS
		Sticks in Aggregate	KT-35	e
		Clay Lumps in Aggregate	KT-7	e
<b>14.</b>	<b>CRUSHED STONE FOR BACKFILL</b>			
		Sieve Analysis of Aggregate	KT-2	a 500 TONS
		Clay Lumps in Aggregate	KT-7	e
<b>15.</b>	<b>STONE FOR RIPRAP, WASH CHECKS &amp; OTHER MISC. USES</b>			
		Sieve Analysis of Aggregate	KT-2	a 500 TONS or yd <sup>3</sup> Note: Tests to be conducted at production site.

### SAMPLING AND TESTING FREQUENCY CHART

ITEM	CONSTRUCTION OR MATERIAL TYPE	TESTS REQUIRED	TEST METHOD	ACCEPTANCE SAMPLES AND TESTS
<b>16.</b>	<b>FLY ASH</b>	Moisture/Density and Compressive Strength Tests	D4609	e 3 series of Standard Proctors Moisture/Density relationships for each earth fill material. Two series incorporating 16% fly ash by dry weight, at delays of 0 and 2 hours. One series incorporating 13% fly ash by dry weight at a compaction delay of 0 hours. Find compressive strength for each series after 7 days at 100.4 degrees Fahrenheit. Min. 5 test specimens per series.
		Inplace Moisture	AASHTO 217	Perform in place moisture tests using the gas pressure ("Speedy") method, at a rate of 1 per 700 sq. yard during initial subgrade preparation and thereafter as directed by the engineer.

SAMPLING AND TESTING FREQUENCY CHART  
FOR  
CITY OF OVERLAND PARK

Code Instruction

- a Normal operation. Minimum frequency for exceptional conditions may be reduced by the Project Engineer on a project basis, written justification shall be made to the City Engineer and placed in the project documents
- b Applicable only when specifications contain those requirements.
- c If, for a given project, no Plastic Index results of ten (10) consecutive tests are closer than 1 Plastic Index to the specifications limit, the specified testing frequency may be reduced by fifty percent (50%). When operating at a reduced testing frequency, should any two (2) consecutive Plastic Index results exceed the test limit results required for reduced testing frequency, testing shall be resumed at the original specified frequency. The original specified testing frequency shall be resumed should any one test result exceed the specification limits. Following a return to the original specified testing frequency, the reduced frequency may be resumed providing the original criteria for reduced frequency are met.
- e Engineer's discretion. Frequency of tests shall be agreed upon by the Field Engineer and the Project Engineer. Frequency will be governed by field conditions. Written documentation of the agreed upon testing frequency shall be included in the project records.
- g For determining moisture content of a material, KT-43, Moisture Content of Asphalt Mixtures or Mineral Aggregates - Microwave Oven Method, can be used in conjunction with KT-2, KT-3, KT-4, KT-8, KT-12, KT-13, and KT-34.
- h Initial frequency. Frequency may be reduced on a project basis, by authority of the Project Engineer, upon continued satisfactory and uniform production. Authorization for reductions in testing frequency shall be documented in the project records.

GENERAL NOTES

Note 1: All sampling and testing frequencies listed are minimum. Additional or other tests will be conducted, as required, to control the work.

Note 2: Frequencies are based on two lane roadways. For four or more lane roadway construction, double the frequencies shown per unit length.

Note 3: All aggregate acceptance tests are to be conducted at the point of usage except for Item 15, Stone for Riprap, Wash Checks, and Other Miscellaneous Uses.

Note 4: For a better explanation of metric (SI) units, see section 5.9 of the KDOT Construction Manual SAMPLING AND TEST METHODS FORWARD.

Note 5: All test methods listed as "KT" are Kansas Test methods and may be found in the KDOT Construction Manual Part V.

## **6 - TRAFFIC CONTROL**

### **6.1 SCOPE**

This work shall consist of the installation of construction and traffic control devices in accordance with these Specifications and as established by the City Engineer.

### **6.2 GENERAL**

All work performed in the right-of-way or which in any way impacts vehicular or pedestrian traffic shall be properly signed, barricaded, and otherwise protected at the permittee's expense. All Traffic Control shall be in conformance with the latest edition of the Federal Highway Administration's Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) as adopted by KDOT and the City of Overland Park Traffic Control Handbook for Street Maintenance and Construction Operations, unless otherwise agreed to by the City.

Whenever there is an excavation by the permittee, the permittee shall be responsible for providing adequate traffic control to the surrounding area as determined by the City Engineer. The permittee shall perform work on the right-of-way at such times that will allow the least interference with the normal flow of traffic and the peace and quiet of the neighborhood.

The permittee responsible for the excavation who leaves debris in the right-of-way shall be responsible for providing safety protection in accordance with the latest edition of the Manual of Uniform Traffic Control Devices and any applicable federal and state requirement.

#### **a. Traffic Control.**

Reasonable ingress and egress from property adjacent to the project shall be maintained at all times throughout the duration of this project. If a traffic control plan is not included in the plans for the project, the following will apply:

- (1) During non-working hours, all lanes of traffic in all directions shall be maintained. During non-peak traffic hours, the Contractor may, with the authorization of the City Engineer, close such traffic lanes at the project location(s), as approved, using appropriate channelizing devices, or any other traffic control devices the City Engineer may designate.
- (2) The Contractor is advised that no work that will restrict traffic in any way will be performed between the hours of 7 A.M. to 8:30 A.M. or 4 P.M. to 6 P.M. or on holidays and weekends unless prior approval is received through the City Engineer or if there are emergency repairs necessary by a utility company or their representative.
- (3) The Contractor shall place the required signing and protective devices prior to beginning construction activity each day and patrol the work area as frequently as needed during the day and at the end of each working day. All traffic cones, signs, barricades, drums, and other devices shall be immediately and properly reset if moved out of place.

### **6.3 REFERENCES**

- (1) Federal Highway Administration Manual on Uniform Traffic Control Devices for Streets and Highways, latest edition (MUTCD)
- (2) KDOT Standard Specification Section 2201: Reflective Sheeting
- (3) National Cooperative Highway Research Program 350 (NCHRP): Recommended Procedures for the Safety Performance Evaluation of Highway Facilities
- (4) Traffic Control Handbook for Street Maintenance and Construction Operations, City of Overland Park



## **6.4 MATERIALS**

### **a. Signs.**

Signs shall conform to the requirements of the MUTCD, unless otherwise directed by the City Engineer or specified herein. Signs shall be .080-inch thick sheet aluminum alloy 6061-T6. Legend, border, and background other than black, shall have a microencapsulated prismatic retro-reflective coating. The physical and optical properties shall conform to the Specifications written by the Federal Highway Administration (FP-74). The colors of the reflective sheeting shall conform to Table II of KDOT Standard Specification Section 2201. All orange construction signs shall be reflectorized with fluorescent orange prismatic grade retroreflective sheeting. All regulatory signs used in the construction traffic control shall be reflectorized with micro-encapsulated prismatic grade retroreflective sheeting. All type I, II, III indicator barricades and channelization devices shall be reflectorized with a Kansas Department of Transportation approved high intensity grade retroreflective sheeting. White bands on conical delineators, tubular markers, drums and cones shall be Kansas Department of Transportation approved High Intensity grade retroreflective sheeting. Orange bands shall be fluorescent prismatic grade sheeting. All markings shall be reflectorized with glass beads.

### **b. Posts.**

Posts shall be of the dimensions necessary to provide a seven-foot clearance from the sign bottom to the ground, and be secured appropriately or be supported by breakaway devices as approved by NCHRP350.

## **6.5 INSTALLATION**

Signs of the various types shall be fabricated and installed in conformance with the MUTCD or as directed by the City Engineer. Posts shall be set vertical at locations as shown on the Construction Plans or as designated by the Engineer.

Flagmen shall be furnished by the Contractor and used when the roadway is partially or wholly blocked by equipment or men and where equipment is crossing a road that is open to through traffic. Flagmen shall be properly attired with retro-reflective garments as outlined in the MUTCD and be courteous and use an approved stop and slow sign to control the traffic.

## **7 - USE AND OCCUPANCY OF THE PUBLIC RIGHT OF WAY**

### **7.1 SCOPE**

The Section governs the use of the Public Right of Way for improvements.

### **7.2 GENERAL**

- (a) No person shall excavate the right-of-way, construct, or use the facilities within the right-of-way of the City except as provided herein.
- (b) All ROW-users shall be subject to all rules, regulations, policies, resolutions, and ordinances now or hereafter adopted or promulgated by the City in the reasonable exercise of its police power and are subject to all applicable laws, orders, rules and regulations adopted by governmental entities now or hereafter having jurisdiction. In addition, the ROW-users shall be subject to all technical specifications, design criteria, policies, resolutions and ordinances now or hereafter adopted or promulgated by the City in the reasonable exercise of its police power relating to permits and fees, sidewalk and pavement cuts, utility location, construction coordination, surface restoration, and other requirements on the use of the right-of-way.
- (c) The City Engineer is the principal City official for administration of right-of-way permits for work and excavations made in the right-of-way. The City Engineer may delegate any or all of the duties hereunder.

- (d) No service provider shall be authorized to utilize the right-of-way in any capacity or manner without registering and obtaining the necessary right-of-way permit from the City.
- (e) Prior to construction, reconstruction, repair, maintenance, or relocation of facilities owned by the service provider in the right-of-way, the service provider shall first obtain the necessary right-of-way permit.
- (f) The service provider shall keep and maintain accurate records and as-built drawings depicting accurate location of all its facilities constructed, reconstructed or relocated in the right-of-way.
- (g) All facilities shall be located and laid so as not to disrupt or interfere with any pipes, drains, sewers, irrigation systems, or other structures or public improvements already installed. In addition, the ROW-user shall, in doing work in connection with its facilities, avoid, so far as may be practicable, disrupting or interfering with the lawful use of the streets, alleys, sidewalks or other public lands of the City.
- (h) Whenever reasonably possible, all newly constructed facilities shall be located underground. The ROW-user shall comply with all requirements of the City relating to underground facilities. This requirement may be waived by the City Engineer at his discretion for safety concerns, or some other good cause under the condition that does not cause discrimination among ROW-users. If this requirement is waived, the facilities shall be located as directed by the City Engineer, including, but not limited to, requirements regarding location and height.
- (i) The ROW-user shall not interfere with the facilities of the other ROW-users without their permission. If and when the City requires or negotiates to have a service provider cease using its existing poles and to relocate its facilities underground, all other service providers using the same poles shall also relocate their facilities underground at the same time.
- (j) All earth, materials, sidewalks, paving, crossings, utilities, other public improvements or improvements of any kind damaged or removed by the ROW-user shall be fully repaired or replaced promptly by the ROW-user at its sole expense and to the reasonable satisfaction of the City. Upon determination by the City Engineer that such repair or replacement is a public safety matter, all such repair or replacement shall be commenced within twenty-four (24) hours of notice from the City, or the City Engineer may direct the City to make such repair or replacement and bill the ROW-user for the City cost. The City Engineer has the authority to inspect the repair or replacement of the damage, and if necessary, to require the ROW-user to do any necessary additional work.
- (k) All technical standards governing construction, reconstruction, installation, operation, testing, use, maintenance, and dismantling of a ROW-user's facilities in the right-of-way shall be in accordance with applicable federal, state and local law and regulations, including those promulgated by national trade associations commonly associated with the service provided by the ROW-user. It is understood that the standards established in this paragraph are minimum standards and the requirements established or referenced in these specifications may be in addition to or stricter than such minimum standards. A ROW-user shall not construct or reconstruct any of its facilities located upon, over, under or within the City right-of-way without first having submitted in writing a description of its planned improvement to the City Engineer and having received a permit for such improvement.
- (l) The City Engineer may require that any drawings, plans and/or specifications submitted be certified by a Kansas registered professional engineer stating that such drawings, plans and/or specifications comply with all applicable technical codes, rules and regulations, unless such plans are based directly on nationally recognized codes, which are appropriately cited, and attested to on the plans by the signature of an authorized official of the organization applying for the permit.

- (m) It shall be the responsibility of the ROW-user to take adequate measures to protect and defend its facilities in the right-of-way from harm and damage.
- (n) Any ROW-user who for any purpose makes or causes to be made any excavation in, upon, under, through or adjoining any street, sidewalk, alley or other right-of-way, and shall leave any part or portion thereof open, or shall leave any part or portion thereof disrupted with rubbish, building or other material during construction and/or the night time, shall cause the same to be enclosed with good substantial and sufficient barricades or drums equipped with the appropriate type warning lights and orange safety fencing material which is properly secured around the excavation or the disruption.
- (o) Whenever a ROW-user shall excavate the full width of any street, sidewalk, alley, driveway approach or other right-of-way, it shall be its duty to maintain an adequate passage for vehicles and pedestrians across or around the excavation until it is refilled as specified.
- (p) Any excavation left open overnight on any thoroughfare or collector type street shall be securely covered. The ROW-user assumes the sole responsibility for maintaining proper barricades, plates, safety fencing and/or lights as required from the time of opening of the excavation until the excavation is surfaced and opened for travel.
- (q) In the event the ROW-user severely disturbs or damages the root structure of any tree in the right-of-way to the detriment of the health and safety of the tree, the ROW-user will be required to remove and replace the tree at the ROW-user's cost. Further, in review of the ROW-user's plan, City Engineer, in his discretion, may require the ROW-user to directionally bore around any tree in the right-of-way.

### **7.3 CONSTRUCTION**

- (a) The work to be done under the right-of-way permit and the repair and restoration of the right-of-way as required herein must be completed within the dates as specified in the permit. However, in the event of circumstances beyond the control of the permittee or when work was prohibited by unseasonable or unreasonable conditions, the City Engineer may extend the date for completion of the project upon receipt of a supplementary application for a permit extension.
- (b) All earth, materials, sidewalks, paving, crossing, utilities, public improvement or improvements of any kind damaged or removed by the permittee shall be fully repaired or replaced promptly by the permittee at its sole expense and the reasonable satisfaction of the City. The City Engineer has the authority to inspect the repair or replacement of the damage, and if necessary, to require the permittee to do the additional necessary work. Notice of the unsatisfactory restoration and the deficiencies found will be provided to the permittee and a reasonable time not to exceed fifteen days will be provided to allow for the deficiencies to be corrected.
- (c) After any excavation, the permittee shall, at its expense, restore all portions of the right of-way to the same condition or better condition than it was prior to the excavation thereof.
- (d) In addition to repairing its own street cuts, the permittee must restore any area within five (5) feet of the new street cut that has previously been excavated, including the paving and its aggregate foundations.
- (e) The permittee responsible for the excavation that leaves any debris in the right-of-way shall be responsible for providing safety protection in accordance with the latest edition of the Manual of Uniform Traffic Control Devices and any applicable federal or state requirement.
- (f) If an excavation cannot be back-filled immediately and left unattended, the permittee shall securely and adequately cover the unfilled excavation. The permittee has sole responsibility for maintaining proper barricades, safety fencing and/or lights as required, from the time of the opening of the excavation until the excavation is surfaced and opened for travel.

- (g) In restoring the right-of-way, the permittee guarantees its work and shall maintain it for twenty-four (24) months following its completion. During the twenty-four (24) months the permittee shall, upon notification from the City Engineer, correct all restoration work to the extent necessary, using any method as required by the City Engineer. Said work shall be completed within a reasonable time, not to exceed thirty (30) calendar days, of the receipt of notice from the Public Works (not including days during which work cannot be done because of circumstances constituting force Majeure or days when work is prohibited as unseasonable or unreasonable). In the event the permittee is required to perform new restoration pursuant to the foregoing guarantee, the City Engineer shall have the authority to extend the guarantee period for such new restoration for up to an additional twenty-four (24) months from the date of the new restoration, if the City Engineer determines any overt action by the permittee not to comply with the conditions of the right-of-way permit and any restoration requirements.
- (h) The twenty-four (24) month guarantee period shall be applicable to failure of the pavement surface as well as failure below the pavement surface.
- (i) Payment of a degradation fee shall not relieve the permittee of the obligation to complete the necessary right-of-way restoration.
- (j) Any excavation, back filling, repair and restoration, and all other work performed in the right-of-way shall be done in conformance with the City's Manual of Infrastructure Standards as promulgated by the City Engineer.
- (k) The permittee shall employ a testing laboratory as approved by the City Engineer, which shall certify the proper back-filling on any street cut. The permittee shall pay all costs associated with such testing. This provision shall be waived when flowable fill is used as backfill or with the permission of the City Engineer.
- (l) The permittee shall notify the office of the City Engineer upon completion of the authorized work permit.
- (m) The permittee will notify the City Engineer to schedule an inspection at the start of back filling. Upon completion of all right-of-way restoration activities, the permittee will schedule a closeout inspection.
- (n) When any corrective actions required have been completed and inspected to the City Engineer's satisfaction, the two (2) year maintenance period will begin.
- (o) In addition to the required scheduled inspections, the City Engineer may choose to inspect the ongoing permitted work in the right-of-way at any time to ensure that all requirements of the approved permit are being met by the permittee.
- (p) At the time of any inspection, the City Engineer may order the immediate cessation of any work, which poses a serious threat to the life, health, safety, or well being of the public. The City Engineer may issue a citation to the permittee for any work, which does not conform, to the applicable standards, conditions, code or terms of the permit. The citation shall state that failure to correct the violation will be cause for revocation of the permit.

## **8 - CLEARING AND GRUBBING**

### **8.1 DESCRIPTION**

This work shall consist of clearing, grubbing, removing and disposing of all vegetation and debris as shown on the plans and in accordance with Special Provision 07-02008 of the Standard Specifications, except as otherwise modified herein.

## **8.2 CONSTRUCTION REQUIREMENTS**

Erosion control measures shall be in place prior to the commencing of any work on the site in accordance with the “Temporary Erosion and Pollution Control” section. If the erosion control measures are not effective or are not approved by the City Engineer, all clearing, grubbing, and other site work shall be halted until such time as the erosion control measures are approved.

All cleared vegetation and debris including sod, stumps, shrubs, trees, and roots located within the grading limits in cut or fill sections shall be completely removed from the project site and disposed of in accordance with all applicable Federal, State and local ordinances.

Clearing shall consist of removal to the ground surface of all trees, shrubs, and stumps, down timber, snags, brush, rubbish, and other obstructions which are objectionable in the opinion of the City Engineer. In areas to receive more than four (4) feet of embankment, trees, stumps, and brush shall be cut off no more than eight (8) inches above the original ground surface or low water level. Clearing operations shall be conducted so as to prevent damage to trees left standing, to existing structures, to structures under construction, as well as to provide for the safety of employees and others.

Areas within the limits of rights-of-way, construction limits, easements, and side street approaches shall be cleared. Individual trees, groups of trees, and other vegetation within the above limits shall be left standing and undamaged as directed by the City Engineer.

Grubbing shall consist of the removal of all stumps, logs, roots larger than three (3) inches in diameter, matted roots, and other debris, to a depth not less than 18 inches below the excavated surface.

Except in areas to be excavated, stump holes and other holes from which obstructions are removed, shall be backfilled with suitable material and compacted in accordance with the “Compaction of Earthwork” section.

Material shall be disposed of off the site of the public improvements, except in the case in which permission from a private property owner is obtained. If the disposal is on private property, the Contractor shall obtain written permission of the property owner on whose property the material is placed. Copies of all agreements with property owners are to be submitted to the City Engineer.

## **9 - REMOVAL OF EXISTING STRUCTURES**

### **9.1 DESCRIPTION**

This work shall conform to Section 202 as amended by Special Provision 07-02007 of the Standard Specifications except as otherwise modified herein and shall include the removal of subsurface structures such as all existing drainage structures, head walls, pipe, inlets, manholes, retaining walls, conduits, foundations, cables, and other obstructions which are encountered during construction. This item shall include any items which may not be specifically listed in the Plans but are in conflict with the new construction and which would normally be encountered upon a careful examination of the site of the work. This includes repair, plugging, or removal of existing pipe after removal of structures.

The work shall also include removal and wasting of surface structures such as concrete curb, pavement of all types, sidewalk, signs and markers, fencing, and abandoned utilities as directed by the Engineer. Excluded are utilities currently in service and structures for which other provisions are made for removal.

### **9.2 CONSTRUCTION REQUIREMENTS**

Erosion control measures shall be in place prior to the commencing of any work on the site in accordance with the “Temporary Erosion and Pollution Control” section. If the erosion control measures are not effective or are not approved by the City Engineer, all removal of existing structures shall be halted until such time as the erosion control measures are approved.

Fences that have portions of the fence removed and not replaced shall be left in a useable condition. The remaining fencing shall be terminated at an existing post, or a new corner post shall be set as shown on the plans or at the direction of the City Engineer.

Existing pavement shall be removed to provide match points as directed by the City Engineer.

Unless otherwise provided, all pipe designated for removal shall be removed and every precaution taken to avoid breaking or damaging those pipes which are to remain. The Contractor shall be held responsible for the repair of any damaged pipe and any such pipe will be replaced at the Contractor's expense. All damaged drainage pipe shall be replaced with the same type, grade and class as exists prior to the damage.

## **10 - EXCAVATION**

### **10.1 DESCRIPTION**

Excavation of the specified materials shown on the plans shall be done in accordance with Section 205 of the Standard Specifications except as otherwise modified herein.

### **10.2 CONSTRUCTION REQUIREMENTS**

Erosion control measures shall be in place prior to the commencing of any work on the site in accordance with the "Temporary Erosion and Pollution Control" section. If the erosion control measures are not effective or are not approved by the City Engineer, all excavation and other site work shall be halted until such time as the erosion control measures are approved.

#### **a. Rough grading**

Areas to be graded shall be cut to the approved subgrade elevations. The graded area shall have adequate drainage at all times. All ditches and channels shall be kept free of debris or obstructions. Erosion control measures shall be taken to protect downstream drainage systems from pollution, sedimentation or erosion caused by grading operations. Any pollution or damage occurring shall be the responsibility of the contractor.

#### **b. Excavation**

Excavation to the finish graded section for construction shall be considered Unclassified Excavation.

All stable and suitable materials from excavation shall be used as far as practicable for fills as shown on the drawings. All stable and suitable material that is hauled offsite by the contractor and is required for fill shall be hauled back onsite by the contractor at no cost to the Owner.

Suitable materials shall be defined as entirely imperishable material with that portion passing the No. 40 Sieve having a liquid limit not exceeding 40 and a plasticity index not exceeding 25 when tested in accordance with ASTM D 4318.

For publicly funded projects the City Engineer may waive or redefine the requirements for suitable material if soil mitigation measures are included in the contract documents.

For privately funded street improvements, the Engineer shall provide a geotechnical report for approval by the City Engineer. The geotechnical report shall analyze proposed subgrade materials and if necessary make recommendations for fly ash or other soil modification as required to meet the soil stability requirements in this specification or shall provide alternate mitigation recommendations.

Unsuitable material encountered in the subgrade during construction shall be removed, wasted, and suitable backfill placed in accordance with "Compaction of Earthwork". All waste sites shall be provided by the Contractor and approved by the City Engineer.

Unstable material is considered to be material that has moisture content above the plastic limit of the soil. Suitable material with excess moisture caused by the Contractor's negligent operations is not

classified as unstable excavation. Excavate and use unstable material in accordance with Subsection 205.4.d.

Where rock, shale or similar material is found, the excavation shall be carried 15 inches below the subgrade for the full width of the paved area, plus an additional width for form work for curbs, catch basins, curb inlets, etc. The excavated area shall be backfilled to the subgrade and shoulder elevations with suitable materials, and compacted as described in "Compaction of Earthwork".

No separate payment will be made for undercutting and overbreakage in rock excavation and for backfilling and compacting this area with the materials as shown in the plans.

## **11 - COMPACTION OF EARTHWORK**

### **11.1 DESCRIPTION**

All subgrade shall be uniformly compacted as indicated on the plans and in accordance with Section 205 as amended by Special Provision 07-02003-R01 of the Standard Specifications except as otherwise modified herein.

### **11.2 CONSTRUCTION REQUIREMENTS**

The embankment fill area shall be cleared and grubbed prior to placing the fill layers. Suitable materials, as specified in "Excavation", shall be used within the top three feet of subgrade. Where the fill is less than four feet below the subgrade, all sod and vegetable matter shall be removed from the surface upon which the fill is to be placed. The cleared surface shall be completely broken up by plowing, scarifying or stepping to a minimum depth of six inches. The material shall be recompacted. The fill shall be spread in layers not to exceed eight inches loose, free from clods, bladed or disced to an even surface, and compacted. In no case shall rocks, larger than three inches in any dimension be deposited within one foot of subgrade elevation. In no instance shall any lift or layer exceed six inches of compacted thickness. The entire embankment fill shall be spread in layers and compacted as hereinafter specified.

After each fill layer has been spread as outlined above, the entire area shall be compacted as set forth in these specifications. The Contractor shall have available adequate hand or mechanical compaction equipment to accomplish the compaction .

#### **a. Compaction in Fill Sections**

Compacted density of soil in fill areas in the top 18 inches shall be equal to or greater than 95% of standard proctor density, Type AA compaction with a moisture range of MR-3-3 except as recommended by a qualified laboratory and approved by the City Engineer. The fill area below the top 18 inches shall be Type B compaction with a moisture range of MR-90 unless more stringent compaction is required by the City Engineer. The maximum density for the material used shall be as determined by ASTM D-698 and within the tolerances of the optimum moisture at maximum density as determined by the Moisture Density Curve obtained for the given material.

Sand and gravel which cannot be compacted satisfactorily with a sheeps-foot roller shall be rolled with a pneumatic-tired roller. Each lift shall be rolled until no further consolidation is evident.

#### **b. Compaction in Cut Sections**

The soil six inches below the finish subgrade line in cut sections shall be scarified, broken up, and then compacted as specified in the "Compaction in Fill Sections" paragraph. The depth of compaction in cut sections shall be a minimum of six inches.

Highly plastic and nonplastic fine-grained material and all unstable and unsuitable material as defined in "Excavation" shall be removed within the top three feet of the subgrade and suitable soil replaced and compacted as specified in the "Compaction in Fill Sections" paragraph.

Filling and compacting operations shall continue alternately until the fill conforms with the lines, grades, and typical cross-sections shown on the approved drawings.

## 12 - OVERLAND PARK SUPERPAVE ASPHALTIC CONCRETE SURFACE AND INTERMEDIATE COURSE

Revision Date:  
1/9/15

### 12.1 DESCRIPTION

The 2007 Standard Specifications for State Road and Bridge Construction, Sections 109, 601, 611 (Class A), 1201, 1202, and 1203 shall govern the asphaltic concrete work except as otherwise modified herein. All testing required by this specification including mix design and field verification of the mix shall be the responsibility of the Contractor. The mix design shall be modified or redesigned whenever a material source changes or a quarry starts producing from a different geological unit or a major change is made to the asphalt plant. This work shall be subsidiary to other bid items.

### 12.2 MATERIALS

#### a. Asphalt Cement

Asphalt cement shall conform to the requirements of AASHTO-MP 1a-04<sup>1,2</sup> Performance Graded Asphalt Binder PG 64-22. The grade of the asphaltic binder shall not be changed without a laboratory remix design. It shall also comply with Sections 1201 and 1202. **Each shipment of asphalt to the asphalt plant shall have a bill of lading stating the asphalt cement meets the specifications referenced above. Copies of the bill of lading shall be submitted to the City Engineer.** Asphalt cement shall not be paid for directly but shall be considered a subsidiary bid item.

#### b. Anti-Stripping Agent

All bituminous mixtures shall contain an anti-stripping agent. AD-here® LOF 65-00 LS as - manufactured by ARR-MAZ Products, L.P. shall be added to the asphalt cement at the rate of 0.75% by weight of the total added asphalt cement. Other asphalt anti-stripping additives and their application rate may be used when proven equal after testing as specified in Paragraph "Resistance of Compacted Bituminous Mixture to Moisture Induced Damage AASHTO T 283-03" and approved by the City Engineer. Copies of the bill of lading shall be submitted to the City Engineer.

#### c. Aggregates General

**The total aggregate (coarse aggregate, fine aggregate, and the material passing the No. 200 sieve) shall contain not less than 85 percent crushed material for intermediate course and surface course.** Coarse aggregate shall be tested in accordance with KT-31. If the Sand Ratio for all aggregates is above 60.0% calculate the percentage of fine aggregate contributed to the total aggregate blend (Percentage Sand Fraction) by the fine fraction of the FRAP stockpiles. Note that individual FRAP sources may have Sand Ratios above 60.0%. Sand Ratio and Percentage Sand Fraction are defined as:

$$\text{SandRatio} = \frac{B - D}{C - D} \times 100$$

Where:

B = % of Gradation passing the No. 30 Sieve

C = % of Gradation passing the No. 8 Sieve

D = % of Gradation passing the No. 200 Sieve

$$\text{PercentageSandFraction} = (\%P8 - \%P100) \times \frac{\%FRAP}{100}$$



Where:

- %P8=Percent of gradation passing the No. 8 Sieve
- %P100 = Percent of gradation passing the No. 100 Sieve
- %FRAP = Percent of combined FRAP within the total aggregate blend

If the Percentage Sand Fraction plus the percentage of natural sand within the total aggregate blend is more than 25.0 percent, the Fine Aggregate Angularity (FAA) shall be determined in accordance with KT-50. The minimum FAA uncompacted void content shall be 45% for the fine aggregate fraction of the entire aggregate blend. This testing shall be conducted as a part of FRAP stockpile prequalification and original submission of the JMF. It will not be required with each lot of asphalt produced provided that the FRAP evaluation remains in specification as described below.

The job mix formula (JMF) shall be within the control points shown below. It shall be noted that when the gradation of extracted plant produced mix varies appreciably from JMF, the test properties of the mix will be out of specifications.

The contractor may use Fractionated Reclaimed Asphalt Pavement (FRAP) as an aggregate source. FRAP is defined as having two or more stockpiles, where Reclaimed Asphalt Pavement (RAP) is processed into coarse and fine fractions. The fine FRAP stockpile will contain only material passing the 1/4 inch screen. The coarse FRAP stockpile will contain milled material retained on the 1/4 inch screen and passing the 3/4 inch screen. The maximum combined FRAP is 35% of the total mix by weight. FRAP may be comprised of coarse or fine FRAP or a combination thereof. Utilize a separate cold feed bin for each stockpile of FRAP used. Do not blend coarse and fine FRAP either in the stockpile or in a cold feed bin. Add FRAP to the mix through the RAP collar. Sources and types FRAP must be recorded and submitted to the City Engineer upon request. Recycled Asphalt Shingles (RAS) are not allowed.

The FRAP used in production shall be similar in composition (extracted gradation and asphalt content) to the source used for design.

The contractor shall submit a complete mix design report annually to the City Engineer, prior to asphalt placement during that calendar year. This report shall contain the calculations as described in the following sections and shall contain material certifications for all materials used in the asphaltic concrete. All aggregate quality tests must have been run within 12 months of the submission date of a mix design or a volumetric test report.

The Contractor shall maintain Control Charts for the percent passing the median sieve, percent passing the No. 200 sieve, and asphalt binder content for each FRAP stockpile contained within the approved JMF. The Control Charts will use the average value of each of the three properties determined from the prequalification of the FRAP stockpile(s) as the target values.

The following table presents Action Limits and Suspension Limits for use with the Control Charts.

<b>Action and Suspension Limits for FRAP Stockpiles</b>		
<b>Property</b>	<b>Action Limits</b>	<b>Suspension Limits</b>
FRAP Asphalt Content	±1.0%	±1.4%
% Passing Median Sieve	±10.0%	±14.0%
% Passing No. 200 Sieve	±3.0%	±4.5%

Evaluation of the Control Charts shall occur with each mix test. Each FRAP stockpile within the JMF will be deemed out of specification, construction stopped and corrective action taken if:

- One point falls outside the Suspension Limits for an individual measurement; or,
- Two points in a row fall outside the Action Limits for individual measurements.

Corrective action may include, but is not limited to, remixing of the FRAP stockpile, utilizing a different FRAP stockpile, development of a new JMF, etc. Anytime that construction is stopped and

corrective actions taken, FRAP stockpile(s) shall go through the prequalification program prior to further construction. New Control Charts shall be developed and evaluated as described above with the target values being the average from the prequalification process.

**d. Aggregate for Asphaltic Concrete Surface Course**

The exact gradation shall be determined by the contractor's laboratory.

Sieve Size	Percent Passing	
	12.5 mm Nominal Size Control Points	
19mm (3/4 inch)	_____	100%
12.5 mm (1/2 inch)	90	100%
9.5 mm (3/8 inch)	80	95%
4.75 mm (No. 4)	_____	_____
2.36 mm (No. 8)	36	48%
1.18 mm (No. 16)	_____	_____
600 µm (No. 30)	_____	_____
300 µm (No. 50)	_____	_____
150 µm (No. 100)	_____	_____
75 µm (No. 200)	2	8%

**Surface mixtures for streets designated thoroughfares by the city shall contain the following:**

Fifteen percent of the minus No. 4 sieve material and 15 percent of the total aggregate shall be chat, crushed sandstone, crushed gravel, crushed steel slag, or crushed porphyry (rhyolite, basalt, granite, and Iron Mountain Trap Rock are examples of crushed porphyry).

**e. Aggregate for Asphalt Concrete Intermediate or Leveling Course**

The exact gradation shall be determined by the contractor's laboratory.

Sieve Size	Percent Passing	
	12.5 mm Nominal Size Control Points	
19 mm (3/4 inch)	_____	100%
12.5 mm (1/2 inch)	85	100%
9.5 mm (3/8 inch)	75	90%
4.75 mm (No. 4)	_____	_____
2.36 mm (No. 8)	34	44%
1.18 mm (No. 16)	_____	_____
600 µm (No. 30)	_____	_____
300 µm (No. 50)	_____	_____
150 µm (No. 100)	_____	_____
75 µm (No. 200)	2	8%

**12.3 CONSTRUCTION REQUIREMENTS**

**a. Superpave Asphaltic Concrete Mix Design Method**

The finished mixture shall meet the requirements described below when prepared in accordance

with AASHTO T 312-04 (using 6 inch nominal size molds) and the volumetric properties of compacted paving mixtures as calculated using Chapter 4 of Superpave Mix Design, Superpave Series No. 2 (SP-2), Third Edition 2001 Printing, Published by the Asphalt Institute referred hereafter as “SP-2”, unless otherwise specified. The procedure shall be as specified in Chapter 5 and 6 of the SP-2. The Theoretical Specific Gravity (G<sub>mm</sub>) shall be determined following AASHTO T 209-99 (2004) and the Bulk Specific Gravity of the Compacted Asphalt Mixture (G<sub>mb</sub>) shall be determined following AASHTO T166-00. The material for the theoretical specific gravity (G<sub>mm</sub>) and the material for the Gyrotory Compactor specimens (pucks) shall be cured at 140+/-3° C (285+/-5° F) for four hours in a closed oven after the mix is produced in the laboratory. Also, the plant-produced mixture shall be tested when the mix is four hours old. The mixture shall be transported to the laboratory in an insulated container and then stored in a laboratory oven at 140 +/-3° C (285 +/-5° F) minimum temperature for the remainder of the curing period. The curing oven shall be the forced air type and may be operated at a temperature not to exceed the maximum temperature at which the mixture may be discharged from the plant as specified in paragraph “Mixing Plants”. This procedure shall be used when the water-absorption as determined by ASTM C 127-04 and ASTM C 128-04a of any individual aggregate stockpile in the aggregate blend exceeds 1.25 percent. The mixture shall be compacted at 140 +/-3° C (285 +/-5° F). The theoretical specific gravity (G<sub>mm</sub>) shall be performed using the Type E-A 4500ml metal vacuum pycnometer with a clear polymethyl methacrylate PMMA lid. The vacuum shall be applied for 15 minutes to gradually reduce the residual pressure in the vacuum vessel to 28 mm Hg. The bulk specific gravity of the Fine Sand Chat shall be determined using the standard Cone Test for Surface Moisture as stated in ASTM C-128-04a unless otherwise directed by the City Engineer. The G<sub>sc</sub> of the FRAP material shall be used as aggregate G<sub>sb</sub> in volumetric calculations provided that the asphaltic cement content of the FRAP fraction is determined through the use of ASTM D-6307-05 Standard Test Methods for Asphalt Content of Hot Mix Asphalt by the Ignition Method. **The AASHTO Specification shall be used when this specification references the AASHTO number.**

Superpave Design and Testing Properties  
 Required Density (% of Theoretical  
 Maximum Specific Gravity (Gmm)  
 Number of Gyration (Average of 2-6 inch specimens)

$N_{\text{initial}}$ 6		85 - 91%
$N_{\text{design}}$ 60	(Mix Design Only)	96%
Percent Air Voids, in compacted mixture 0% FRAP	Mix Design Only Field	4.0% 3.0-5.0%
Percent Air Voids, in compacted mixture 5-25% FRAP	Mix Design Only Field	3.7% 2.8-4.5%
Percent Air Voids, in compacted mixture 26-35% FRAP	Mix Design Only Field	3.4% 2.6-4.1%
VEA% <sup>1</sup>	(0% FRAP) (5-25% FRAP) (26-35% FRAP)	10.0% 10.3% 10.6%
The ratio of minus 75 $\mu$ m (No. 200) material to % effective asphalt control (Pbe)based on the weight of the aggregate from the extraction test	Mix Design Field (0-25% FRAP) Field (26-35% FRAP)	0.6-1.2 0.6-1.6 0.5-1.5

<sup>1</sup>VEA% = Volume of Effective Asphalt (%) which is the numerical difference between VMA and Air Voids.

**When the aggregate absorption is high, the produced mixture will be tender until the asphalt is absorbed into the aggregate. Therefore, it may be beneficial to silo the mixture at the plant for a time before delivering to the project site. This is more important when the truck haul is short.**

**b. Resistance of Compacted Bituminous Mixture to Moisture Induced Damage**

AASHTO T 283-03

The index of retained strength must be greater than 80 percent as determined by AASHTO T 283-03 (using a 4 inch nominal size mold). Specimens shall be conditioned by freezing and thawing. When the index of retained strength is less than 80 the amount of anti strip may have to be adjusted. No additional payment will be made to the Contractor for addition of anti-stripping agent required. The mix shall contain the anti-stripping agent specified in paragraph "Anti-Stripping Agent" and tested by AASHTO T 283.

(1) Method of determining the retained strength of plant-produced mixtures. Sample the plant produced mixture at the plant site in accordance with ASTM D 979 or behind the paver using the procedure specified herein. Transport the mixture to the laboratory and determine the theoretical specific gravity as specified in paragraph "Asphaltic Concrete Mix Design Method". Prepare the specimens for the AASHTO T 283 test using the same four-hour cured material and compact to 7

± 0.5 percent air voids. Allow the samples to cool and cure overnight at room temperature and proceed with testing by determining the thickness and bulk specific gravity, then separating the specimens into subsets and preconditioning as specified herein. Then proceed with the testing as specified in AASHTO T 283.

(2) Test for AASHTO T 283

One set of tests for each mix design from each plant shall be made as the final verification of the plant produced mix design by the contractor's laboratory.

(a) One set of tests for each mix produced for Public Works Department Contracts shall be taken during the initial production each year and one set of tests for each 10,000 tons produced that year. Sampling frequency shall be adjusted when the Contractor has multiple contracts with the Public Works Department so that tests are taken every 10,000 tons of production. The City Engineer may take an additional test at his expense. Any test that fails will require the contractor to adjust the JMF and take additional test at the contractor's expense.

(b) One set of tests shall be made and approved by the City Engineer at contractor's expense when any of the material sources change or when requested by the City Engineer.

### **c. Contractor's Laboratory**

Asphaltic Concrete Mix Design shall be the responsibility of the Contractor's Laboratory. The laboratory shall be a commercial testing laboratory meeting the requirements of ASTM D 3666-05a. The manager of the laboratory shall submit a signed certificate stating that the laboratory has a current certificate stating that the laboratory meets the ASTM D 3666-05a requirements. The laboratory shall have past experience in testing materials and making Superpave Asphaltic Concrete mix designs. The laboratory shall be approved by the City Engineer. The laboratory shall establish the mix design using the criteria specified herein. Certified test results of the mix design and materials shall be submitted 30 days prior to commencing construction for review by the City Engineer. The test results shall include all detailed raw calculations for the composition of the mix design and shall include all specific gravity calculations. The calculations must be legible but not necessarily typed.

### **d. Verification of the Plant Produced Mix Design by the Contractor's Laboratory**

(1) All test properties of the mix shall be verified by sampling and testing the uncompacted mix placed behind the paver. The test shall be performed in accordance with paragraph "Superpave Asphaltic Concrete Mix Design Method" and shall indicate the test properties of the mix shown in paragraph "Superpave Design and Testing Properties". Also, an extraction and gradation test shall be made using the ignition oven. The contractor's laboratory shall adjust the mix design entering the plant to obtain the test properties behind the paver.

(2) The properties of the plant produced mix shall be determined using uncompacted mix sampled behind the paver. The properties shall be determined at  $N_{\text{design}}$  from the average of two 6 inch nominal size samples.

(3) Material for the sample shall be from the following locations

One from each side of the placed bituminous mat and one from the center of the mat. A square, pointed shovel shall be used for taking the sample and for evenly laying material back into the disturbed mat. Care shall be taken not to get foreign material or tack oil into the sample.

(4) A test shall be taken at least daily, or as directed by the engineer when the plant has produced a minimum of 200 tons.

(a) The test shall also consist of one gradation test ASTM C-136-96a of hot bin material for conventional plants, or total aggregate material from the final feed belt for dryer-drum plants.

**NOTE: The result of the gradation test is very important in determining how to adjust the mix. After the gradation or the bitumen content has been adjusted to obtain the properties of the mix, this verified mix design becomes the Job Mix**

**Formula (JMF). The plant settings may have to be adjusted again whenever the gradation of the materials change. When a change is made it shall be reported on the Superpave Asphaltic Concrete Test Report form.**

(b) Gradation and asphalt content of the mix shall be performed using ASTM D-6307-05 Standard Test Methods for Asphalt Content of Hot Mix Asphalt by the Ignition Method and ASTM D 5444-05. The initial temperature setting of the Ignition Oven shall not exceed 525° C (975° F). If FRAP is used, control tests as described above and an additional gradation and asphalt content test shall be performed for the combined FRAP sampled from the RAP cold feed into the plant.

(c) Laboratory test results shall be shown on the test report form “Superpave Asphaltic Concrete Test” shown at the end of this specification section. Test results shall be received by the contractor and the City Engineer field representatives within approximately 7 hours after the samples are taken. The laboratory shall determine the Percent Voids, VMA and VEA as soon as possible and evaluate in accordance with paragraph below: **“Corrective action to be taken when Asphaltic Concrete Test indicates the mix is out of specification.” Whenever the Percent Voids or VEA is out of specification the laboratory shall contact the Contractor and the City Engineer immediately.** The Contractors testing laboratory shall send the test results directly to the Contractor and the City immediately upon completion of the test. Signed checked copies may be sent later. The Contractors laboratory shall furnish the City’s laboratory other items such as the JMF mix gradation, plant setting, the bulk specific gravity of the aggregate  $G_{sb}$  and the specific gravity of the asphalt  $G_b$ . Laboratories shall compare final test results when the mix is out of specification. The test results shall indicate whether the plant needs adjusting and recommendations shall be provided on correcting the problem.

(d) The most recent Asphalt Concrete Test that indicates the mixture meets the specifications is the current mix design, except that a complete mix design shall be submitted at the beginning of each paving season or if the FRAP stockpile becomes out of specification.

**(5) Corrective action to be taken when Asphaltic Concrete Test indicates the mix is out of specification.**

(a) Asphaltic Concrete Surface and Asphaltic Concrete Intermediate or Leveling Course

The mix should be adjusted when consecutive lot tests show the percent voids in the compacted mix are getting close to being the minimum or the maximum field values.

Paving shall stop and the mixture shall be redesigned whenever any of the following occurs: three consecutive sets of lot tests show the percent voids in the compacted mix are less than the minimum field value or more than the maximum field value; or two consecutive sets of lot tests show the percent voids in the compacted mix are less than 0.5 percent below the minimum field value or 0.5 percent greater than the maximum field value.

(b) Also paving shall stop and the mix shall be redesigned whenever three consecutive sets of lot tests show the VEA is more than 1.0% greater or 1.0% less than the VEA specified in paragraph 12.3.a.

(c) Asphaltic Concrete mixtures with a test indicating the VEA is 2.0% above the value specified in paragraph 12.3.a shall be removed unless directed otherwise by the City Engineer.

(6) Pre-Construction test strips

Test strips shall be constructed by the Contractor off city property at the contractor’s expense. However, the City shall observe the sampling and testing. The contractor may negotiate the construction of

a test strip on the project with the engineer. In that event, asphalt not meeting specification shall be removed at contractor's expense. Asphalt meeting specifications will be paid for at unit prices.

(a) The Contractor's laboratory shall test the final belt gradation if the plant is a dryer-drum plant or the hot bin material if the plant is a conventional plant, and adjust the feeds to insure the plant is producing the gradation of the mix design, before hot mix production begins for the tested strip.

(b) Test strips shall contain at least 85 tons of asphaltic concrete. A test sample shall be taken behind the paver at 80 tons. The paver shall be set 12 feet wide and at plan depth when the sample is taken. Care shall be taken not to get foreign material or tack oil into the sample.

(c) If the laboratory test results indicate the mix can be adjusted to meet the properties stated in paragraph "Superpave Design and Testing Properties", project paving may begin.

However, this has to be agreed upon by the Contractor's laboratory, the Contractor, and the City Engineer. Otherwise, another test strip shall be constructed. Test strips will not be required on other projects which use this mix design. However, all materials have to be from the same sources and geological units. Also, the mix has to be produced by the same plant.

**e. Verification testing of the plant produced asphaltic concrete by the city.**

The City Engineer will take verification tests at random times, at the City's expense.

**f. Mixing Plants**

Mixing plants shall meet the requirements of KDOT's latest specification in effect when this project's bids are received by the City, except the mixture discharged from the plant shall not exceed 157.2°C (315°F).

**g. RAP Stockpiles**

RAP stockpiles shall be prequalified in accordance to the paragraph entitled "Aggregates General" and procedures described in "Recycled Asphalt Pavement Stockpile Use in Overland Park, Kansas, October 9, 2014", available from the office of the City Engineer. The report from this process shall be included in the mix design submittal. The City Engineer may verify the uniformity of the RAP stockpile at any time at the City's expense.

**h. Asphalt mixtures having temperatures less than 113°C (235°F), when dumped into the mechanical spreader will be rejected.**

(1) All bituminous mixtures shall be delivered to the paver at a temperature sufficient to allow the material to be placed and compacted to the specified density and surface tolerance.

(2) All delivery trucks shall be totally covered with a water proof tarpaulin at the asphalt plant and shall not be uncovered until they are next in line to unload.

**i. Placing**

Asphaltic concrete intermediate and surface courses shall not be placed in compacted lifts greater than 3 inches deep except when otherwise indicated on maintenance project plans. Asphaltic concrete surface course shall not be placed thinner than 2 inches deep. Asphaltic concrete intermediate course used as surface shall not be placed thinner than 2 inches. Interim layers of intermediate course shall not be left uncovered by the subsequent course for more than 5 days, weather permitting. Material trucks hauling materials other than asphaltic concrete or tack coat shall not travel on previously constructed layers of asphaltic intermediate course until the final course of the intermediate is constructed.

(1) The Contractor shall schedule and route his hauling operation to minimize hauling over a final course as much as feasible.

(2) Bituminous-Materials Spreaders

Bituminous-materials spreaders shall be the self-propelled type equipped with hoppers, tamping, or vibrating devices, distributing screws (augers), adjustable screeds operated either manually or automatically, equipment for heating the screeds and equalizing devices. The spreader shall be capable of spreading hot bituminous mixtures without leaving indented areas, tearing, shoving, or gouging and capable of confining edge of strips to true lines without use of stationary side forms and capable of placing

the course to the required thickness. It shall also be capable of producing a finished surface conforming to the smoothness requirements specified. Spreaders shall be designed to operate forward at variable speeds and in reverse at traveling speeds of not less than 100 feet per minute. If an automatic grade control device is used on the spreader for two-lane paving operations, it shall consist of sensing device for control of one end of the screed and a slope-control mechanism for control of the other end of the screed, or a sensing device on each side of the paving machine. Where the paver is used on multiple paving lanes (more than two paving lanes), sensing devices shall be used on each side of the spreader for control of the screed. The slope-control mechanism shall not be used for grade control in multiple paving lane operations.

(a) When the contractor chooses to pave lanes through the project wider than 12 ft. the spreader (paver) shall be equipped with auger extensions.

(b) Through lanes shall be paved before left turn lanes and side street intersections. Through lane pavers shall not stop for other areas to be paved.

### (3) Special Procedures to Prevent Segregation

The wings of the spreader hopper shall not be emptied (flipped) between truck loads. The depth of the material in the screed auger chamber shall be kept approximately three-fourths (3/4) full - all the way out to the end gate. The augers should be running automatically and the vibrating screed turned on. The hopper conveyor shall always have approximately 6 inches of material covering it and not be allowed to run out of material. Whenever the paver is run empty (conveyor exposed) the area behind the paver should be checked for a segregated spot. If a spot exists the paver should be stopped and the segregated spot repaired before it is rolled.

### (4) Joints General

Joints between old and new pavements or between successive day's work shall be cut back vertical with a saw. Other joints shall be sawed vertical as directed by the City Engineer. All joints shall be tacked and shall be made carefully to insure continuous bond between old and new sections of the course. All joints shall have the same texture, density, and smoothness as other sections of the course. The tack shall be overlapped onto the previous pavement 1 inch to 2 inches. Contact surfaces of previously constructed pavements, curbs, gutters, manholes, etc., shall be tacked. Surfaces that have become coated with dust, sand, or other objectionable material shall be cleaned by brushing or cut back with an approved power saw, as directed. The surface against which new material is to be placed shall be sprayed with a thin, uniform coat of bituminous material conforming to the requirements of paragraph TACK COAT stated hereinafter. The material shall be applied far enough in advance of placement of the fresh mixture to insure adequate curing. Care shall be taken to prevent damage or contamination of the sprayed surface.

(a) Edges of previously placed pavement that have cooled and are irregular, honeycombed, poorly compacted, damaged, or otherwise defective unsatisfactory sections shall be cut back to expose a clean, sound surface for the full thickness of the course as directed by the City Engineer.

#### (b) Transverse Joints

The roller shall pass over the unprotected end of freshly placed mixture only when placing of the course is discontinued or when delivery of mixture is interrupted to the extent that unrolled material may become cold. In all cases, the edge of the previously placed course shall be cut back to expose an even, vertical surface the full thickness of the course. In continuing placement of the strip, the mechanical spreader shall be positioned on the transverse joint so that sufficient hot mixture will be spread to obtain a joint after rolling which conforms to the required density and smoothness specified herein.

A string line shall be used to set pavement elevations twenty-five feet after a beginning at a transverse joint or twenty-five feet before an ending at a transverse joint.

#### (c) Offsetting Joints in Intermediate and Surface Courses

The surface course shall be placed so that longitudinal joints of the surface course will not coincide with joints in the intermediate course by approximately 9 inches. Care shall be taken when possible to offset longitudinal joints in a manner that the final surface course joint is in the center of the



pavement or at the location shown on the plans. Transverse joints in the surface course shall be offset by at least two feet from transverse joints in the intermediate course.

(d) Special Requirements for Placing Paving Lanes Succeeding Initial Lanes

In placing each succeeding lane after the initial lane has been placed and compacted as specified hereafter, the screed endgate of the mechanical paver shall overlap the previously placed lane slightly and shall be approximately 1.25 times thicker than the existing compacted lane to allow for compaction roll down and produce a smooth compacted joint with the specified density. Mixture placed on the edge of the previously placed lane by the mechanical paver shall be pushed back (tucked) to the edge of the lane being placed by use of a lute (rake). The pushed back material shall form a ridge on the uncompacted lane along the edge of the previously placed lane. The height of the ridge above the uncompacted lane should be approximately equal to the thickness being allowed for roll down during compaction. These procedures shall be used to facilitate getting a smooth joint with density. Excess mixture shall be removed and wasted. Excess material shall not be spread over the uncompacted mat.

(5) Steel-Drum Rollers

Steel-drum rollers shall be self-propelled, tandem (two-axle) with both drums the same size, powered by both drums, vibratory types, weighing not less than 20,000 pounds static weight and not less than 150 lb/in of drum. Drums shall be equipped with adjustable scrapers, water tanks, and sprinkling apparatus for keeping the drums wet, thereby preventing the bituminous mixture from sticking to the wheels. Rollers shall be capable of reversing without backlash and free from worn parts. Roller drums with flat and pitted areas or projections that leave marks in the pavement will not be permitted.

(6) Heavy Pneumatic-Tired Rollers

Heavy pneumatic-tired rollers shall be self-propelled and shall consist of two axles on which are mounted an odd number of pneumatic-tired wheels. The roller shall have at least nine pneumatic-tired wheels in such manner that the rear group of wheels will not follow in the tracks of the forward group, but spaced to give essentially uniform coverage with each pass. Axles shall be mounted in a rigid frame provided with a loading platform or body suitable for ballast loading. Tires shall be smooth, inflated to 90 p.s.i.. Construction of the roller shall be such that each wheel can be loaded to a minimum of 2,300 pounds.

(7) Blowers and Brooms

Blowers and brooms shall be power type and suitable for cleaning the surface to be paved. Open faced brooms may only be used when approved by the City Engineer.

**j. Compaction of Mixture**

The contractor is responsible for the development of a compaction procedure that will obtain the required density. The following paragraphs describe a procedure that generally obtains density. **The contractor shall determine the exact amount of rolling (coverages needed) to obtain a density meeting paragraph: “Density and Density Test”. The ideal density is an average density between 92% and 94%.**

(1) General

The surface of the placed material shall be corrected if necessary before compaction begins. Compaction of the mixture shall be accomplished using a minimum of two steel-drum rollers and a pneumatic-tired roller as specified above. Breakdown rolling shall be as close behind the paver as possible. The break down roller shall be a steel-drum and operated in the vibratory mode on the first forward pass and may be operated in vibratory mode on subsequent passes either forward or back. Delays in rolling freshly spread mixture will not be permitted. The pneumatic-tired roller shall be used as an intermediate roller; however, it shall also roll closely behind the break down roller. The pneumatic-tired roller shall always be kept moving in order to keep its tires warm. The second steel-drum roller shall be used as a final finish roller. Rollers shall not travel faster than 3 mph. Steel-drum rollers shall not be used in the vibratory mode except for initial breakdown rolling. When steel-drum rollers are used in the

vibratory mode they shall be operated at maximum frequency and minimum amplitude. Rolling shall be continued until density is obtained in all portions of each course.

The speed of rollers shall be slow enough at all times to avoid displacement of the hot mixture. Displacement of the mixture resulting from reversing the direction of the roller or from any other cause shall be corrected at once by raking or removing and replacing fresh mixture when necessary. Alternate passes of the roller shall be varied slightly in length. During rolling, the wheels of steel-drum rollers and plates of vibro plate compactors shall be moistened to prevent adhesion of the mixture to the drums or plates, but excess water will not be permitted. Tires of heavy pneumatic roller shall be moistened with soapy water when required to prevent mixture from sticking to tires during rolling. Rollers shall not be permitted to stand on finished courses until the courses have thoroughly cooled. The contractor shall supply ample rollers to obtain the specified density. Places inaccessible to rollers shall be thoroughly compacted with hot hand-tampers or vibro plate compactors.

#### (2) Break Down Rolling

Rollers shall be operated as specified above. The unconfined edge or low side edge of the paving lane shall be broken down first. The other edge shall be broken down second and the middle broken down last. **This is considered one coverage.** Steel-drum break down rollers shall not hang over the free edge of the mat or stay back from it even though they are going to back up for the adjoining lane. The entire lane shall be broken down at the same temperature.

##### (a) Intermediate Rolling

The rubber tired roller shall be close behind the break down roller after the mat has cooled a few degrees. The rubber tired roller shall roll the same pattern making the same coverage as the breakdown. The rubber tired roller should stay the thickness of the lift from the free edge.

(b) The number of coverages shall be determined by the contractor. This will change with temperature, humidity and thickness of the lift.

##### (c) Longitudinal Joint Break Down Rolling of Paving Lanes Succeeding Initial Lanes

The break down roller in the vibratory mode shall lap over the tucked joint approximately six inches (6") on to the previously placed compacted lane.

As part of the break-down rolling and immediately after the break-down roller completes its first passes, the longitudinal joint shall be pinched to ensure compaction with the pneumatic-tired roller. The rubber tired roller shall make at least one complete pass (forward and backward) operated on the hot lane with the outside tire pinching the joint.

After the rubber tired roller rolls the joint, it shall make at least one pass over the rest of the mat and then drop back to its intermediate rolling. The steel drum roller in static mode shall immediately smooth out the rubber tired marks.

##### (d) Finish Rolling

Finish rolling should start when the mat has cooled down 20°F to 40°F below the intermediate rolling (This could be approximately 225°F). The steel wheeled roller in static mode shall immediately smooth out the rubber tired marks using the same pattern making the same type coverages as the breakdown roller. Do not roll until cracks appear, let it cool. Finish rolling can continue until the temperature reaches 175°F to 150°F.

**The finish rolling shall continue until the pavement is smooth and has the density specified above.**

#### **k. Sampling Pavements for Density**

Samples of finished pavement shall be obtained by the contractor or the contractor's laboratory. A minimum of one test (three cores) shall be taken for each tonnage lot represented by a Superpave Asphaltic Concrete test. Lots larger than 1200 tons shall have one set of (three cores) for each 1000 tons placed or as directed by the Engineer. The cores samples shall be taken at locations throughout the tonnage lot. The locations shall not be previously marked. The core locations shall be marked by the City Engineer after each tonnage lot placement is completed. Cores shall be at least 4 inches in diameter. Sample holes shall

be backfilled by the contractor using Quikrete, Rapid Road Repair manufactured by The Quikrete Companies, Atlanta Georgia, 30329, Crystex manufactured by L&M Construction Chemicals Inc., Omaha Nebraska, 68152 or approved equal. The top of the patch shall be sprayed black with paint. The samples shall be tested by the contractor's laboratory to determine conformance to density and thickness. The City Engineer may require the contractor to take more samples at the contractor's expense if the density is marginal.

**l. Density and Density Test**

Density of the compacted mixture of the surface or intermediate course shall be determined by tests made on specimens taken from the compacted course in accordance with the requirements of the previous paragraph: SAMPLING PAVEMENTS FOR DENSITY. The density shall be the average of the three cores 92% to 96% of max theoretical specific gravity of the Superpave Asphaltic Concrete test for the lot. No core shall be less than 90%.

**m. Weather Limitations**

Weather limitations in Section 611.3(b) of the Standard Specifications shall apply except that the following table shall be used.

<b>Asphalt Placement Temperature Limitations</b>			
<b>Paving Course</b>	<b>Compacted Thickness (inches)</b>	<b>Air Temperature (°F)</b>	<b>Road Surface Temp. (°F)</b>
Surface	All	55	60
Subsurface	< 1.5	50	55
Subsurface	≥ 1.5 and < 3	40	45
Subsurface	≥ 3	30	35

**n. Road Surface Preparation**

When the bituminous mixture is placed on an existing bituminous surface, the surface shall be cleaned of all foreign material and broomed as necessary to remove dust. Areas shown on the plans or designated by the City Engineer to be patched shall be excavated to a depth directed by the City Engineer, filled with bituminous mixture and compacted. When the contract does not provide for a patching item, an amount two and one-half times the unit price for the bituminous mixture shall be used. The excavation required will not be paid for directly but will be considered subsidiary. In addition to brooming, a high pressure type water truck, capable of washing all fines, dirt, and debris from the surface, may be required prior to overlaying as directed by the City Engineer. Equipment compliance with this specification shall be visual observation by the City Engineer at the commencement of washing operations. Unless specified, no direct payment shall be made for this item, as it shall be considered subsidiary to other bid items.

**o. Tack Coat**

Emulsified Asphalt CSS-1h meeting the requirements of Section 1203 of the Standard Specifications shall be used for tack coat. All existing and new asphaltic concrete surfaces shall receive a tack coat not more than six hours prior to placing an asphaltic concrete paving course. Surfaces previously tack coated and not covered with new asphaltic concrete for more than six hours shall be retacked. The rate of application shall be 0.05 gal./sy to 0.12 gal./sy, or as otherwise directed by the City Engineer. At locations where asphalt is being placed on top of existing concrete pavement, or for night work where temperatures warrant, the emulsified asphalt shall be diluted 10 percent with water versus the normal 50 percent dilution with water. Tack coat shall not be paid for directly but shall be considered subsidiary to other bid items.

**p. Surface Smoothness**

The surface course, upon completion of final rolling, shall be smooth and true to grade and cross-section. When a 12-foot straightedge is laid on the surface parallel with the centerline, the surface shall not vary more than 1/8 inch from the straightedge. When the 12-foot straightedge is laid on the surface

transverse to the centerline between the crown and edge of pavement, the surface shall not vary more than 1/4 inch from the straightedge. Low or defective areas shall be immediately corrected by cutting out the faulty areas and replacing with fresh hot mixture and compacting the area to conform to the remainder of the pavement. Testing for plan grade conformance and surface smoothness shall be performed by the Contractor in the presence of a representative of the City Engineer. Tests shall be made at intervals as directed by the City Engineer. The City Engineer may direct the contractor to diamond grind areas that are out of tolerance in lieu of above replacement.

**SUPERPAVE ASPHALTIC CONCRETE TEST (Verified Mix Design)**

Description:			
LAB I.D.:		<b>TIME</b>	<b>TONS</b>
Sample Date:		Belt	
Sample I.D.:		Hot Mix	
Supplier:			

**GRAIN SIZE DATA – ASTM D5444, C136, C117**

Sieve Size	Belt Sample	RAP/FRAP Sample*	Hot-Mix Sample*	Master Grade Limits	Cal. Single Point
19mm (3/4")					
12.5mm (1/2")					
9.5mm (3/8")					
4.75mm (No. 4)					
2.36mm (No. 8)					
1.18mm (No. 16)					
600µm (No 30)					
300µm (No 50)					
15 µm (No 100)					
75µm (No 200)					

**\*EXTRACTION DATA-ASTM D6307**

* from uncompacted mat	FRAP	Sample	Plant Setting	Recycled AC %
%AC, total mix basis				mat
Aggregate Type	%**	Aggregate Type		%**
				**total aggregate basis

**VOLUMETRIC DATA 6" NOMINAL SIZE Gyratory Specimens**

Gyrations (average of 2 specimens) @ 280-290 deg F – AASHTO T312 - 01  
 | Ndes = 60 | Nini = 6

Sample*	Specifications	
Mix bulk specific gravity @ Ndes, Gmb	--	
%Voids @ Ndes	3.0-5.0/2.8-4.5/2.6-4.1	AASHTO T T-169 0%/5-25%/26-40% RAP
%VMA @ Ndes, Gsb basis		
%VEA @ Ndes	9.0-11 9.3-11.3 9.6-11.6	=%VMA-%Voids (0-5% 5-25% 26-40% RAP)
%Gmm @ Nini	85-91	AASHTO T 166-00
Ratio (-) 75µm (No. 200) to % Eff Binder	0.6-1.6/0.5-1.5	0-25%/26-40% RAP
Tensile Strength Ratio, %	80 minimum	AASHTO T 283-03
Max Theoretical Specific Gravity Gmm	--	AASHTO T 209-99(04)
Max Theo. Density, pcf	--	
Effective specific gravity Agg. Gse	--	
Bulk Specific Gravity of Total Agg., Gsb	--	ASTM C128, C127
Specific Gravity of Asphalt, Gb	--	
Shale or shale-like (virgin aggregates only)	1.0% maximum	KT-8

**COMMENTS:**

## 13 - METHODS OF MILLING OPERATIONS

### 13.1 DESCRIPTION

This work will consist of the removal of the existing surface to the depth and limits shown on the Plans or established by the Engineer and in accordance with Section 612 of the Standard Specifications except as otherwise modified herein. It shall also include the loading and stockpiling, if required, of the milled material and the cleaning of milled surfaces prior to applying a tack coat.

### 13.2 CONSTRUCTION REQUIREMENTS

#### a. Milling Operations

The nature and condition of the milling equipment and the manner of performance of the work shall be such that the finished milled surface of the pavement is not torn, gouged, shoved, broken, oil coated or otherwise injured by the milling operation.

The milling operation shall provide for a windrowing of cuttings, pick-up and elevation into dump trucks, all in a single lane operation. Use of front-end loaders as the primary means of pick-up will not be construed as a single lane operation, nor will side loading of dump trucks be permitted.

All side streets shall have a butt joint of 1 inch unless otherwise specified on the plans. All driveways greater than 1 inch after milling shall be ramped.

#### b. Milling Machine and Equipment

The milling machine to be used in this contract shall be designed and built for cold milling work; shall be self-propelled; and shall have a means of milling the old pavement surface. The drum patterns shall leave a grooved surface finish. The milling machine drum shall have its teeth in a triple turn type pattern. The drum shall be totally enclosed to prevent discharge of any loosened material on adjacent work areas. A dust suppression system must be part of the equipment. Maximum width of the milling machine shall be 12'-6"; drum widths shall be minimum to maximum. Smaller machines may be used for auxiliary purposes only. A milling machine attached and powered by a uniloader capable of a 3-1/2 inch to 4 inch deep cut shall be used for asphalt repair work.

The cold milling machine shall have adequate power to force the cutting edge(s) of the drum teeth to the desired depth below the surface of the pavement without causing undue irregularities in the surface of the planned pavement.

The surface shall be milled flush to all curbs, inlets, manholes or other similar obstruction within the paved area.

#### c. Joints

All areas with 1 inch in depth or greater not replaced within the work day limitations, or as directed by the City Engineer, shall have temporary material placed to allow traffic full access. The temporary material shall be hot mixed asphalt.

#### d. Special Cleaning of Milled Surfaces

Milled surfaces shall be cleaned with a street sweeper immediately prior to applying tack coat. The sweeper shall remain on the project during application of tack. Each lane shall be cleaned to the satisfaction of the City Engineer. Open faced brooms may only be used in conjunction with the sweeper when approved by the City Engineer.

##### (1) Street Sweeper Brooms

- (a) The sweeper shall have right and left gutter brooms.
- (b) Speed of broom shall be independent of pickup broom speed.
- (c) Gutter brooms shall be adjustable from inside cab for down pressure and wear. Both gutter brooms tilt angle shall be controlled from inside the cab.
- (d) Gutter brooms shall be protected from impact with automatic return to work position.
- (e) Pickup broom shall have hydraulic pickup for transport.
- (f) Pickup broom down pressure shall be manually adjusted.

- (g) Minimum sweep path of 125".
- (2) Pickup brooms adjustments

The pickup broom shall be adjusted to have a heavy sweeping (5" to 7" pattern) (this is the longitudinal contact of the broom with the roadway shall be between 5" and 7"). Each side of the broom shall have the same contact with the roadway.

**Additional cleaning may be required using compressed air as directed by the City Engineer.**

## **14 - STREET WASHING**

### **14.1 DESCRIPTION**

A high pressure type water truck, capable of washing all fines from the planed surface may be required prior to overlaying as directed by the City Engineer. Equipment compliance with this specification shall be by visual observation by the City Engineer at the commencement of washing operations.

## **15 - AGGREGATE BASE COURSE (OP SPECIAL)**

### **15.1 DESCRIPTION**

This work shall consist of furnishing and placing aggregate base course in accordance with the following specifications and as shown on the plans.

### **15.2 MATERIALS**

#### **a. Compaction**

Compaction requirements shall be based on the results of a test section constructed by the Contractor, using the materials, methods, and equipment proposed for use in the work. The test section shall meet the requirements of paragraph "Test Section" and shall be observed by the City Engineer.

#### **(1) Compaction Equipment**

A dual or single smooth drum roller with vibratory capability and static weight not less than 150 lbs/in width of drum.

#### **b. Sampling and Testing**

#### **(1) Samples**

Samples for material gradation, liquid limit, and plastic limit tests shall be taken in conformance with ASTM D 75.

#### **(2) Initial Test**

One of each of the following tests shall be performed on the proposed material, prior to commencing construction for each source (geological unit) of material: Sieve analysis, wear test, soundness, absorption, specific gravity, liquid limit and plasticity index, and moisture-density relationships. Certified test results shall be submitted to the City Engineer prior to commencing construction.

#### **(3) Sieve Analyses**

Sieve analyses shall be made in conformance with ASTM C 117 and C 136. Sieves shall conform to ASTM E 11.

#### **(4) Liquid Limit and Plasticity Index:**

Liquid Limit and plasticity index shall be determined in accordance with ASTM D 4318.

#### **(5) Testing Frequency**

Testing frequency for sieve analysis, liquid limit and plasticity index -- Results shall verify that the material complies with the specifications. After the initial test, a minimum of one analysis shall be

performed for each 835 tons of material placed, with a minimum of one analysis for each day's placement until the base course is completed. When the source of materials is changed or deficiencies are found, the initial analysis shall be repeated and the material already placed shall be re-tested to determine the extent of unacceptable material. All in-place unacceptable material shall be replaced.

(6) Density

Density will be determined by roller pattern. The City Engineer may perform check density test as specified herein at random times.

(7) Soundness, Wear, Absorption, and Specific Gravity Test shall conform to the requirements of Section 1104 of the standard specifications. The above test shall be performed in accordance with test methods stated in Section 1115 of the standard specifications.

**c. Approval of Material**

(1) Aggregates

Aggregates shall consist of clean, sound, durable particles of crushed limestone stone. The Contractor shall obtain materials that meet the specification and can be used to meet the grade and smoothness requirements specified herein, after all compaction operations have been completed. The aggregates shall be free of silt and clay as defined by ASTM D 2487, vegetable matter, and other objectionable materials or coatings. The portion retained on the No. 4 sieve shall be known as coarse aggregate; that portion passing the No. 4 sieve shall be known as fine aggregate.

(2) Coarse Aggregates

Coarse aggregates shall be angular particles of uniform density. The percentage of flat and/or elongated particles shall not exceed 20 in the fraction retained on the 1/2 inch sieve and in the fraction passing the 1/2 inch sieve. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the requirements set forth herein.

(3) Fine Aggregate

Fine aggregate shall be natural sand or angular particles produced by crushing stone or gravel that meets the requirements for wear and soundness specified for coarse aggregate.

(4) Gradation Requirements

**Gradation requirements specified herein shall apply to the completed compacted base course.** The aggregates shall have a maximum size of 2 inches and be graded continuously well within the limits specified in Table I. Sieves shall conform to ASTM E 11.

TABLE I. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve:

Sieve Designation	Percent Passing
50 mm (2 inches)	100
37.5 mm (1 ½ inches)	70-100
25 mm (1 inch)	45-80
12.5 mm (1/2 inch)	30-60
4.75 mm (No. 4)	10-35
2.36 mm (No. 8)	5-25
425 µm (No. 40)	4-18
75 µm (No. 200)	0-10



Liquid limit and plasticity index requirements stated herein shall apply to any aggregate component that is blended to meet the required gradation and also to the aggregate in the completed base course. The portion of the aggregate passing the No. 40 sieve shall be either non-plastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

(5) Stockpiling Material

Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. Aggregates shall be stockpiled on the cleared and leveled areas designated by the City Engineer so as to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

### 15.3 CONSTRUCTION REQUIREMENTS

#### a. Preparation Of Surface

Immediately prior to placing aggregate base course, the previously constructed underlying surface course shall be cleaned of all foreign substances; if the surface of the underlying material has been damaged after placement or has inadequate compaction or other deviations from this contract specification requirements, such defects shall be repaired immediately prior to placement of this course.

#### b. Grade Control

During construction, the lines and grades including crown and cross slope indicated for the base course shall be maintained by means of line and grade stakes placed by the Contractor.

#### c. Weather Limitation

Base courses shall be placed when the atmospheric temperature is above 36° F. Areas of completed base course that are damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirement.

#### d. Mixing of Materials

The coarse and fine aggregates shall be mixed in a stationary plant. **Water shall also be added to the aggregate prior to placement at a stationary mixing plant. The amount of water added shall be considerably above optimum moisture.** The Contractor shall make such adjustments in mixing procedures or in equipment as may be directed to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory base course meeting all requirements of this specification.

#### e. Placing

The mixed material shall be placed on the prepared sub-grade or sub-base in layers of uniform thickness with an approved spreader box when possible as directed by City Engineer. Tracked equipment operated on base course material shall have street tracks. When a compacted layer 6 inches or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 6 inches is required, the material shall be placed in layers of equal thickness. No layer shall exceed 6 inches or be less than 3 inches when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the base course is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, content, and to insure an acceptable base course. Mixed material shall not be placed on or above frozen material.

#### f. Test Section

##### (1) General

A test section shall be constructed to evaluate placement and compaction procedures. Test section data will be used by the City Engineer to determine the required number of passes and the field dry density requirements for full scale production. The test section shall be located within the limits of the base course construction area at a location approved by the City Engineer. The underlying courses shall be completed, inspected and approved in the test section prior to constructing the base course. The test section shall be 12

feet wide and contain approximately 100 tons of completed base course. Whenever the quarry starts producing the base course material from a different geological unit, a new test section shall be constructed.

**(2) Mixing, Placement, and Compaction**

Mixing, placement, and compaction shall be accomplished using equipment meeting the requirements stated hereinbefore. Compaction equipment speed shall be no greater than 1.5 miles/hour.

**(a) Procedure**

The test section shall be constructed with aggregate in a moist state so as to establish a correlation between number of roller passes and dry density achievable during field production. Density and moisture content tests shall be conducted at the surface and at intervals of 2 inches of depth down for the total layer thickness, in accordance with ASTM D 2922 and ASTM D 3017. Sieve analysis tests shall be conducted on composite samples, taken adjacent to the density test locations, which represent the total layer thickness. One set of tests (i.e. density, moisture, and sieve analysis) shall be taken before compaction and after each subsequent compaction pass at three separate locations as directed by the City Engineer. Compaction passes and density readings shall continue until the difference between the average dry densities of any two consecutive passes is less than or equal to 0.5 pcf.

**(3) Evaluation**

Within 5 working days of completion of the test section, the Contractor shall submit to the City Engineer a Test Section Construction Report complete with all required test data and correlations. The City Engineer will evaluate the data and provide to the Contractor the required number of passes of the roller, the dry density for field density control during construction, the depth at which to check the density, and the need for a final static pass of the roller.

**g. Compaction**

Compaction shall be accomplished using rollers meeting the requirements of paragraph "Compaction Equipment" and operating at a rolling speed of no greater than 1.5 miles per hour. Each lift of material, including shoulders, shall be compacted with the number of passes of the roller as specified by the City Engineer. In addition, a minimum field dry density, as specified by the City Engineer, shall be maintained. If the required field dry density is not obtained, the number of roller passes shall be adjusted. Excessive rolling resulting in crushing of aggregate particles shall be avoided. In all places not accessible to the rollers, the material shall be compacted with mechanical hand operated tampers.

**h. Finishing**

The surface of top layer of base course shall be finished after final compaction, by cutting any overbuild to grade and rolling with a steel-wheeled roller. In no case will thin layers of material be added to the top layer of base course to meet grade. If the elevation of top layer of base course is 1/2 inch or more below the grade, the top layer of base shall be scarified to a depth of at least 3 inches, new material shall be added, and the layer shall be blended and recompact to bring to grade. Adjustments in rolling and finishing procedures shall be made as may be directed to obtain grades, to minimize segregation and degradation of base course material, to adjust the water content, and to insure an acceptable base course. Material found unacceptable shall be removed and replaced, as directed, with acceptable material. As stated here in before the gradation applies to the completed compacted base.

**i. Edges of Base Course**

Acceptable material shall be placed along the edges of the base course in such quantity as will compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, at least a 1 foot width of the shoulder shall be rolled and compacted simultaneously with the rolling and compacting of each layer of the base course, as directed.

**j. Smoothness Test**

The surface of the top layer shall not deviate more than 1/2 inch when tested with 10 foot straightedge applied parallel with and at right angles to the centerline of the area to be paved. Deviations exceeding 1/2 inch shall be corrected as directed. Measurements taken at right angles to the centerline shall be taken at a minimum of 50 foot intervals.

**k. Thickness Control**

The completed thickness of the base course shall be within 1/2 inch of the thickness indicated. The thickness of the base course shall be measured at intervals providing at least one measurement for at least each 500 square yards of base course. The depth measurement shall be made by test holes at least 3 inches in diameter. Where the measured thickness of the base course is more than 1/2 inch deficient, such areas shall be corrected by excavating to the required depth and replacing with new material. Where the measured thickness of the base course is 1/2 inch more than indicated, it will be considered as conforming with the requirements plus 1/2 inch, provided the surface of the base course is within 1/2 inch below established grade and not above the established grade. The average job thickness shall be the average of the job measurements as specified above but within 1/4 inch of the thickness indicated.

**l. Maintenance**

The base course shall be maintained in a condition that will meet all specification requirements until accepted. As directed by the City Engineer and at the Contractor’s expense, aggregate base course that is contaminated by foreign material or sediment shall be removed and replaced.

Within 15 days after completion of the aggregate base course it shall be covered with asphaltic concrete intermediate course. The aggregate base course shall not be used as a haul road except for curb construction.

**16 - AB-3 OVERLAND PARK MODIFIED**

**16.1 DESCRIPTION**

AB-3 Overland Park Modified shall be supplied in accordance with Section 1104 of the Standard Specifications, except as otherwise modified herein.

**16.2 MATERIALS**

Paragraph 1104.2(a) composition shall be modified so that the AB-3 Overland Park modified shall consist of 100% limestone or dolomite produced by mechanical crushing.

Table 1104-1: Gradation and Plasticity of Aggregates for Aggregate Base Construction shall be modified so that the AB-3 Overland Park modified shall have the gradation shown on line AB-3; however, the P.I. shall be between 0 and 5 and the liquid limit shall be 25 maximum.

The material shall be mixed with water in a stationary plant, before delivery to the project site, to obtain the moisture content as directed by the City Engineer.

**16.3 CERTIFICATION OF THE MATERIAL**

The Contractor shall submit with the delivery of the material to the project, a certificate indicating the gradation, plasticity index, and the moisture-density relationships of the material using ASTM D698 complies with the above material specification.

**17 - FLY ASH TREATED SUBGRADE**

**17.1 DESCRIPTION**

This work shall consist of constructing one or more courses of a mixture of soil, fly ash, and water, in accordance with Special Provision to the Standard Specifications 07-03002 except as otherwise modified herein.

## **17.2 MATERIALS**

All fly ash materials shall conform to Section 2005 of the Standard Specifications, and water used for fly ash modified subgrade shall conform to Section 2402 of the Standard Specifications.

Water used for fly ash modified subgrade shall be provided by the Contractor.

## **17.3 CONSTRUCTION REQUIREMENTS**

The Contractor shall make every reasonable attempt to utilize the most suitable material on site, as designated by the City Engineer, for preparation of the areas to receive fly ash treatment. Prior to constructing grades in these areas the Contractor shall inform the City Engineer of the materials to be used, in order that tests to determine the suitability of the materials may be conducted.

Fly Ash application equipment shall be approved by the City Engineer one week prior to beginning fly Ash operations. The contractor shall use equipment capable of producing a consistent application rate.

The amount of fly ash to be used for treatment shall be established by the City Engineer, based on laboratory tests on the site materials and specific fly ash to be supplied by the Contractor. The required moisture content shall be established by the City Engineer, based on laboratory tests on the site materials and specific fly ash content to be used for the treatment.

When the thickness is greater than 8 inches, compact multiple lifts of equal thickness with a maximum lift thickness of 8 inches.

Fly ash trimmings shall be removed from the site and disposed of in accordance with all local, state, and federal regulations governing fly ash.

# **18 - CONCRETE CONSTRUCTION**

## **18.1 DESCRIPTION**

All concrete construction shall meet the requirements of Section 401 and Special Provision 07-04001-R01 of the Standard Specifications except as otherwise modified herein.

## **18.2 MATERIALS**

### **a. Mix Designs**

The mix designs shall be approved by the Kansas City Metro Materials Board as meeting the designation "KCMMB 4K" or "KCMMB 5K".

### **b. Ready-mixed Concrete**

Ready-mixed concrete shall be mixed and placed in accordance with the requirements of the Standard Specifications, except that ready-mixed concrete shall be transported with agitation. All concrete shall meet the slump requirements specified. Any addition of water shall be in accordance with the KCMMB specification and prior approval of the Engineer. A diligent effort shall be made by the Contractor and the ready-mix concrete producer to deliver concrete at regular intervals, and to maintain a uniform mix throughout each concrete pour. Concrete shall be delivered at intervals frequent enough to prevent any cold joints.

### **c. Structural Concrete Construction**

All concrete used in construction of reinforced box culverts, concrete bridges, retaining walls, and headwalls shall be classified as KCMMB 5K. The actual mixed proportions of cement, aggregates and water shall be determined by the Contractor.

### **d. KCMMB 4K Construction**

All concrete used in construction of concrete pavement and driveways, curbs and gutters, storm sewer inlets and junction boxes, concrete inverts, aprons, collars, sidewalks, integral sidewalk retaining

walls, concrete ditch liner, and median noses shall be classified as KCMMB 4K. The actual mixed proportions of cement, aggregates and water shall be determined by the Contractor.

**e. Curing**

Wet covering and waterproof covering shall conform to KDOT Sections 1405- 1407 of the Standard Specifications. Liquid membrane-forming compound shall conform to the requirements for Type 2 White Pigmented Compound as specified in AASHTO M148. Clear liquid membrane-forming compound shall not be used.

**f. Reinforcing Steel**

- (1) Reinforcing bars shall be in accordance with “Reinforcing Steel”.
- (2) Welded wire fabric shall conform to the requirements of ASTM A 185, Grade 60 and shall be supplied in sheets. Rolls shall not be used.

**g. Water**

Water shall be clean and free from deleterious substances.

**18.3 CONSTRUCTION REQUIREMENTS**

**a. Placement and Curing**

The Contractor shall provide 24 hours notice of his intention to place concrete to allow for adequate supervision.

Table 710-1 of the Standard Specifications shall be modified to require a minimum curing period of 5 days for Other Formed Surfaces.

**b. Admixtures**

KCMMB Concrete shall not be supplied with any admixtures designated as (Optional) in the Mix Design Testing Data without prior approval of the City Engineer.

Concrete admixtures will not be added to concrete after leaving the batch plant without approval of the City Engineer.

**c. Forms**

Forms shall be of steel or wood, free from warp and shall be sufficiently strong and rigid and securely staked and braced to obtain a finished product correct to the dimensions, lines and grades required. All forms must be cleaned and oiled before each use. In no case shall forms obstruct the waterways of the storm sewer system.

**d. Special Weather Conditions**

(1) Cold Weather

The Contractor shall comply fully with the provisions of ACI 306.1-90 as modified below:

- (a) Average daily temperatures as defined in ACI 306.1-90 will be determined and recorded by the City Engineer.
- (b) Concrete temperatures will be determined through the use of high-low thermometers placed and operated by the City below insulated blankets, or where the concrete is uncovered, by checking air temperatures. Uncovered concrete, which has been subjected to freezing temperatures of any duration during the first 24 hours will be considered “frozen,” and shall be rejected.
- (c) The months of December, January and February will be considered “Cold Weather” and will require concrete protection, regardless of temperature.
- (d) Concrete shall reach 75% of its design strength prior to backfilling. This strength can be determined through the use of field-cured cylinders, made and tested at contractor’s expense. Concrete must have 5 days where the average daily temperature is above 50 degrees F prior to backfilling unless field cured cylinders are taken. These days do not need to be consecutive.

(2) Concrete operations in hot weather shall conform to Section 402.07 (a) of the Standard Specifications.

**e. Backfill**

Backfill of concrete structures shall be in accordance with Section 204.3.f of the Standard Specifications.

**f. Strength Acceptance Requirements**

Cylinders used for determination of concrete strength shall be sampled and field cured in accordance with KT-22, and tested in accordance with ASTM C39. Testing frequency shall be in accordance with the City Sampling and Testing Frequency Chart. All KCMMB 4K concrete shall have a minimum compressive strength of 4000 psi at 28 days. All KCMMB 5K concrete shall have a minimum compressive strength of 5000 psi at 28 days. Concrete not meeting these strength requirements as determined by ACI 318-11 Section 5.6.3.3 shall be removed and replaced at the contractor's expense.

## **19 - PORTLAND CEMENT CONCRETE PAVEMENT**

### **19.1 SUMMARY**

This section includes the construction of Portland cement concrete pavement. This work shall be performed in accordance with Section 502 of the Standard Specifications as modified by KDOT Special Provision 07-05003, latest revision, except as otherwise modified herein.

### **19.2 MATERIALS**

**a. Concrete**

Concrete shall conform to the specifications for Kansas City Metro Materials Board (KCMMB) 4K Concrete.

**b. Entrained Air Content**

Air entrainment shall be accomplished by addition of an approved air entraining agent.

Air content shall be determined on each day of production as early and as frequently as necessary until the air content is consistently acceptable. The intended content of finished concrete is 6.0% and the "target" air content in front of the paver shall be determined to account for air loss during consolidation of concrete during slip form paving. The difference between the before and after paver air contents for a given location shall be considered the "air loss".

On the first day of paving, the "air loss" and "target" air content shall be established. Samples shall be taken at the point of acceptance (behind the paver) by the Contractor. The air loss shall be determined at a minimum of two locations. The air loss from both locations shall be averaged and added to 6.0% to establish the target air content, rounded to the next higher 0.5%. After the air loss has been established, the air content before the paver shall be the target air content plus 1.5% or minus 1.0%.

Once the target air content and air loss has been established, the air content shall be tested before the paver and shall be the target air content plus 1.5% or minus 1.0%. The air loss shall be checked at intervals determined by the City Engineer. A new target air content shall be established if the average air loss from two consecutive tests deviates by more than 0.5% from the air loss.

All testing required to establish and maintain the target air content is the responsibility and at the expense of the Contractor. No separate payment will be made for any Contractor testing required.

**c. Forms**

All forms shall be in good condition, clean, and free from imperfections. Each form shall not vary more than 1/8 inch in horizontal and vertical alignment for each 10 feet of length.

(1) Material & Size

Forms shall be made of metal and shall have a height equal to or greater than the prescribed edge thickness of the pavement slab.

(2) Strength

Forms shall be of such cross-section and strength, and so secured as to resist the pressure of the concrete when struck off, vibrated, and finished, and the impact and vibration of any equipment that they may support.

**d. Reinforcement**

(1) Steel Bars

Steel bars for concrete reinforcement shall conform to Subsection 1601 of the Standard Specifications as modified by KDOT Special Provision 07-16001-R01. Epoxy coated deformed steel bars for concrete reinforcement shall conform to Subsection 1602 of the Standard Specifications as modified by KDOT Special Provision 07-16006.

(2) Welded Steel Wire

Welded steel wire fabric shall conform to Subsection 1603 of the Standard Specifications.

(3) Supporting Elements

Representative samples of supporting elements shall be submitted and approved by the City Engineer prior to their use in the project. Supporting elements shall be epoxy coated.

**e. Expansion Joint Fillers**

Expansion joint fillers shall conform to ASTM D 1752-04a, Section 4.1. Expansion joint material shall be compatible with hot-poured joint sealing compounds.

**f. Joint Sealing Compounds**

Hot-poured joint sealing compounds shall conform to Subsection 1501 of the Standard Specifications.

**g. Curing Membrane**

All material to be used or employed in curing Portland cement concrete must be approved by the City Engineer prior to its use. It shall be of the liquid membrane type and shall conform to ASTM C 309, Type II, Class B.

**19.3 CONSTRUCTION REQUIREMENTS**

Portland cement concrete pavement shall be constructed to the configuration, and to the lines and grades shown on the plans.

**a. Grading and Subgrade Preparation**

All excavation or embankment shall be as defined in the specifications. If areas of the subgrade are below the lines and grades shown on the plans, they shall be brought to the proper line and grade by additional fill material placed in accordance with "Compaction of Earthwork". When forms are used, the top surface of the subgrade shall be checked with a template riding on the forms to assure full thickness of pavement.

**b. Forms**

(1) Installation

Forms shall be set true to line and grade, supported through their length and, joined neatly in such a manner that the joints are free from movement in any direction.

(2) Preparation

Forms shall be cleaned and lubricated prior to each use and shall be so designed to permit their removal without damage to the new concrete.

**c. Joints**

Joints shall be formed at right angles to the true alignment of the pavement and to the depths and configuration specified by the appropriate standard or as modified by the plans and specifications. The required material shall be furnished and placed by the Contractor. Sufficient fastenings shall be used to insure joint assemblies and materials remaining in position during the entire period of concrete placing, striking off, vibrating and finishing.

(1) Expansion joints

Expansion joints shall be placed at all locations where shown on the plans and standards or as directed by the City Engineer.

Expansion joints shall extend the entire width of the pavement and extend from the subgrade. The material will have a suitable tear strip or removable expansion board cap provided to allow for the application of the joint sealer.

Under no circumstances shall any concrete be left across the expansion joint at any point.

(a) Material

Expansion joints shall be formed by a one piece, 1 inch thick preformed joint filler cut to the configuration of the correct pavement section.

(b) Stability

Expansion joints shall be secured in such a manner that they will not be disturbed during the placement, consolidation and finishing of the concrete.

(c) Dowels

Expansion joints that are specified to be equipped with dowels shall have dowels of the size and type specified, and shall be firmly supported in place, by means of a dowel basket that shall remain in place. One half of each dowel shall be lightly painted or lubricated with a product approved by the City Engineer. All dowels shall be epoxy coated meeting the requirements of ASTM A934. Epoxy coating shall have a minimum 10 mil thickness.

(2) Contraction joints

Contraction joints shall be placed where indicated and to the depth indicated by the plans, specifications and standards.

(a) Method

Longitudinal and transverse contraction joints shall be sawed. When sawing joints, the contractor shall begin as soon as the concrete hardens sufficiently to prevent excessive raveling along the saw cut and shall finish before conditions induce uncontrolled cracks, regardless of the time or weather. The cut shall be approximately 1/4 inch wide, and the depth shall be one-third the thickness of the slab (minimum) or as shown in the plans.

(b) Dowels

Dowels for contraction joints shall be of the size and type specified and shall be firmly supported in place and accurately aligned parallel to the pavement line and grade with an allowable tolerance of 1/8 inch. All dowels shall be epoxy coated meeting the requirements of ASTM A934 with a minimum of 10 mil thickness.

(3) Longitudinal and Construction joints

Longitudinal joints or construction joints shall be placed as shown on the plans or where the Contractor's construction procedure may require them to be placed. Longitudinal construction joints (joints between construction lanes) shall be tied joints of the dimensions shown on the plans or standards.

Keyways shall not be allowed.

All construction joint tie bars shall be drilled and epoxy coated.

(4) Center joints

Longitudinal center joints shall be constructed using the methods specified in "Contraction joints."

(5) Transverse Construction joints

Transverse construction joints of the type shown on the plans or standards shall be placed wherever concrete placement is suspended for more than 30 minutes. The joint shall be placed in a location consistent with a planned contraction or expansion joint.

(6) Tie bars

Tie bars shall be of epoxy coated deformed steel of the dimensions specified by the plans or standards. Tie bars shall be installed at the specified spacing and secured firmly so as not to be disturbed by the construction procedure.



Tie bars shall be evenly spaced along the length of the slab and no tie bar shall be within 2 feet of a contraction joint. Tie bars shall be supported in the proper position by chairs driven into the subgrade, or may be placed by approved mechanical methods into the plastic concrete within the limits of the finishing screed. Tie bars shall NOT be inserted by driving (or “poking”) them into the finished consolidated concrete.

(7) Plastic Filler

After the pavement has been properly cured all open joints including expansion joints, construction joints, and the joints between the pavement and other structures, if any, shall be cleaned and poured full of a hot-poured joint sealing compound. The joint sealing compound shall be heated in a heater specifically manufactured for this purpose. The heat shall be controlled to within 20° F of the manufacturers recommended application temperature by a thermostat and the compound shall not be permitted to come in contact with the open flame which shall be contained in an oil bath. The compound shall be agitated to prevent segregation. The melted compound shall be poured so that the joint is filled to the level of the adjacent concrete pavement surface.

Joints shall be clean and dry before seal is poured.

**d. Placing, Finishing, Curing, and Protection**

Concrete shall be furnished in quantities required for immediate use and shall be placed in accordance with the requirements of the Standard Specifications. Prior to commencing construction, the contractor shall furnish a concrete delivery plan which includes at a minimum the number of trucks which will be dedicated to the project, the location of the concrete plant, the route and distance from the plant to the job site, and the anticipated rate of concrete usage. It is essential that concrete be delivered in sufficient quantities to prevent stoppage of the paving operation.

The concrete supplier shall have a representative on-site at all times for concrete placement operations over 200 cubic yards.

(1) Concrete Placement

The concrete shall be deposited on the subgrade to the required depth and width of the construction lane in successive batches and in a continuous operation without the use of intermediate forms or bulkheads. The subgrade shall be moistened prior to the placement of concrete. The concrete shall be placed as uniformly as possible in order to minimize the amount of additional spreading necessary. While being placed, the concrete shall be vibrated and compacted with suitable tools so that the formation of voids or honeycomb pockets is prevented.

When it is necessary to drop concrete a distance of more than three feet, troughs, pipes, or chutes shall be used as aids in placing concrete and shall be arranged and used in such a manner that ingredients of the concrete shall not be separated. Where steep slopes are required, the chutes shall be equipped with baffle boards or short lengths that reverse the direction of movement. All chutes, troughs and pipes and reinforcing steel shall be kept clean and free from coatings of hardened concrete. All troughs and chutes shall be either metal or metal lined and shall extend as nearly as possible to the point of deposit. Depositing in a large quantity at any point and running or working it along the forms in a manner which will cause segregation or separation will not be permitted. At no time shall concrete be dropped freely a distance of more than three feet.

The concrete shall be well vibrated and tamped against the forms and along all joints. Care shall be taken in the distribution of the concrete to deposit a sufficient volume along the outside form lines so that the curb section can be consolidated and finished simultaneously with the slab.

No concrete shall be placed around manholes or other structures until they have been brought to the required grade, alignment, and cross slope.

Concrete shall not be allowed to extrude below the forms.

## (2) Concrete Finishing Methods

The pavement shall be struck off and consolidated with a mechanical finishing machine. Hand finishing methods may be used for small or irregular areas. Furnish paving and finishing equipment applicable to the type of construction as follows:

### (a) Slip-form Machines

A self propelled slip form paving machine shall be used for all mainline Portland Cement Concrete Paving operations where the design speed is 40 mph or above. The slip form paver shall meet the requirements set forth in Section 154.5 of the Standard Specifications and be capable of paving at least a 24 feet wide section in a single pass.

### (b) Self-Propelled Form-Riding Machines

Shall not be used without approval of the City Engineer.

### (c) Manual Fixed-Form Paving Machines

Shall not be used without approval of the City Engineer.

### (d) Hand Methods

If hand operated equipment is used, the concrete pavement shall be struck off with a vibratory screed, cut to the crown of the pavement and weighing not less than fifteen pounds per linear foot. The screed shall rest on the side forms and be drawn forward with a sawing motion. A depth of at least two inches of concrete shall be carried in front of the strike-off screed for the full width of the slab, whenever the screed is being drawn forward. In hand finishing, the vibrating shall be so executed that all voids in a body of the concrete are closed and porous places on the surface of the concrete eliminated. Additional concrete shall be added to the remaining low places and porous spots, and the concrete restock and revibrated. The striking and compacting shall continue until the entire pavement has a uniform, even surface that is free from porous or rough spots, waves or depressions, has the required crown, and is at the specified grade.

The system and methods of vibrating shall be subject to approval of the City Engineer. Vibrating equipment shall, under no circumstances, be used as a tool for moving concrete laterally on the grade.

The concrete pavement shall be uniform in appearance, composition, density and strength. All strike boards shall be straight, free from warp, shod on the striking surface with a strip of steel, and have the required crown. They shall be not less than two feet longer than the width of the pavement unit under construction and they shall be equipped with handles so constructed that the workmen can easily manipulate them in the manner required. All strike boards and templates shall be kept well oiled and protected so that they will not warp or twist.

## (3) Concrete Finishing

### (a) Floating

All surfaces shall be consolidated and floated within 15 minutes of initial concrete placement and prior to final surface finish.

### (b) Straight edging

Straight edging in conformance with the specifications shall be used when the optional smoothness section is not used.

### (c) Surface Tolerance

After the longitudinal floating has been completed and the excess water has been removed, and while the concrete is still plastic, the slab shall be tested for trueness with a highway straightedge. The highway straightedge shall be held in successive positions parallel to the road centerline in contact with the surface and the whole area worked from one side of the slab to the other as necessary. Advancement along the pavement shall be in successive stages of not more than one half the length of the highway straightedge. Any depressions found shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. The surface shall be checked longitudinally while concrete is still plastic; correcting any surface deviations greater than 1/8 inch in 10 feet.

### (d) Edging

Before final finishing is completed and before the concrete has taken its initial set, the edges of the slab and curb shall be finished to 1/8 inch radius, or that shown on the plans or standards by the paving equipment, or with hand edging tools.

(e) Final Surface Finish

(f) Dragged Surface Treatment

Burlap shall be dragged longitudinally over the finished surface to produce a tight, uniform, textured surface, and the edges shall be rounded in a workmanlike manner for roadways with a design speed of 45 MPH or to be posted 45 MPH or less. The texture achieved by the burlap drag shall be tested by the Contractor in accordance with ASTM E 965, "Test Method for Measuring Surface Macrotexure Depth Using a Sand Volumetric Technique", to ensure the texture is adequate for skid resistance when this surface treatment is used for roadways to be posted 50 MPH or more. The City Engineer will determine test locations. The results of ASTM E 965 shall show an average texture depth of any lot, as defined below, shall have a minimum value of 0.032 inch. Any lot showing an average of less than 0.032 inch but equal to or greater than 0.024 inch will be accepted as substantial compliance but the contractor shall amend their operation to achieve the required 0.032 inch minimum depth. (It is not the intention of this tolerance to allow the contractor to continuously pave with an average texture depth of less than 0.032 inch). Any lot showing an average texture depth of less than 0.024 inch shall require diamond grinding of the pavement represented by this lot to attain the necessary texture. Any individual test showing a texture depth of less than 0.020 inch shall require diamond grinding of the pavement represented by this lot to attain the necessary texture. Limits of any failing individual test shall be determined by running additional tests at 100 foot intervals before and after the failing test location. All testing of the surface texture shall be completed no later than the day following pavement placement.

(g) Curing

As soon as practical after the concrete is finished it shall be cured with liquid curing membrane applied in accordance with the manufacturer's directions.

(h) Method of Applying Curing Membrane

A nozzle producing a uniform fan pattern will be used on all spray equipment when applying the liquid curing membrane. The curing compound should be applied after final finishing operations have been completed, and immediately after the free water has left the surface of the concrete. Two smooth coats shall be used to ensure complete coverage and effective protection, with each coat applied at an application rate not less than 300 square feet per gallon.

(i) Curing Formed Surfaces

If the forms are removed from finished concrete pavement within a period of 72 hours or if a slip form paving machine has been used, these surfaces shall also be cured. The Contractor shall repair curing membrane damaged by joint sawing operations as directed by the City Engineer.

(4) Protection

The Contractor shall, at his own expense, protect the concrete work against damage or defacement of any kind until the City Engineer has accepted it.

All vehicular traffic shall be prohibited from using the new concrete pavement until it has attained strength in accordance with Section 502 of the Standard Specifications with the following revision:

Delete Section 502.3.i.(3).(a) and replace with:

(a) Construction Traffic Only

The compressive strength of the pavement shall meet or exceed 2800 psi. Compressive strength shall be determined by testing in accordance with ASTM C39, or by the use of calibrated maturity meters. If testing is not done, a four (4) day curing period shall be observed before motorized traffic is allowed on the pavement. All costs associated with calibration of the maturity meter testing required for opening pavement to traffic shall be subsidiary to other bid items.

The Contractor shall submit a maturity testing proposal to the City Engineer and receive approval at least 30 days prior to any concrete paving. Maturity meter readings shall be taken with the Owner's representative present.

The compressive strength of the pavement shall meet or exceed 4000 psi at 28 days of cure. The compressive strength shall be determined by testing in accordance with ASTM C39.

Provide protection to keep foreign material out of the unsealed joints by an approved method.

Concrete pavement that is not acceptable to the City Engineer because of damage or defacement, shall be removed and replaced, or repaired to the satisfaction of the City Engineer, at the expense of the Contractor.

**(5) Diamond Grinding**

Grind the riding surface to reduce or eliminate the irregularities.

Use a self-propelled grinding machine with diamond blades mounted on a multi-blade arbor.

Avoid using equipment that causes excessive ravels, aggregate fractures, or spalls. Provide uniform texture the full width of the lane. Transverse grooving will not be required.

Use vacuum equipment or other continuous methods to remove grinding slurry and residue.

Prevent the grinding slurry from flowing across lanes being used by traffic.

After corrections have been made to the riding surface, test the pavement for smoothness using the same technique used to determine smoothness originally. Furnish and operate the smoothness measurement equipment, and evaluate the results as specified.

Where smoothness is determined through the use of a profilograph, run two traces in each lane that has been corrected. Run one trace three feet from the longitudinal joint between the lanes, and another trace three feet from the shoulder or curb edge of the lane. Assure that a trained and certified operator performs the profilograph testing and evaluation. Within two days after the corrections to the riding surface are made, furnish the City Engineer with the profilogram and its evaluation.

Evaluate the profilogram of the corrected riding surface in 250 foot sections per lane. The required profile index per trace is 15 inches per mile.

Perform additional grinding as required to attain the required profile index. Correct all deviations (in excess of 1/2 inch in a length of 25 feet) within each section regardless of the profile index value.

**(6) Temperature Limitation**

Concrete work shall be in accordance with the requirements of Concrete Construction specification.

**e. Backfill**

A minimum of 24 hours shall elapse before forms are removed and 5 days shall elapse, or the concrete must have attained 75% of its 28-day compressive strength, before pavement is backfilled unless otherwise approved by the City Engineer. Backfill shall be accomplished in accordance with the specifications.

The Contractor shall be responsible for the repair of any existing street pavement damaged by the construction to the satisfaction of the City Engineer.

**f. Joint Sealing and Cleanup**

All joints shall be sealed with an approved joint sealer meeting the requirements of the Standard Specifications applied in accordance with the manufacturer's directions within 7 days of the placement of the concrete and prior to the opening of the pavement to traffic.

The Contractor shall be responsible for the removal of excess dirt, rock, broken concrete, concrete splatters, and over spray from the area of the construction.

**g. Pavement Smoothness and Surface Defects**

Concrete pavement smoothness shall be in conformance with Section 502 of the Standard Specifications except as modified herein.

Average profile index shall be 710 mm/km or less per 0.1 km section.

**No price adjustments will be made based on profilograph results.**

**h. Repairing Defects**

Contractor shall develop and submit a plan to the City Engineer for approval of repair methods prior to beginning any corrective work. The repair methods should at a minimum meet the requirements of 502.3.k.

**20 - REINFORCING STEEL**

**20.1 DESCRIPTION**

All fabrication and placement of reinforcing steel shall be in conformance with Section 711 of the Standard Specifications. All reinforcing shall be as shown on the drawings and shall be held in place and positioned by pins or bar chairs or other approved devices or methods.

**20.2 MATERIALS**

Reinforcement shall be new billet ASTM A615 Grade 60 for KCMMB 5K concrete construction, or as shown on the plans. Reinforcing shall be new billet ASTM A615 Grade 40 for all other construction, or as shown on the plans.

**20.3 CONSTRUCTION REQUIREMENTS**

Reinforcing steel shall not be inserted into fresh concrete.

**21 - CURB CONSTRUCTION**

**21.1 DESCRIPTION**

Concrete curb shall be installed, or removed and replaced as shown on the plans and in accordance with the requirements of the "Concrete Construction" specification and Section 825 of the Standard Specifications except as otherwise modified herein.

**21.2 MATERIALS**

**a. Reinforcing Steel**

Reinforcement for curb and gutter shall be three No. 4 bars in accordance with "Reinforcing Steel".

**b. Concrete**

Concrete for curb and gutter shall be in accordance with "Concrete Construction".

**21.3 CONSTRUCTION REQUIREMENTS**

**a. Concrete Placement**

A slip form curb machine, with electronic control, shall be required on all continuous curb construction of lengths greater than 100 feet.

The concrete shall not be placed until the subgrade has been inspected for compaction and moisture. The concrete shall be consolidated with an approved internal type vibrator. The surface shall be shaped by use of a steel tool to produce the sections shown on the drawings. The edges shall be rounded with edgers to form the radii indicated on the drawings.

The surfaces shall be finished with a wooden or metallic float and brushed. All concrete shall be cured in accordance with the "Concrete Construction" specification.

**b. Reinforcement**

No reinforcement shall be required when curb and gutter is laid on four inches or more of asphaltic concrete base.

**c. Joints**

All joints shall be formed at right angles to the alignment of the curbing.

(1) Expansion Joints

Expansion joints shall be placed at points of curvature, curb returns, curb inlet transitions, and at intervals not to exceed 250 feet. The expansion joints shall consist of one-half inch premoulded bituminous, nonextruding and resilient expansion joint material cut to the configuration of the curb section. The material shall extend through the full curb section. The edges of the joints shall be rounded with an edging tool of one-quarter inch radius.

After curing, the joints shall be sealed with urethane sealant meeting ASTM C 920. The sealant shall be Class 35 ( $\pm 35\%$  Joint Movement), Type S and Grade NS.

(2) Contraction Joints

Curbing shall have contraction joints formed at 15 feet intervals. They shall extend across the entire curb section. The cut shall be approximately 1/4 inch wide, and the depth shall be one-third the thickness of the curb (minimum) or as shown in the plans. The contraction joints may be formed by any approved method. If sawing joints, the contractor shall begin as soon as the concrete hardens sufficiently to prevent excessive raveling along the saw cut and shall finish before conditions induce uncontrolled cracks, regardless of the time or weather.

**d. Line and Grade**

The new concrete curb and gutter shall be accurately placed in accordance with the line and grade as established by the Engineer. Curbs shall be formed to the cross section as shown on the drawings with a mule; or templates supported on the side forms and with a float not less than 4 feet in length, for hand placed curb.

The finished surface of the curb and gutter shall be checked for no more than 1/4 inch deviation, by the use of a 10 foot straightedge, and corrected if necessary. Where grades are flat and while the concrete is still plastic, the drainage of the gutter should be checked with a 4 foot carpenter's level.

**e. Finish**

The surfaces of curb and gutter shall be finished with a wooden or steel float and broomed. Brooming shall be perpendicular to the curb line. The brooming operation shall be so executed that the marks will be uniform in appearance and not more than one-sixteenth inch in depth. Brooming shall be completed before the concrete is in such condition that it will be torn or unduly roughened and before the concrete has attained its initial set.

**f. Curing and Backfilling**

(1) Curing

Concrete curbs and gutters shall be cured in accordance with "Concrete Construction".

(2) Backfilling

Backfilling operations shall not commence prior to the completion of the curing period, or until the concrete attains 75% design strength, as shown by compressive tests of field cured cylinders. All backfill material shall consist of soil suitable for vegetation. The area shall be prepared such that sod can be placed on bare soil.

**g. Notification of Property Owner**

The City will give advance notice to property owners whose curb has been marked for repairs. The Contractor shall notify each property owner when the work will actually commence.

## 22 - CONCRETE PAVER STONES

### 22.1 DESCRIPTION

Solid concrete paver stones shall be used in the medians or as shown on the plans.

#### a. Work Included

Supply and place sand laying course.

Supply and install interlocking concrete paver stones in quality, shape, thickness and color as specified.

Supply and place all accessory items as required by the contract.

#### b. Product Handling

Paver stones shall be delivered and unloaded at jobsite on pallets and bound in such manner that no damage occurs to the product during handling, hauling and unloading.

### 22.2 MATERIALS

#### a. Interlocking Concrete Paver Stones

Paver stones shall be red, cobblestone style, in accordance with ASTM C936. The layer should consist of full stones, (4 5/8" X 7" X 2 3/8"); two thirds stones, (4 5/8" X 4 5/8" X 2 3/8"); and one third stones, (4 5/8" X 2 5/16" X 2 3/8"), or as approved by the City Engineer. The mix of stones sizes shall be approximately 28% full size, 57% two thirds size and 15% one third size.

#### b. Concrete Base Course

The concrete base course shall be KCMMB 4K concrete. The concrete base course shall be the responsibility of the paver stone installer.

#### c. Sand Laying Course

The sand laying course shall be a well graded, clean washed, sharp sand with 100% passing a 3/8" sieve size and a maximum of 3% passing a No. 200 sieve size. This is commonly known as manufactured concrete sand, limestone screening, or similar. Mason Sand will not be permitted. The sand laying course should be the responsibility of the paver stone installer.

### 22.3 CONSTRUCTION REQUIREMENTS

Prior to commencing placement of the concrete paver stones, submit to the City Engineer a sample stone for each color. No stones shall be installed prior to approval by the City Engineer.

#### a. Installer

The paver stone installer/contractor must have related experience in the installation of interlocking concrete paver stones.

#### b. Concrete Base Course

The concrete base course shall be shaped to the grade and cross section as shown on the plans with an allowable tolerance of 1/4". The base course shall be 3-3/8" below finish grade for 2-3/8" pavers.

#### c. Construction of the Sand Laying Course

The finished base course shall be approved before the placement of the sand laying course. The uncompacted sand laying course shall be spread evenly over the area to be paved and then screened to a level that will produce 1" thickness when the paver stones have been placed and vibrated. Once screened and leveled to the desired elevation, the sand laying course shall not be disturbed in any way.

#### d. Laying of Concrete Paver Stones

The paver stones shall be installed in rows perpendicular to the major axis of the median being paved. Within each row the stone sizes shall be randomly mixed so that joints between stones are not normally aligned with joints between stones in adjacent rows. No joints shall be aligned for more than three consecutive rows. The paver stones shall be laid in such a manner that the desired pattern is maintained and the joints between the stones are as tight as possible. For maximum interlock it is

recommended that joints between stones do not exceed 1/8". String lines should be used to hold all pattern lines true.

All edges of the installed paver stone shall be restrained by the concrete curb, concrete sidewalk, or suitable method of preventing movement of edge stones.

The gaps at the edge of the paver surface shall be filled with standard edge stones or with stones cut to fit. Curing shall be accomplished to leave a clean edge to the traffic surface using a double-headed breaker or a masonry saw. However, when cutting precision designed areas, a masonry saw is recommended. Whenever possible, no cuts should result with a paver less than 1/3 of original dimension.

Paver stones shall be vibrated to their final level in the sand laying course by two or three passes of a vibrating compactor capable of 3,000 to 5,000 pounds compaction force with the surface clean and joints open. After vibration, clean concrete sand containing at least 30% of 1/8" particles shall be spread over the paver stone surface, allowed to dry, and vibrated into the joints with additional passes of the plate vibrator so as to completely fill the joints.

Surplus material shall then be swept from the surface. Upon completion of work covered in this Section, the Contractor shall clean up all work areas by removing all debris, surplus material and equipment from the site.

After final vibrating, the surface shall be true to grade and shall not vary by more than 1/4" when tested with a 10' board at any location on the surface.

## **23 - DRIVEWAY ENTRANCES**

### **23.1 DESCRIPTION**

This work shall consist of the construction of driveway entrances in accordance with the Specifications and conformance to the lines and grades shown on the drawings or as approved by the City Engineer.

### **23.2 MATERIALS**

#### **a. Concrete**

Portland Cement Concrete shall be classified as KCM MB 4K in accordance with "Concrete Construction".

#### **b. Concrete Pavers**

Concrete pavers shall be in accordance with "Concrete Paving Stones"

### **23.3 CONSTRUCTION REQUIREMENTS**

Residential driveway entrances shall be a minimum of six inches of concrete or concrete paver brick within the public right-of-way except in RE District where a dust-free surface must be maintained.

Commercial driveway entrances and driveway entrances other than a R-1, RE or R-2 zoned unit shall be a minimum of six inches of non-reinforced concrete.

For residential driveways with concrete pavers four inches of concrete or commercial grade asphalt shall be used as a base plus one inch of bedding sand. For commercial driveways with pavers, six inches of concrete or commercial grade asphalt shall be used as a base plus one inch of bedding sand. Edge restraint must be provided in any case to confine the paved section to the design dimensions.

All joints in concrete driveways shall be tooled, or as approved by the City Engineer. Joints shall be tooled after brooming to provide a "picture frame" appearance.



## **24 - PRIVATE DRIVES AND PARKING AREAS OUTSIDE OF PUBLIC RIGHT-OF-WAY**

### **24.1 DESCRIPTION**

This work shall consist of the construction requirements of all privately-funded private drives and parking areas constructed outside of public right-of-way, except for single family driveways.

These specifications shall apply to new construction and reconstruction of all private drives and parking areas outside of public right-of-way, except for residential developments located in the A, R-1, R-1A, RE, RP-OE and RP-OS zoning districts.

### **24.2 MATERIALS**

The materials shall comply with the design engineer's specifications and the approved geotechnical report. If a geotechnical report is not provided, the minimum design standards included in Table IV of the Design and Construction Standards may be used in lieu of a pavement design.

### **24.3 CONSTRUCTION REQUIREMENTS**

Earthwork operations shall be performed in compliance with the construction documents and recommendation provided within the geotechnical report when provided. Materials and operations shall meet industry standards with regards to suitable material, moisture content, and density.

Construction of all private drives and parking areas under the jurisdiction of this section are subject to inspection and acceptance by the City.

The area designated for private drive and parking areas shall be free of mud, ruts, standing water and other adverse conditions prior to commencement of paving operations.

The contractor shall notify the City a minimum of 24 hours prior to the placement of any concrete curb and gutter or commencement of any paving operation.

At the completion of subgrade preparation and prior to the placement of aggregate, curb or pavement, the Contractor shall demonstrate that the subgrade is adequately compacted by providing to the City inspector, a special inspection certification from a certified geotechnical testing company..

A City inspection shall be performed at final completion of the project prior to a certificate of completion being provided.

If asphalt is proposed, it shall be placed in maximum compacted lift thickness of no more than 4 inches.

## **25 - TYPE I STREET REPAIR**

### **25.1 DESCRIPTION**

This item of work shall consist of repair of existing roadway pavement damaged by construction of the proposed utility conduit. All roadway repair shall conform to the requirements of Section 833 of the Standard Specifications except as otherwise modified herein.

### **25.2 CONSTRUCTION REQUIREMENTS**

Repair shall be accomplished by first determining the width of trench required to excavate for the various sizes of storm sewer pipes involved. All excavated material and pavement shall be removed from the site and not used for backfill. All trench walls shall be in a vertical plane. Shoring and bracing shall be used when necessary to prevent undercutting of undisturbed pavement.

Trenching shall be backfilled with removable flowable fill to within 8 inches of the pavement surface. A minimum 12 inch bench shall be provided on each side of the trench and a pavement base consisting of 6 inches of high early strength KCM MB 4K concrete shall be placed for the full width of disturbed pavement area. The concrete course shall be placed to 2 inches below the existing surface course. Once the concrete has reached a minimum compressive strength of 3,000 psi tack coat shall be applied and

2 inches of asphaltic concrete surface course placed and compacted to a density in accordance with the requirements set forth in “OVERLAND PARK SUPERPAVE ASPHALTIC CONCRETE SURFACE AND INTERMEDIATE COURSE”. The surface of the patch shall match existing grade and cross slope of the surrounding pavement.

## **26 - TYPE II STREET REPAIR**

### **26.1 DESCRIPTION**

This item of work shall consist of repair of existing roadway pavement damaged by construction of the proposed storm sewer. All roadway repair shall conform to the requirements of Section 833 of the Standard Specifications except as otherwise modified herein.

### **26.2 CONSTRUCTION REQUIREMENTS**

Type II Street Repair may be used only if excavation width exceeds 6 feet and with the approval of the City Engineer.

Repair shall be accomplished by first determining the width of trench required to excavate for the various sizes of storm sewer pipes involved. All excavated material and pavement shall be removed from the site and not used for backfill. All trench walls shall be in a vertical plane. Shoring and bracing shall be used when necessary to prevent undercutting of undisturbed pavement.

Trenching shall be backfilled removable flowable fill to within 8 inches of the pavement surface. A minimum 12 inch bench shall be provided on each side of the trench. Two 3 inch lifts of asphalt concrete intermediate course shall be placed for the full width of disturbed pavement area. The remaining 2 inches shall be asphaltic concrete surface course placed and compacted to a density in accordance with the requirements set forth in “OVERLAND PARK SUPERPAVE ASPHALTIC CONCRETE SURFACE AND INTERMEDIATE COURSE”. Tack coat shall be applied between all lifts of asphaltic concrete. The surface of the patch shall match existing grade and cross slope of the surrounding pavement.

## **27 - FLOWABLE FILL**

### **27.1 DESCRIPTION**

The contractor shall use low strength flowable fill as shown in the Plans and in accordance with Section 843 of the Standard Specifications except as otherwise modified herein.

### **27.2 MATERIALS**

A flowable fill mix design shall be submitted to the City Engineer for approval and shall be such that it can be pumped. The contractor shall submit a laboratory mix design that shows compliance with the Low-Strength Mixture compressive strength and unit weight requirements shown in Table 843-1.

Unit weight testing will be performed at a frequency in accordance with the City Sampling and Testing Frequency Chart as outlined in the section entitled “Portland Cement Concrete Structures and Miscellaneous Construction.”

The Engineer will accept the flowable fill based on the visual inspection of the mixture placed on the project. Compressive strength tests will not be performed unless ordered by the Engineer to confirm compliance with the approved mix design. Mix designs may be approved for all projects and will remain in effect unless material sources or batch weights change. Flowable fill that fails tests will be removed and replaced at contractor’s expense as directed by the Engineer.

### **27.3 CONSTRUCTION**

No removable flowable fill shall be placed on frozen subgrade. Insulating blankets shall be required to protect flowable fill from cold weather. All flowable fill provided to the project must include a delivery ticket with batch weights of all materials and admixture dosages.

## **28 - CONCRETE SIDEWALK CONSTRUCTION**

### **28.1 DESCRIPTION**

All sidewalk construction shall be constructed to the lines and grades shown on the Drawings or established by the City Engineer.

### **28.2 MATERIALS**

All sidewalks shall be constructed using Portland Cement Concrete or concrete paver brick. Portland Cement Concrete and concrete paver brick shall conform to “Concrete Construction” and “Concrete Paver Stones”, respectively.

All concrete used in construction of sidewalks shall be classified as KCM MB 4K.

### **28.3 CONSTRUCTION REQUIREMENTS**

All sidewalks shall be constructed in compliance with the American with Disabilities Act of 1990, 42 U.S.C. 12101 et seq.

#### **a. Location**

All public sidewalks constructed within the City shall be located in the public right-of-way or within a public sidewalk easement. The standard location shall be one foot from the right-of-way or easement line, except when a ditch section is used in RE Districts where they shall be one foot from the shoulder. Sidewalks shall be constructed to allow access to all pedestrian signal actuation devices.

#### **b. Dimensions**

The width of any sidewalk repair shall be the same as that being replaced. The width of new sidewalk construction shall be as indicated on the plans. The minimum width of public sidewalks shall be four feet with a five foot square passing space every 200 feet. The minimum width of public sidewalks along thoroughfare corridors shall be five feet. The minimum allowable thickness shall be four inches, except within a driveway approach area, where the minimum allowable thickness shall be six inches. Sidewalks constructed with concrete paver brick shall meet the following specifications: Four inches of concrete shall be used as a base plus one inch of bedding sand for the pavers. Edge restraint must be provided in any case to confine the paved section to the design dimensions.

#### **c. Grades and Slopes**

The grade or slope along the length of the walk shall be as near parallel to the street gradient as practical. The maximum longitudinal slope shall be one inch per foot, except where a variance from street grade has been approved by the City Engineer. The cross slope shown on the Overland Park Standard Details is one foot per 100 feet or 1%; with the intention of enforcing a 2% maximum with absolutely no tolerance for exceeding 2%, due to Federal requirements. This maximum cross slope standard also applies when the walk crosses drives and shall slope toward the street, except in RE Districts where a ditch section is used. The finish grade of the sidewalk shall be such that the slope of the finish grade between the curb and the sidewalk will not exceed one-half inch per foot and will not be less than one-quarter inch per foot and shall slope toward the street, except in RE Districts where a ditch section is used.

#### **d. Subgrade Preparation**

The subgrade shall be uniformly compacted to a Type B density of 90% with a moisture range of MR-90. The subgrade shall be evenly graded to the required subgrade elevation. All loose or extraneous material shall be removed from the subgrade and soft spots shall be uniformly recompacted prior to

placement of concrete. Sidewalk concrete material shall not be placed on frozen subgrade. The Contractor shall have available adequate hand or mechanical compaction equipment to accomplish the compaction as set forth in these specifications. The subgrade shall be properly moistened prior to placing concrete.

**e. Forms**

All forms shall be sufficiently strong and rigid and securely staked and braced to obtain a finished product correct to the dimensions, lines and grades required. Forms may be of steel or wood at the option of the contractor.

Each form shall not vary more than one-quarter inch in longitudinal and vertical alignment for each ten feet in length. All forms must be cleaned and oiled before each use. A slip-form machine, equipped with electronics, may be used in lieu of forms. The machine shall be equipped with mechanical internal vibrators and shall be capable of placing the finished sidewalk to the correct cross section, line and grade as required in this section. Adjustments of the string line and/or slip-form machine shall be made to give a smooth and accurate line and grade.

**f. Reinforcing**

Reinforcing of sidewalks will not be required except in unusual conditions where the City Engineer may require reinforcing or welded wire fabric. When welded wire fabric is used it shall be placed two inches (2") from the finished surface of the sidewalk. The reinforcement shall be supported using set spacing such that between the supports, the reinforcement does not deflect or sag excessively. There will be no direct payment for this item, and it shall be subsidiary to the unit price bid for sidewalk replacement.

**g. Placing and Finishing Concrete**

The contractor shall provide adequate tools and equipment to produce quality workmanship in placing and finishing concrete. The sidewalk and ramps shall be finished to the top of the forms and the surface finished with a wood or steel float and surface texture shall be a course broom finish transverse to the slope of the sidewalk or ramp. No "plastering" of the surface shall be permitted.

(1) Contraction Joints

The sidewalk surface shall be marked off into nominal squares of dimensions equal to the width of the sidewalk with a maximum distance between joints of seven feet.

All joints in formed concrete sidewalks shall be tooled. Joints shall be tooled after brooming to provide a "picture frame" appearance. A standard joint tool having a width of one-eighth inch and one inch deep having a lip radius of one-eighth inch to one-quarter inch shall be used in forming the joints.

All joints in slip-formed concrete sidewalks shall be sawed. If sawing joints, the contractor shall begin as soon as the concrete hardens sufficiently to prevent excessive raveling along the saw cut and shall finish before conditions induce uncontrolled cracks, regardless of the time or weather.

(2) Expansion Joints

Expansion joints shall be constructed at locations where the sidewalk abuts existing concrete curbs, driveways, and similar structures, and every two hundred fifty feet and as shown on approved plans. Expansion joints shall be formed with one-half inch prefabricated non-extruding filler and shall extend the full depth of the slab.

**h. Curing Concrete**

Sidewalk slabs shall be cured either by wet covering, waterproof covering, or liquid membrane-forming compound in accordance with "Concrete Construction". The curing period shall be a minimum of five days. Curing shall be commenced as soon as possible after the finishing operation and when the concrete has set sufficiently so that it will not be damaged in the process.

**i. Backfilling Concrete**

Backfilling operations shall not commence prior to the completion of the five day curing period, or until the concrete attains 75% of design strength. All backfill material shall consist of soil suitable for vegetation. The area shall be prepared such that sod can be placed on bare soil.

**j. Right-of-Way Limits**

All sidewalks to be replaced are located within the public street right-of-way and generally not closer than one foot from the right-of-way line. The Contractor shall confine his work to the right-of-way limits unless express approval of the property owner has been granted to the Contractor. The City Engineer shall be informed as to any such arrangements that the Contractor makes on his behalf in these matters. The Contractor shall contact the City Engineer or his authorized representative in the case there is any question as to right-of-way width.

**k. Notification of Property Owner**

The City will give advance notice to property owners whose sidewalk has been marked for repairs. The Contractor shall notify each property owner when the work will actually commence.

**29 - SIDEWALK RAMPS**

**29.1 DESCRIPTION**

This work shall be constructed in accordance with the lines and grades shown on the Drawings.

**29.2 CONSTRUCTION REQUIREMENTS**

**a. Wheelchair Accessible Curb Ramps**

Wheelchair accessible curb ramps shall be constructed at all street crossings. Maximum desirable slope of ramps shall be one inch per foot. Minimum width shall be four feet, except along thoroughfare corridors where the width shall be five feet. The minimum allowable thickness for wheelchair accessible curb ramps shall be six inches. Curbs at ramp locations must provide a gradual transition from gutter line to back of curb, not exceeding one inch in height or slopes of greater than one inch per foot. Side slopes of ramps shall not exceed one inch per foot where such side slopes are in the normal path of pedestrians on adjacent portions of sidewalk. If the street curb has not been constructed to receive the sidewalk ramp, the sidewalk constructor shall remove a section of the curb and reconstruct as required.

Ramps shall be constructed with or without a detectable warning surface as specified on the plans. Type M mortar shall be used for the setting bed and grouted joints for the detectable warning surface paver bricks in accordance with ASTM C270, Table 1 (Masonry Cement Type only).

**30 - INTEGRAL SIDEWALK RETAINING WALL**

**30.1 DESCRIPTION**

Integral sidewalk retaining walls of reinforced concrete shall be constructed at location shown on the plans and in accordance with details shown on the plans, and the requirements of Section 710 of the Standard Specifications.

**30.2 MATERIALS**

Concrete and reinforcing steel shall meet the requirements herein under "Concrete Construction", and "Reinforcing Steel".

**30.3 CONSTRUCTION REQUIREMENTS**

All form ties used for construction of retaining walls shall be of an approved type so as to have a minimum breakback of 1/2 inch. All tie holes shall be grouted and all form marks shall be removed with a diamond grinder or approved equal.

## 31 - STORM SEWERS

### 31.1 DESCRIPTION

All storm sewers, structures and appurtenances shall be located as shown on the plans and as determined by the Engineer.

### 31.2 MATERIALS

#### a. Concrete Pipe

##### (1) Pipe

Except as modified or otherwise provided in this chapter, the manufacture of concrete pipe shall be governed by ASTM C-76, ASTM C-506 and ASTM C-507. Except for fittings and closure pieces, each piece of the pipe shall not be less than eight feet long for pipe diameters 48 inches or less and shall not be less than six feet long for pipe diameters larger than 48 inches.

The wall thickness of concrete pipe shall be not less than Wall B.

The pipe class in each case shall be as designated on the plans, and shall not be less than Class III.

##### (2) Reinforcement

Circumferential reinforcement shall be full-circle type. Elliptical or part-circle reinforcement will not be approved. All reinforcing shall be located and spaced as recommended by the pipe manufacturers.

##### (3) Joints

Rubber gasket joints shall be required for all round pipe. Mastic joints shall be required for all other pipe shapes.

The City Engineer reserves the right to require joint testing on pipe sections, either at the plant or in place, as designated by the City Engineer to demonstrate compliance.

##### (4) Rubber Gasket Joints

Rubber gasket joints shall conform to ASTM C 1628-06 with the following additions and exceptions:

(a) Replace ASTM C 1628-06 5.1.1 with: Circular Cross-Section or "O-Ring" Gaskets for standard use shall meet Class A requirements. Non-Circular Cross-Section or "Profile" Gaskets for standard use shall meet Class E requirements.

(b) Replace ASTM C 1628-06 9.4 with: The manufacturer shall conduct concurrently the hydrostatic test described in 9.2 and the structural test described in 9.3. If proven watertight under these combined conditions, hairline cracks that do not leak shall not be cause for rejection. A vacuum test, run in accordance with the current written plant certification procedures of the American Concrete Pipe Association, may be used in lieu of the hydrostatic test referenced above.

(c) Joint design details shall be submitted for approval together with design data and test results verifying the adequacy of the joint design.

(5) Fine aggregate shall consist of clean natural sand conforming to ASTM C-33. Artificial or manufactured sand will not be approved.

##### (6) Lift Holes

Lift holes are prohibited for all concrete storm sewer pipes.

(7) No concrete pipe shall be delivered to the site of the work until concrete control cylinders representing such pipe shall have attained a compressive strength of at least 80% of the specified minimum 28 day strength.

**b. Corrugated Metal Pipe**

(1) All corrugated metal pipe shall be fabricated from galvanized iron corrugated metal sheets, aramid polymeric fiber bonded on both sides and bituminous coated. The U.S. Gauge number shall, in each case, be as designated on the plans, and as recommended by the manufacturer of the pipe for the depth of installation and classification of soil.

(2) The aramid polymeric fiber mat shall be embedded in the zinc on both sides of the metal sheets at the time of galvanizing and before the zinc has solidified. All work shall conform to AASHTO M-36 for base metal and galvanizing and to AASHTO M-190 for bituminous coating. All joints in corrugated metal pipe shall be made using watertight coupling bands, not less than twelve inches wide, fabricated from the same material as the pipe and coated in the same manner. Each coupling band shall be lubricated sufficiently to insure that the corrugation of the band seats into the corrugations of the two pipes being joined, when the bolts are tightened.

(3) Corrugated Metal Pipe manufacturer's certification shall be submitted to the City Engineer.

**c. Concrete Lined Ditch**

Concrete shall be as specified in "Concrete Construction". Wire fabric shall conform to ASTM A-185. Wire fabric shall be supplied in flat sheet form.

**d. Embedment**

Embedment materials both below and above the bottom of the pipe, the classes of embedment to be used, and the placement and compaction of embedment materials shall conform to the requirements shown in the current Standard Details and to the supplementary requirements in this section.

**e. Tamped Backfill**

All backfill materials shall be in conformance with the City's Manual of Infrastructure Standards for Right of Way Restoration as promulgated by the City Engineer.

**f. Special Pipe**

All special pipe sections necessary to complete the storm sewer system as shown on the plans shall be furnished by the Contractor. These sections shall include, but not be limited to, drop joint or radius pipe, bends, tees, and Type III end sections. The pipe manufacturer shall provide shop drawings indicating the exact methods to be used to achieve the lines and grades indicated on the plans, including a pipe laying schedule, and the configuration and number of any special pipe sections. All special pipe sections used shall be subsidiary to other bid items.

**31.3 CONSTRUCTION REQUIREMENTS**

**a. Location and Grade of Sewers**

The grade and alignment of the pipe shall be determined and maintained from tacked offset stakes located alongside the trench upon which cuts and elevations have been established by the Contractor. Pipe alignment during construction shall be maintained by the use of laser alignment equipment. A minimum of eighteen inches of cover shall be maintained over the storm sewer pipe.

**b. Post Construction Video**

Once installation and backfill of the proposed storm sewer has been completed and all grading over and around the storm sewer is completed, the Contractor shall be responsible for video taping each run of storm sewer pipe, less than 60 inches in diameter, to verify that the segment of pipe is in sound, stable condition and that no failures have occurred during construction. This video shall be delivered to the City Engineer for approval prior to any permanent pavement being placed over any said storm sewer. The development and delivery of this video shall be considered subsidiary to other bid items.

**c. Blasting**

The contractor shall comply with all laws, ordinances, applicable safety code requirements, and regulations relative to the handling, storage, and use of explosives and the protection of life and property. He shall be responsible for all damage caused by his blasting operations. All blasting within the City shall conform to City Ordinance Chapter 5.36 for Explosive and Blasting Agents.

Suitable weighted plank coverings or mattresses where required shall be provided to confine all materials lifted by blasting within the limits of the excavation or trench.

All rock which cannot be handled and compacted as earth shall be kept separate from other excavated materials and shall not be mixed with backfill or embankment materials except as specified or directed.

**d. Unauthorized Excavation**

Except where otherwise authorized, shown or specified, all material excavated below the bottom of concrete walls, footings, slabs on grade, and foundations shall be replaced by and at the expense of the contractor, with concrete placed at the same time and monolithic with the concrete above.

**e. Removal of Water**

The contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed, therein is completed to the extent that no damage from hydrostatic pressure, flotation, or other causes will result.

All excavations for concrete structures or trenches which extend down to or below the static ground water elevations shall be dewatered by lowering and maintaining the ground water surface beneath such excavations a distance of not less than 12 inches below the bottom of the excavation.

Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without causing damage to adjacent property.

The contractor will be held responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipes or conduits shall be left clean and free from sediment.

**f. Sheet piling and Shoring**

Except where banks are cut back on a stable slope, excavation for structures and trenches shall be properly and substantially sheeted, braced, and shored, as necessary, to prevent caving or sliding, to provide protection for the workmen and the work, and to provide protection for existing structures and facilities. Sheet piling, bracing and shoring shall be designed and built to withstand all loads that might be caused by earth movement or pressure, and shall be rigid, maintaining shape and position under all circumstances. The contractor shall brace and shore all trenches in full accordance with Occupational Safety and Health Standards - Excavations; Final Rule 29 CFR Part 1926.

**g. Stabilization**

Trench bottoms and subgrades for concrete structures shall be firm, dense and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workmen.

Trench bottoms or subgrades for concrete structures which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with one or more layers of crushed stone or gravel. Not more than one-half inch depth of mud or muck shall be allowed to remain on stabilized trench bottoms when the pipe bedding material is placed thereon. The finished elevation of stabilized subgrades for concrete structures shall not be above the subgrade elevations shown on the plans.

**h. Crushed Rock or Gravel Fills**

Crushed rock or gravel fills shall be placed on a suitably prepared subgrade and tamped to the extent necessary for consolidation. Crushed rock or gravel shall be free from dust, clay, or trash and shall be graded one and one-half inches to No. 4 as defined in ASTM C 33-05.



Where crushed rock or gravel fills are to be covered with concrete after the fills have been installed, the top surface thereof shall be graded to the required subgrade surface and covered with polyethylene film.

**i. Trench Excavation**

The contractor shall not open more trench in advance of pipe laying than is necessary to expedite the work. One block or 400 feet (whichever is the shorter) shall be the maximum length of open trench permitted on any line under construction. Except where tunneling is shown on the plans or is permitted by the City Engineer, all trench excavation shall be open cut from the surface.

**j. Alignment, Grade and Minimum Cover**

The alignment and grade or elevation of each pipeline shall be fixed and determined by means of offset stakes. An approved laser beam may be used in addition to offset stakes. Vertical and horizontal alignment of pipes, and the maximum joint deflection used in connection therewith, shall be in conformity with the requirements of the specification covering the installation of the pipe being laid in each case.

Where pipe grades or elevations are not definitely fixed by the contract drawings, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of the pipe of eighteen inches.

**k. Limiting Trench Widths and Pipe Clearances**

Trenches shall be excavated to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing, and embedment. However, the limiting trench widths below an elevation six inches above the top of the installed pipe, and minimum permissible clearances between the installed pipe and either trench wall, shall be as shown in the current Standard Details.

The stipulated minimum clearances shown in the table are not minimum average clearances, but are minimum clear distances which will be permitted between any part of the pipe as laid and any part, projection or point of rock, shale, stone or boulder.

Where necessary to reduce the earth load on trench banks to prevent sliding and caving, the banks may be cut back on slopes which shall not extend lower than one foot above the top of the pipe.

**l. Unauthorized Trench Widths**

Where for any reason, the width of the lower portion of the trench as excavated at any point exceeds the maximum permitted either pipe of adequate strength, special pipe embedment, or arch concrete encasement, as required by loading conditions and as determined by the City Engineer, shall be furnished and installed.

**m. Mechanical Excavation**

The use of mechanical equipment will not be permitted in locations where its operations would cause damage to trees, buildings, or other existing property, utilities, or structures above or below ground; in all such locations, hand-excavating tools and methods shall be used.

Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be so operated that the rough trench excavation bottom elevation can be controlled, that uniform trench widths and vertical side walls are obtained at least from an elevation one foot above the top of the installed pipe to the bottom of the trench, and that the trench alignment is such that the pipe when accurately laid to specified alignment, will be centered in the trench with adequate clearance between the pipe and side walls of the trench. Undercutting of the trench sidewall to obtain clearance will not be permitted.

All mechanical trenching equipment, its operating condition, and the manner of its operation, shall be subject at all times to the approval of the City Engineer.

**n. Excavation Below Pipe Subgrade**

Except where otherwise required, pipe trenches shall be excavated below pipe subgrade elevations, as shown in the current Standard Details on file in the office of the City Engineer, to provide for the installation of granular foundation material.

**o. Artificial Foundations in Trenches**

Whenever so ordered by the City Engineer, the contractor shall excavate to such depth below grade as the City Engineer may direct, and the trench bottom shall be brought to grade with such materials as the City Engineer may order installed. All timber, concrete foundations, wooden inverts, pipes, posts, stringers, and/or saddles, made necessary by quicksand or other treacherous soil, shall be installed as directed by the City Engineer.

**p. Bell Holes**

Bell holes shall provide adequate clearance for the tools and methods used in installing the pipe. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or the granular fill when the pipe is jointed.

**q. Placement and Compaction**

All granular fill material beneath the pipe shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. It will be permissible to slightly disturb the finished subgrade surface by the withdrawal of pipe slings or other lifting tackle.

After each pipe has been graded, aligned, placed in final position on the bedding material, and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to firmly hold and maintain the pipe in proper position and alignment during subsequent pipe jointing, embedment, and backfilling operations.

Embedment material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement of the pipe. Tamped backfill materials shall be placed in uniform layers and shall have a moisture content ensuring that the maximum density will be obtained with the compaction method used.

**r. Trench Backfill**

All trench backfill above pipe embedment shall conform to the following requirements.

(1) Tamped Backfill

Tamped Backfill is only allowable within unpaved areas of the ROW. It may also be used outside of the ROW and when backfilling Sanitary Sewer installations.

Materials for tamped backfill and the method of placement and compaction thereof shall be as specified for tamped backfill for pipe embedment, Subsection Tamped Backfill.

(2) Flowable Fill

Flowable Fill is required within all paved portions of the ROW including future paving, if they are known, per the Manual for Infrastructure Standards For Right of Way Restoration and City of Overland Park Standard Details.

(3) Structure Backfill

Backfill around structures shall be compacted, to the extent necessary to prevent future settlement, by tamping, placement of flowable fill, or other means approved by the City Engineer. Flowable fill is required around all structures within paved portions of the ROW including future paving, if they are known.

Material for backfill shall be as specified in this Chapter, Section Materials. and shall contain no wood, grass, roots, broken concrete, stones, trash, or debris of any kind. No tamped or otherwise mechanically compacted backfill shall be deposited or compacted in water.

**s. Drainage Maintenance**

Trenches across roadways, driveways, walks, or other trafficways adjacent to drainage ditches or water courses shall not be backfilled prior to the completion of backfilling of the trench on the upstream side of the trafficway to prevent the impounding of water after the pipe has been laid. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by the contractor. Backfilling shall be done so that water will not accumulate in unfilled or partially filled trenches. All material deposited in roadway ditches or other water courses crossed by the

line of trench shall be removed immediately after backfilling is completed and the section grades and contours of ditches or water courses shall be restored to their original condition. Surface drainage shall not be obstructed longer than necessary.

**t. Protection of Trench – Backfill in Drainage Courses**

Where trenches are constructed in or across roadway ditches or other watercourses, the backfill shall be protected from surface erosion by adequate means. Where the grade of the ditch exceeds one percent, suitable ditch checks as approved by the City Engineer shall be installed as directed. Ditch checks may be creosote lumber, stone, or concrete as authorized. In any case, the ditch check shall extend not less than two feet below the original ditch or watercourse bottom for the full bottom width and not less than 18 inches into the side slopes thereof.

**u. Disposal of Excess Excavated Materials**

Except as otherwise permitted, all excess excavated materials shall be disposed of away from the site of the work.

Excess earth from excavations located in unimproved property shall be distributed directly over the pipe trench and within the pipe line right-of-way to a maximum depth of six inches above the original ground surface elevation at and across the trench, and sloping uniformly each way therefrom. Material thus wasted shall be carefully finished with a drag, blade machine, or other suitable tool to a smooth uniform surface without obstructing drainage at any point. Wasting of excess excavated material in the above manner will not be permitted where the line of trench crosses or is within a railroad, public road, or highway right-of-way.

**v. Maximum Trench Widths**

Plans or specifications submitted to the City Engineer for approval shall show the maximum trench width for the sizes and classes of pipe at the various cover depths for the particular project.

**w. Settlement**

Whenever trenches or other excavations made by the Contractor in the performance of the work have not been properly filled, or where settlement has occurred at any time prior to final acceptance of the entire public improvement project, to the extent that the top of the backfill is below the original ground surface, such trenches shall be refilled and the surface compacted and smoothed to conform to the elevations of the adjacent ground surface. All sod in lawns and parks removed or damaged by reason of such settlement, and the repair thereof shall be restored to their original conditions.

**x. Concrete Pipe**

(1) Rubber Gasket Joints

Non-Circular Cross-Section or “Profile” Gaskets shall be installed in strict accordance with the pipe and gasket manufacturer's recommendations.

For Circular Cross-Section or “O-Ring” Gaskets, immediately before jointing the pipe, the outside of the spigot and gasket and the inside of the receiving bell shall be thoroughly cleaned and coated with a suitable lubricant. The position and conditions of the rubber gasket shall be checked with a feeler gauge after the piping unit is installed.

(2) Mastic Joints

Mastic joints will be required for all non-round pipe shapes. Mastic joints shall be constructed to attain a watertight joint. Sufficient mastic will be applied so as to completely fill any space between the spigot end of one pipe and the bell end of the adjoining pipe.

(3) Marking

Each pipe, fitting, or special section shall have plainly and permanently marked thereon:

- (a) Pipe class;
- (b) Date of manufacture;
- (c) Manufacturer's name or trademark;
- (d) On mitered pipe, amount of miter and point of maximum miter.

Markings shall be indented in the pipe or painted thereon with waterproof paint. Each end of each mitered pipe, fitting or special section shall be marked with a stripe of paint approximately one and one-half inches wide and two feet long, applied along the top center line.

(4) Joint Openings

Round pipe shall have rubber gasketed joints in accordance with ASTM C 1628-06 with noted exceptions above in this Chapter, Subsection Rubber Gasket Joints. Other shapes shall use mastic joints as follows. In laying pipe, the maximum mastic joint opening shall not exceed the manufacturers' recommendations, or the following table, which ever is less.

Pipe Size (Round equivalent)	Maximum Joint Opening
12"-24"	1/4"
27"-84"	1/8"/ft. of equivalent internal diameter, max. 5/8"
90" and larger	3/4"

The above maximum openings are for the purpose of compensating for minor irregularities in the manufacture of the pipe joints. The pipe is to be laid to line and grade so that the sections are pushed completely home at least one point around the circumference of the joint, without spalling the concrete. Permissible openings may exist at other points around the circumference of the pipe.

In laying pipe, the maximum rubber gasket joint pull and deflection shall not exceed the manufacturer recommendations.

(5) Bends

When special engineering conditions exist, the City Engineer may allow bends. Bends for concrete pipe shall be fabricated from segments of a steel cylinder with concrete or mortar lining and reinforced concrete exterior covering or from segments of concrete pipe miter cut while the pipe is still green. The deflection angle between adjacent segments shall not exceed 30°.

Steel cylinders shall be at least U.S. 10 gauge and shall be lined with concrete or mortar at least three-quarters inch thick. Bends fabricated from steel cylinders shall be designed for the same three-edge bearing loads as the adjacent pipe.

In bends fabricated from miter cut segments of concrete pipe, the reinforcing steel shall be welded and the entire bend shall be encased in concrete after installation. Concrete encasement shall be at least eight inches thick all around and shall extend the full length of the bend.

(6) Handling

Pipe, fittings, and accessories shall be handled in a manner that will insure installation in sound, undamaged condition.

Concrete pipe and fittings shall be handled carefully and shall not be bumped or dropped. No hooks shall be permitted to come in contact with joint surfaces. Pipe units shall be kept from contact with adjacent units during handling and storage.

Lift holes are prohibited for all concrete storm sewer pipe.

(7) Cleaning

The interior of all pipe and fittings shall be thoroughly cleaned of foreign matter before being installed and shall be kept clean until the work has been approved. All joint contact surfaces shall be kept clean until the jointing is completed.

Every precaution shall be taken to prevent foreign material from entering the pipe during installation. No debris, tools, clothing, or other materials shall be placed in the pipe. Whenever pipe laying is stopped, the open end of the line shall be suitably closed. Culverts, sewers, and drains shall have the upper end closed with an end board closely fitting the end of the pipe and having a number of small holes drilled near the center to prevent the trench from filling with water. All water that may have entered the trench shall be pumped out before the closure is removed. It is essential that no mud, sand or other material shall be placed in the pipe.

(8) Alignment

Piping shall be laid to the lines and grades shown on the drawings. Storm sewers shall be designed with straight pipe runs between structures. Where warranted by special engineering conditions, the City Engineer may approve the design of curved sections. Pipe lines or runs intended to be straight shall be laid straight. Curves may be formed by using fittings or mitered joints or by opening the joints for pipe 36 inches in diameter and larger. Complete curve data shall be shown on the plans. The contractor shall erect hub stakes to determine and check pipe subgrades. Not less than three hub stakes shall be maintained in proper position at all times when trench grading is in progress. If a laser beam is not used, batter boards shall be used at intervals of not more than 25 feet.

(9) Laying Pipe

Pipe shall be protected from lateral displacement by pipe embedment material. Under no circumstances shall pipe be laid in water and no pipe shall be laid under unsuitable weather or trench conditions.

Pipe shall be laid with the bell ends facing upstream unless an exception is granted by the City Engineer. Prior to assembling each joint, the new pipe section being added to the already installed pipe(s), shall be on line and grade to help insure uniform gasket contact around the entire perimeter of the bell end.

**y. Corrugated Metal Pipe**

All pipe, pipe couplings, and accessories therefore shall be unloaded, stockpiled, hauled, distributed, and otherwise handled in a manner which will prevent damage thereto. Care shall be taken to insure that no damage will occur to coating of pipe and pipe couplings. All hooks or other tools inserted in the ends of the pipe, and slings if used in contact with the outside of the pipe, shall be well padded.

All pipe coating which has been damaged prior to laying the pipe or placing the backfill shall be repaired in strict conformity with the pipe manufacturer's instructions and recommendations, using materials of a type and quality equal to that used in originally coating the pipe.

Special care shall be taken to lay all pipe to exact grade and line. All pipe, when jointed, shall form a true line of sewer. Any pipe that has a grade or joint disturbed after laying shall be taken up and re-laid. All pipes shall be laid with the separate sections joined firmly together, with outside laps of circumferential joints pointing upstream, and the center line of the invert coinciding with the specified alignment of the pipe.

The interior surfaces of all pipe shall be thoroughly cleaned of all foreign matter before being lowered in the trenches and shall be kept clean during laying operations. In addition, the exterior surfaces of the ends of corrugated metal pipe over which the coupling bands are to be installed, and all interior and exterior surfaces of the bands shall be both clean and dry when the pipe is laid and the joints coupled as required.

Coupled joints shall be made in strict conformity with the corrugated metal pipe manufacturer's recommendations and instructions, using watertight coupling bands and accessories as specified above.

**z. Concrete Lined Ditch**

(1) Reinforcing

The reinforcing for the concrete shall be designed to withstand all earth and water pressures imposed upon the sides. The minimum amount of reinforcing placed in any section of the concrete paving shall be six inch by six-inch spacing welded wire fabric, W3 thickness. Wire fabric shall be supplied in flat sheet form. Wire fabric shall be supported on fabricated steel bar supports at three foot maximum spacing.

(2) Joints

Transverse expansion joints shall be placed at maximum intervals of 250 feet, and where new construction adjoins existing liners or other structures. Smooth dowel bars, two feet long by five-eighths inch diameter, sleeved, at 18-inch centers, shall be carried through the expansion joints. Expansion joints shall consist of one-half inch premolded, non-extruding expansion joint material. Cut-off walls shall be placed at the downstream side of all expansion joints.

Contraction joints shall be sawed or tooled to a minimum depth of one and one-half inches, at ten-foot maximum centers. No longitudinal joints shall be placed at the flow line. Joints shall be filled with an approved joint sealer material.

(3) Weep Holes

Two inch diameter plastic weep holes shall be placed at 15 foot centers and backfilled with three-quarter inch clean rock, 15 inches in all directions above the flow line. Weep holes shall be flush with the face of the concrete and the back screened.

**aa. Concrete Box Culverts**

(1) Lifting Inserts

Embedded lifting inserts shall provide a water tight lift point, which does not require patching or grouting. Insert type, size, and location shall be on the shop drawing.

(2) Rigging

Rigging and installation guidelines shall follow the manufacturer's recommendations.

(3) Pre-cast Box Joint Openings

In laying pre-cast box culverts, the maximum mastic joint opening shall not exceed the manufacturers' recommendations, or the following table, which ever is less.

Box Size (Internal span)	Maximum Joint Opening
≤ 7'	1/2"
> 7'	3/4"

(4) Handrails

Fabricated steel handrail and guard fence shall be hot dip zinc coated in accordance with the latest edition of ASTM A 123. Hardware for handrail and guard fence shall be hot dip zinc coated in accordance with the latest edition of ASTM A 123.

## 32 - HDPE STORM SEWERS (PRIVATE)

### 32.1 DESCRIPTION

This section defines requirements for the use of HDPE pipe as an alternate material for privately maintained storm sewer systems originating on private property.

**a. Definitions**

- (1) HDPE pipe – For the purposes of this section, acceptable HDPE pipe is defined as: Type S, double wall (smooth interior, corrugated outer wall), high density polyethylene pipe utilizing a bell-and-spigot joint system and providing a water tight joint.
- (2) Incidental landscape drainage system – Systems where the size of the pipe is typically less than a 15" diameter and the City considers the system to be minor in nature.
- (3) PE – Polyethylene.
- (4) Private storm sewer system – For the intent of this section shall be defined as a system which mainly collects and conveys runoff from a single property and is privately maintained by the property owner. The City will make final determinations regarding which systems may be private versus public during the plan review process.
- (5) Roof drain – A pipe system which conveys only runoff from building roofs.
- (6) Storm water detention facility – A facility which controls the maximum release rate from a site. It is considered to be separate by definition from the storm sewer system for regulation and specification purposes.

**b. General**

- (1) HDPE pipe is allowed only for private storm sewer systems.
- (2) A private system using HDPE pipe may enter the public right-of-way to connect with a public

storm sewer at a structure. However, HDPE pipe is not allowed to be installed underneath public streets.

(3) The only allowed sizes of HDPE pipe for private storm sewer systems are as follows: 15-inch diameter, 18-inch diameter, and 24-inch diameter.

(4) Roof drains and Incidental landscape drainage systems may use pipe with a diameter less than 15-inches in size. Pipe material must meet industry standards and the Storm Drainage section of the International Building Code as adopted by the City of Overland Park.

(5) Storm water detention facilities may use 15-inch through 60-inch diameter HDPE circular pipe.

(6) HDPE /plastic storm drainage junction structures and inlets are not allowed as part of the private storm sewer system.

**c. Authority**

Section 15.10.100 Storm Water Management Standards

**d. References**

(1) ASTM F2306 (Latest Version)  
Standard Specification for 12 to 60 in. [300 to 1500 mm] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications

(2) AASHTO M294  
Standard Specification for corrugated PE pipe

(3) ASTM D3350 (Latest Version)  
Standard Specification for Polyethylene Plastic Pipes and Fittings Materials

(4) ASTM F477 (Latest Version)  
Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

(5) ASTM D2321 (Latest Version)  
Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

(6) ASTM D3212 (Latest Version)  
Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

(7) City of Overland Park (Engineering Services) Standard Details

**e. Certification**

All HDPE pipe used in storm sewer applications shall conform to the requirements in the latest edition of AASHTO M294 and ASTM F2306.

**32.2 MATERIALS**

**a. Manufacturers**

Pipe shall be provided only by manufacturers that are certified through the Plastic Pipe Institute (PPI) Third Party Certification program and/or the National Transportation Product Evaluation Program (NTPEP).

**b. HDPE Pipe & Accessories**

(1) Pipe.

The manufacturer of HDPE pipe shall be governed by the latest edition of ASTM F2306-07 and AASHTO M294. Pipe and fittings shall be made from virgin PE compounds which conform to the requirements of cell class 435400C in the latest edition of ASTM D3350-06.

(2) Joints.

(a) Pipe joints shall consist of in-line integral bell and spigot with rubber gasket that meets ASTM F477. Bell shall span over three spigot corrugations.

(b) Water tight joints shall be provided which meet a 10.8 psi laboratory test in accordance with ASTM Test Method D3212.

(3) Fittings.

- (a) Fittings shall not reduce or impair the overall integrity or function of the pipeline system.
- (b) Fittings shall meet the requirements of AASHTO M294 and ASTM F2306.
- (c) Fittings may be either molded or fabricated.
- (d) Only fittings supplied or recommended by the manufacturer shall be used.

**c. Installation**

- (1) Installation shall be per ASTM D2321 and the manufacturer's specifications. In the case of a discrepancy between the two, the more restrictive requirements shall govern.
- (2) Exception: The minimum cover over the pipe shall be 18-inches for pipes up to 24-inches in diameter. The minimum cover for pipes larger than 24 inches in diameter and up to 60 inches in diameter shall be 24-inches.

**32.3 CONSTRUCTION REQUIREMENTS**

All pipe, pipe couplings, and accessories shall be unloaded, stockpiled, hauled, distributed, and otherwise handled in a manner which will prevent damage thereto.

Special care shall be taken to lay all pipes to exact grade and line. All pipe, when jointed, shall form a true line of sewer. Any pipe that has a grade or joint disturbed after laying shall be taken up and re-laid.

All pipes shall be laid with the separate sections joined firmly together, with outside laps of circumferential joints pointing upstream, and the center line of the invert coinciding with the specified alignment of the pipe.

The interior surfaces of all pipes shall be thoroughly cleaned of all foreign matter before being lowered in the trenches and shall be kept clean during laying operations.

Joints shall be constructed to attain a watertight joint.

**a. Marking.**

Each pipe, fitting, or special section shall have markings per AASHTO M294. Required information shall be plainly and permanently marked on each item. Markings shall include: specification designation, the nominal size, the manufacturer's name, trade name or trademark, plant designation code, and date of manufacture (or appropriate code).

**b. Deflection.**

Maximum deflection (reduction of the barrel base inside diameter) is 5%. Time of measurement shall be not less than 30 days nor more than 60 days following installation.

Deflections in excess of 5% may require the pipe to be removed and new pipe installed.

**c. Field Quality Control & Testing**

- (1) All storm sewer shall be inspected by City inspectors prior to backfilling the pipe.
- (2) Mandrel testing (or other approved method) shall be required when visual inspection reveals excessive deflection as determined by the City. Testing shall be at the expense of the contractor.

**33 - STORM SEWER INLETS AND MANHOLES**

**33.1 DESCRIPTION**

Storm sewer inlets and manholes shall be constructed to the lines, grades, and dimensions shown on the Drawings.

**33.2 MATERIALS**

**a. Mix Designs**

All concrete used in construction of storm sewer structures shall be KCM MB 4K.



**b. Concrete Structures**

(1) Concrete structures shall be constructed of reinforced concrete as specified in “Concrete Construction”.

(2) The entire surface of all steel frames shall be thoroughly cleaned and hot dip zinc galvanized in accordance with the latest edition of ASTM A 123.

**c. Gray-Iron Castings**

Gray-iron casting shall conform to ASTM A 48.

**d. Steel Castings**

Steel castings shall conform to ASTM A 27, Grade 65-35, fully annealed.

**e. Structural Steel**

All structural steel shall conform to ASTM A 36.

**f. Reinforcing Steel**

Reinforcing steel used in inlets and manholes shall be ASTM A 615 grade 40.

**g. Steps**

Steps used in inlets and manholes shall conform to ASTM C 478

**h. Shop Drawings**

The details for curb inlets, junction boxes, manholes, area inlets and all other cast structures, either site constructed or pre-cast, shall be submitted to the City Engineer for approval.

**33.3 CONSTRUCTION REQUIREMENTS**

**a. Curb Inlets**

Curb inlets shall be set back from the normal curb line one foot and the top of the slab for the curb inlet shall be at the same elevation as the top of the curb.

Curb inlets shall have a ten-inch opening per the current Standard Detail and a minimum size horizontal bar of three-quarters inch diameter approximately centered in the opening. Where warranted by special engineering conditions, the City Engineer may approve the use of a six-inch opening steel frame, in which case the inlet will not be set back from the curb line as indicated in this Chapter Subsection 3.6.A.3.

The top of the curb inlet shall be cast in place and anchored to the walls. All curb inlet tops shall include an access manhole frame and cover. Access cover design shall be submitted for approval by the City Engineer.

The bottom of the curb inlet shall have concrete so placed that the invert through the curb inlet will conform in shape and slope to that of the storm sewer, and the minimum thickness of the invert shall be four inches, or two inches below the bottom of the lowest pipe.

The curb inlet shall be constructed on a reinforced concrete slab at least eight inches thick.

The curb shall transition to the inlet in ten feet on the upstream side and five feet on the downstream side; inlets located in a sump condition shall have both transitions five feet in length.

**b. Area Inlets**

Area inlets shall be constructed the same as stipulated under curb and gutter inlets where applicable, with the following additional items:

Area inlets shall be of the side opening type with a frame as specified in this Chapter Subsection 3.4.A.4. Each side of the area inlet with a frame shall have a minimum two feet concrete apron with vertical wing walls to contain grade around the inlet.

The City Engineer may approve area inlets with a top inlet grate where warranted by special engineering conditions. The top inlet grate shall be heavy cast iron, or fabricated steel and as manufactured for this particular purpose. The fabricated steel grate shall be hot dip zinc coated in accordance with the latest edition of ASTM A 123-02.

Area inlets shall be located and designed to adequately convey and transport the storm water into the storm sewer system.

**c. Manholes and Junction Boxes.**

Manholes and junction boxes shall be constructed the same as stipulated under curb inlets where applicable. Manholes shall also conform to the latest edition of ASTM C478. Manholes and junction boxes shall be constructed in accordance with the following additional items:

Manhole and junction box frames and covers shall be heavy duty where located in streets and trafficways. Access cover design shall be submitted for approval by the City Engineer.

Manholes shall be equipped with eccentric cones, except that flat slab tops may be used in shallow structures as approved by the City Engineer.

Junction boxes may be used with pipe sizes of any diameter.

Minimum inside diameter of manholes shall be four feet for pipe size 24 inches or less. When pipe size exceeds 24 inches in size, junction boxes shall be used. Where warranted by special engineering conditions, the City Engineer may approve junction boxes or manholes with alternate design elements.

**d. Structure Connections**

Pipes connected to structures shall be cut parallel with the inside face of the structure. For poured in place structures, the pipe shall extend to and be flush with the inner face of the structure wall. For precast structures, the pipe projection beyond the inside face of the wall shall be not less than 2 inches and no more than 4 inches except where prior approval is given by the City.

**34 - PIPE UNDERDRAIN**

**34.1 DESCRIPTION**

At the locations determined by the engineer, underdrain shall be constructed in accordance with the plans and Section 822 of the Standard Specifications except as otherwise modified herein. All materials shall meet the requirements of Section 1907 of the Standard Specifications, except as otherwise modified herein. Under no circumstance shall Type H Pipe be installed within the same underdrain system as Type L Pipe.

**34.2 MATERIALS**

**a. Pipe Underdrain**

Pipe underdrain shall be Type H, PVC Corrugated Sewer Pipe with smooth interior and fittings in accordance with ASTM F 949, or, Type L, Corrugated Polyethylene Drainage Pipe in accordance with AASHTO M252, Type SP.

**b. Outlet Pipe**

Outlet pipe shall be Type K, PVC Corrugated Sewer Pipe with smooth interior and fittings in accordance with ASTM F 949, or, Type E, Corrugated Polyethylene Drainage Pipe in accordance with AASHTO M252, Type S.

**c. Joints**

All joints shall be installed in accordance with the manufacturer's instructions. The contractor shall submit certified test results that the mechanical joints with elastomeric seals meet the requirements of ASTM D 3212 and ASTM F 477.

**d. Perforations**

Type H pipe shall be perforated in accordance with ASTM F 949. Type L pipe shall be perforated in accordance with AASHTO M252, Type SP with Class 2 perforations.

## 35 - GEOTEXTILE

### 35.1 DESCRIPTION

The work shall consist of furnishing all equipment, labor and material for placing geotextile as specified herein and shown on the contract drawings and maintaining the geotextile until placement of the base course, curb and gutter and select soil backfill is completed and accepted.

### 35.2 MATERIALS

Geotextile shall meet the requirements of AASHTO M-288-00 except as modified herein.

The geotextile shall be a nonwoven sheet of plastic yarn as defined by ASTM D 123 and conform to the criteria presented in Table 1. These requirements shall be based on the Minimum Average Roll Value (MARV) which is defined as the value that can be expected, with 95 percent confidence, to be the minimum test average obtained on a roll sampled and tested in accordance with ASTM D 4759.

TABLE 1 PHYSICAL REQUIREMENTS

Geotextile Class 1			
Physical Property	ASTM Test Procedure	Minimum Acceptance Criteria	
		English	Metric
Grab strength tensile	D 4632	200 lbs	890 N
Grab Elongation at Break	D 4632	50%	50%
Puncture Strength	D 4833	80 lbs	355 N
Mullen Burst Strength	D 3786	260 psi	1790 Kpa
Trapezoidal Tear	D 4533	80 lbs	355 N
Apparent Opening Size (AOS)	D 4551	70-100 US Std. Sieve	150-212 μm
Geotextile Class 2			
Grab strength tensile	D 4632	120 lbs	530 N
Grab Elongation at Break	D 4632	60%	60%
Mullen Burst Strength	D 3786	90 psi	620 Kpa
Apparent Opening Size (AOS)	D 4551	60/70 US Std Sieve	250/212 μm

## 36 - GUARDRAIL, STEEL PLATE (GALVANIZED)

### 36.1 DESCRIPTION

Steel plate guardrail and guardrail end terminals shall be furnished and installed in accordance with Section 827 of the Standard Specifications.

### 36.2 MATERIALS

Material for steel plate guardrail and guardrail end terminal shall be in accordance with Division 1600 and Division 2300 of the Standard Specifications. The Contractor shall file with the City Engineer a

Brand Registration and Guarantee. The brand registration and guarantee shall show the brand name or designation, the manner in which it will appear on the fabricated beams, the typical mechanical properties, the class and type of guardrail, and typical weights of galvanized coating on the rails and end sections.

All steel plate guardrail shall have retroreflective delineators mounted on the face of the rail at 25 foot spacings. Mounting brackets shall be galvanized after fabrication and delineators shall be mounted to face oncoming traffic in the adjacent lane. Delineators shall be white Sate-Lite 35 or approved equal.

## **37 - STREET LIGHTING INSTALLATION**

### **37.1 DESCRIPTION**

This work shall consist of furnishing all labor, materials and equipment to complete in place the street lighting system as shown on the plans (including standard details), as specified in the following specifications, as directed by the City Engineer, and in those sections of the standard specifications of the City of Overland Park, Kansas, and the Kansas Department of Transportation, that are either directly or by reference included herewith.

#### **a. Plans**

The plans that accompany these specifications shall be considered a part thereof. Whenever any part of the plans shall be in conflict with any other part or parts of the plans, or any part of these specifications shall be in conflict with any other part or parts of these specifications or any of the items proposed to be constructed shall appear to be impracticable, or impossible to construct, then the matter shall be immediately brought to the attention of the City Engineer or his agent. The City Engineer's decision in the matter shall be final, and the Contractor shall follow his directions to avoid any such conflict in the plans or specifications.

All incidental parts which are not shown on the plans or specified herein and which are necessary to complete the street lighting system shall be furnished and installed as though such parts were shown on the plans or specified herein. All systems shall be complete and in operation to the satisfaction of the City Engineer at the time of acceptance of the work.

All appurtenances shall be located as shown on the plans. Any deviations must be established by the City Engineer in the field. The Contractor shall have a copy of the plans and specifications at the job location at all times and accessible to the City Engineer or his authorized representative.

Prior to the acceptance of the work, the Contractor shall submit an "As Built" or corrected plan showing in detail all construction changes, especially location and depth of conduit.

#### **b. Grades**

All work shall conform to line, elevation and grades as shown on the plans.

#### **c. Preliminary schedule of equipment and material**

Prior to commencement of construction activities, the Contractor shall submit a complete schedule of materials and equipment proposed for installation for the approval of the City Engineer. This schedule shall include catalog cuts, diagrams, drawings, and other such descriptive data as may be required by the City Engineer. In the event any items of material or equipment contained in the schedule fail to comply with specification requirements, such items may be rejected.

#### **d. Rejected materials**

Rejected materials shall be immediately removed from the project site by the Contractor and shall not again be brought upon the project site. Work shall be commenced and continued at such points as may be approved by the City Engineer and shall be carried on diligently and without unnecessary or unreasonable delay.

**e. Coordination with existing utilities**

All existing conduit/conductor runs and other utility information were obtained from existing office records. It shall be the Contractor's responsibility to locate all utilities, whether above, on, or below the ground, and to protect the City against any and all damages arising from work under this project.

No new fixture shall be constructed as part of this contract which is in conflict with any existing utilities' facility or the code required thereby, unless approved by the City Engineer.

**f. Permit**

The Contractor is responsible for obtaining an electrical Building Permit from the City of Overland Park, Building Safety Division, 8500 Santa Fe Drive. The permit shall be taken out before any excavation for the controller foundation takes place.

**g. Notification**

The Contractor shall notify the City Engineer before beginning work on the project. The Contractor shall keep the City Engineer advised as to the progress of the project and the Contractor's proposed schedule. The Inspector or City Engineer may, at their option, cause any work completed without their knowledge or inspection to be dismantled and inspected to their satisfaction.

The contractor shall notify each property owner at least one day in advance of construction activity being started in front of the respective property. The City will provide notices for the contractor's distribution.

**h. Protection of work and cleanup**

The Contractor shall care for all work until final completion and acceptance by the City. All damage done to existing improvements by the Contractor shall be repaired by the Contractor. The Contractor shall remove all surplus material and rubbish from the work as it accumulates and before the Contractor makes application for the acceptance of the work.

**i. Traffic control**

Reasonable access to and egress from property adjacent to the project shall be maintained at all times throughout the duration of this project. If a traffic control plan is not included in the plans for the project, the following will apply:

During non-working hours, all lanes of traffic in all directions shall be maintained. During non-peak traffic hours, the Contractor may, with the authorization of the City Engineer, close such traffic lanes at the project location(s), as approved, using traffic cones, portable barricades, or any other traffic control devices the City Engineer may designate.

The Contractor is advised that no work that will restrict traffic in any way will be performed between the hours of 7 A.M. to 8:30 A.M. or 4 P.M. to 6 P.M. at the project location(s).

The Contractor shall provide proper signing and protective devices as required by the latest edition of the Overland Park Traffic Control Handbook for Street Maintenance and Construction Operations. The Contractor shall place the required signing and protective devices prior to beginning construction activity each day and patrol the work area as frequently as needed during the day and at the end of the working day. All traffic cones, signs, barricades, drums, and other devices shall be immediately properly reset if they are accidentally moved.

**j. Turn-on and testing**

The Contractor shall notify the Inspector for a Field Safety Inspection as soon as the system(s) is (are) ready. Upon approval with this inspection, the Contractor shall contact the City of Overland Park, Community Standards Division, for an Electrical Inspection as soon as the control center(s) is (are) ready. The Kansas City Power & Light Company should be notified in advance as to when the system would need to be energized.

All street lighting system elements shall function properly as a complete system for a minimum period of fifteen (15) days before acceptance by the City. The fifteen (15) day test period shall be continuous. Any malfunction observed or recorded shall stop the test period as of the time of the

malfunction. A period shall start when the malfunction has been repaired to the satisfaction of the Inspector.

### **37.2 MATERIALS**

The material for street lighting shall be in accordance with this specification. All materials used in the fabrication or assembly of the items listed below shall be new and of the best grade and shall be approved by the City Engineer and comply with the applicable parts of Section 814, "Electrical Lighting and Traffic Signals" and Section 1703, "Electrical Lighting and Traffic Signal Equipment" of the "Standard Specifications" with the additions as stated herein.

#### **a. Approved Manufacturer's List**

All material for street lighting used by the Contractor shall be from the City's approved list of vendors. It is important that users be completely knowledgeable of all application requirements and procedures prior to product application. It is the responsibility of the installer to contact the supplier of all streetlighting materials if questions regarding application procedures or conditions arise.

#### **b. Regulations and code**

All electrical equipment shall conform to the standards of the National Electrical Manufacturers Association (NEMA). In addition to the requirement of these specifications, the plans and the lighting specifications, all material and work shall conform to the requirements of the National Electrical Code, the Standards of the American Society for Testing Materials (ASTM), the American Standards Association (ASA), and local ordinances.

Wherever reference is made in these specifications or in the standard provisions to the code, the safety orders, the general order, or the standards mentioned above, the reference shall be construed to mean the code, order, or standard that is in effect at the date of advertising of these specifications.

#### **c. Aluminum standards**

The type of pole and length of luminaire arm (if any) shall be as specified on the plans. This pole specification is in addition to the pole detail sheet included in the plans - refer to the pole detail sheet, which describes the material specifications and pertinent design details.

##### **(1) Pole shafts 30' and 40' in length**

The aluminum lighting shaft assembly shall be spun from one piece of seamless tubing and after fabrication, it shall have mechanical strength of not less than T6 temper. The cross section of the pole shall be round, and the shaft shall be fabricated in a continuous true taper from at least 6" above the handhole to the top of the shaft. The shaft shall have no longitudinal or circumferential welds, except at the lower end joining the shaft to the base. To protect the shaft during shipping, the assembly shall be tire wrapped with a non-staining paper.

Pole dimensions shall be as specified in the City of Overland Park Standard Details. It is the responsibility of the fabricator to verify and attest that the material sizes proposed are structurally adequate and in full compliance with this specification and the pole detail sheet.

The shoe base shall be a permanent mold casting. The base shall be free of cracks, pits, and blow holes and of sufficient size and strength to withstand full design loads. The base shall telescope the shaft; and the one weld shall be on the inside of the base at the end of the shaft, while the other weld shall be on the outside at the top of the base. The shoe base and the two (2) welds shall develop the full strength of the pole assembly.

The single member arm shall be tapered by cold working from round tubing. After tapering, the member shall be flattened to produce an elliptical cross-section with the major diameter in the vertical plane, perpendicular to the wind. The outboard end of the arm shall remain round with a two-inch (2") slipfitter for mounting the luminaire. The single member arm shall be designed to meet given design factors and mounting dimensions.

The truss type member arm assembly shall be a one piece welded assembly consisting of an upper arm and lower arm (brace) securely joined by a vertical strut and a connector or weld at the outboard end

of the arm assembly. The upper arm shall be tapered by cold working from round tubing. After tapering, the upper arm shall then be flattened to produce an elliptical cross-section with the major diameter in the horizontal plane, parallel to the wind. The outboard end of the upper arm shall remain round with a two-inch (2") slipfitter for mounting the luminaire. The outboard end of the lower arm (brace) shall be covered by an end cap.

(2) Pole shafts 14' in length

The 14' aluminum lighting shaft shall be spun from one piece of seamless tubing and after fabrication; it shall have mechanical strength of not less than T6 temper. The cross section of the pole shall be round, and the shaft shall be fabricated in a continuous true taper from at least 6" above the handhole to the top of the shaft. The shaft shall have no longitudinal or circumferential welds, except at the lower end joining the shaft to the base. To protect the shaft during shipping, the shaft shall be tire wrapped with a non-staining paper.

Pole dimensions shall be as specified in the City of Overland Park Standard Details. It is the responsibility of the fabricator to verify and attest that the material sizes proposed are structurally adequate and in full compliance with this specification and pole detail sheet. The pole shall have a 3" O.D. slipfitter end, without a tenon, for mounting the post-top luminaire.

The aluminum shoe base shall be a permanent mold casting. The base shall be free of cracks, pits, and blow holes and of sufficient size and strength to withstand full design loads. The base shall telescope the shaft; and the one weld shall be on the inside of the base at the end of the shaft while the other weld shall be on the outside at the top of the base. The shoe base and the two (2) welds shall develop the full strength of the pole assembly.

The base shall be cast with four (4) slotted holes to receive the anchor bolts-threaded studs and tapped holes for attaching the four (4) cast aluminum alloy removable bolt covers provided for each pole. The bolt covers shall attach to the upright portion of the body of the base. The bolt circle is provided in Table 1 of the pole detail sheet.

**d. High Pressure Sodium Cobra Head Luminaire**

Cobra Head style luminaires shall be constructed of a single piece die-cast aluminum upper housing and two-piece bottom door, hinged at the back and latched on the street side. The luminaire shall be equipped with an integral slipfitter for 2-inch luminaire arm mounting. The mounting device shall allow the luminary to be mounted absolutely level and shall have no more than four (4) fasteners serving both the leveling and clamping functions. It shall allow one man to install the luminaire by simultaneously holding it in position and tightening the fasteners, such that the luminaire will be properly level at the first attempt. The luminaire shall be equipped with a 'trigger latch' for easy, one-hand, no-tools opening of the fixture for installation and servicing. A factory installed bird guard shall fit snugly around the mounting device. The luminaire shall provide a moisture proof and dust proof chamber and weather protection for the ballast.

A removable power-pad/module with quick-connect electrical hookup for easy installation of the electrical system and easy access to the ballast compartment shall be mounted on the door. Top housing mounting or a bridge assembly configuration will not be accepted.

The lens shall be a single piece of optically clear, flat, heat-resistant, impact resistant glass. The sealed optical assembly shall be a true 90° cutoff. The reflector shall be natural unpainted alzak aluminum and shall be secured to the top housing. The lamp socket shall be preset at the factory to provide I.E.S. Type III Medium Cutoff light distribution. The luminaire shall not be provided with a photocell receptacle unless otherwise noted on the plans or special provisions.

(1) Luminaires, 250 Watt and Above:

The luminaire shall be pre-wired, requiring only connection of service wires to a terminal board. The luminaire shall be equipped with a regulator, high power factor of 0.90 or better, ballast for high-pressure sodium at a voltage of 120/208/240/277 volts. The ballast shall be capable of reliably operating the lamp with a line voltage varying plus or minus 10 percent from normal. The entire ballast, including

condensers, shall be easily removable and replaceable with gloved hands and without tools through the use of quick disconnecting mechanical devices and electrical plugs.

(2) Luminaries, 150 Watt:

The luminaire shall be pre-wired, requiring only connection of service wires to a terminal board. The luminaire shall be equipped with a HPF reactor, high power factor of 0.90 or better, ballast for high-pressure sodium at a voltage of 120/208/240/277 volts. The ballast shall be capable of reliably operating the lamp with a line voltage varying plus or minus 5 percent from normal. The entire ballast, including condensers, shall be easily removable and replaceable with gloved hands and without tools through the use of quick disconnecting mechanical devices and electrical plugs.

**e. LED Cobrahead Luminaire**

All LED cobrahead luminaires shall be as listed on the Pre-Approved Materials List and rated as Class A, B, C or D as indicated.

**f. Post Top Luminaire**

The luminaire housing shall be constructed of cast aluminum and painted black. The ballast shall be a regulator type, high power factor, for high-pressure sodium at a voltage of 120/208/240/277 volts. The ballast components shall be housed in a totally enclosed integral compartment, and the optical section of the unit shall be completely sealed and gasketed. The pressed prismatic refractor shall be one piece polycarbonate plastic. The refractor shall be for I.E.S. Type III distribution or Type V if specified on the plans.

**g. Lamps**

Lamps shall be high pressure sodium (HPS) rated with a 24,000 hour average life. The wattages and lumen rating shall be as follows:

400 watt lamps shall be rated at 50,000 lumens

250 watt lamps shall be rated at 30,000 lumens

150 watt lamps shall be rated at 16,000 lumens

100 watt lamps shall be rated at 9,500 lumens

**h. Secondary Cable and Power Lead-In Cable**

Power lead-in cable, sized per plans, and #4 A.W.G. secondary cable shall be stranded annealed copper, single conductor cables for operation at 600 volts maximum with black insulation. Material shall meet the applicable requirements of I.P.C.E.A. Standard S-19-81, with thermoplastic insulation of GRS-Rubber base meeting Appendix K (A) of I.P.C.E.A. and listed by U.L. as Type U.S.E. for direct burial; or material shall meet the applicable requirements of I.P.C.E.A. Standard S-66-524, interim standard #2, with thermo setting insulation of cross link polyethylene meeting requirements of Column "A" of I.P.C.E.A. and listed by U.L. as Type U.S.E. RHW-75°C. Parallel conductors on the same cable reel is permitted as long as the cables are not twisted or braded together.

**i. Pole Wiring**

Pole wiring above handhole in pole to luminaire(s) shall be single conductor cable with minimum 600 volt rating, No. 10 A.W.G. Type THHN/THWN. Conductor shall be stranded annealed copper. The pole wiring cables for twin luminaire poles shall be colored red for the north or west oriented luminaire and colored black for the south or east oriented luminaire.

**j. Control Center**

Control center shall be an underground service type, rated for 100 A or 200 A (as specified on the plans), 240 volts, unless otherwise noted. It shall have a ringless meter socket with horn bypass meeting requirements of the local electrical utility. The pedestal shall be fabricated from 0.125 aluminum and with raintight construction. It shall have an individual meter, panel, contactor, and rear service pull "compartments". Meter and panel/contactor compartments shall have piano hinged doors with padlocking provisions. The panel and contactor compartments shall have an inside panel door. The outer front and inside panel doors shall be equipped with an approved doorstop. Meter base shall be of the type used by the local utility. Panelboard shall have silver plated copper buss and shall accept twelve 1 inch plug in



breakers. Panelboard compartment shall contain a photocell and test switch. All factory installed wire shall be copper. Pedestal finish shall be natural aluminum unless otherwise indicated in the plans.

**k. Conduit:**

Conduit shall meet the following specifications for the type of conduit material as indicated on the plans.

(1) PVC Conduit Material

Rigid nonmetallic conduit shall be Schedule 40 polyvinyl chloride (PVC) conduit. The conduit shall bear an Underwriters' Laboratories label and shall conform to Federal Specification WC 1094A (latest version).

(2) HDPE Conduit Material

The conduit shall exhibit good workmanship and be free from holes, blisters, inclusions, cracks, and homogenous throughout. There should not be any foreign particles embedded in the plastic as a result of the extrusion process. There should not be any surface distortions that penetrate either internally or externally into the conduit wall greater than 10% of the minimum wall thickness. The conduit shall be constructed of polymeric materials which are lightweight, flexible, corrosion resistant and nonconductive. The base material shall be clean, virgin grade high-density polyethylene (HDPE) which conforms to ASTM D3350, most recent edition, Type III. Any regrind material shall be non-wide specification, reworked from the same virgin material from the same manufacturer as the original conduit. The conduit shall have a controlled outside diameter with the cross-sectional dimensions meeting SDR 13.5 manufactured to ASTM D3035 specifications and having a minimum ASTM cell classification 334480EB. The conduit shall be smooth walled inside and out with a minimum coefficient of friction of 0.35. The conduit shall meet the following minimum requirements:

Density	> 0.940 g/cc	ASTM D-1505
Melt Index	< 0.4 gm/10 min.	ASTM D-1238(E)
Flexural Modulus	> 80,000 psi	ASTMD-790
Tensile Strength	> 3,000 psi	ASTM D-638
Slow Crack Growth		
ESCR (Bell Test)	10% Igepal	ASTM D-1693
Test Duration	192 hours minimum	ASTM D-1693
Failure	10% max	ASTM D-1693
Molded Plaque	3	ASTM D-1693
Hydrostatic Strength Class	NPR	ASTM D-2837
Color and UV Stabilizer	E > 2%	ASTM D-3350
Ultimate Elongation	>400 %	ASTM D-638

Minimum wall thickness shall be in accordance with the following table:

<u>Diameter</u>	<u>Wall Thickness</u>
2" SDR 13.5	0.176"
3" SDR 13.5	0.259"

Streetlighting conduit shall be sized according to the plans for 2" or 3" in diameter. The conduit shall be pigmented throughout the entire cross-section so as to produce a uniform grey color, forming an integral part of the product. All colors shall be produced from light stabilized pigments, which are further protected from ultra-violet (UV) degradation by the incorporation of Hindered Amine Light Stabilizers (HALS) allowing protection for up to two years of outside storage. The conduit shall be sequentially

marked and identified along its outer length in contrasting color and with a print of at least 0.125" height. The print interval shall not exceed five feet and shall include: 1) Manufacturer's name, 2) Product name/number, 3) Production code and 4) Length of Conduit (in feet).

The conduit coming off the reel shall return to a circular shape upon the release of tension when it is unreeled. The conduit ovality as defined in ASTM D-2122 shall not exceed the percentage listed in the following table per ASTM F-2160:

<u>Diameter</u>	<u>% Ovality</u>
2"	7%
3"	10%

When conduit 3" or above in diameter exceeds 10% ovality, it may be used if the contractor uses re-rounding equipment until 10% ovality or less is achieved. The mean elongation defined as the change in length divided by the original length, multiplied by 100 at a given load shall not be more than 10%. The conduit shall recover to a minimum of 95% of its original outer diameter upon release of a 200 pound load or shall not deflect to more than 5% of its original inside diameter within 10 minutes after removal of the compressive load.

**(3) HDPE Conduit Fittings**

An approved factory coupling as listed in the Overland Park Approved Equipment List shall be used for connection of the HDPE conduit to a 90° factory PVC elbow or between two lengths of HDPE conduit.

**37.3 CONSTRUCTION REQUIREMENTS**

The contractor shall only use qualified laborers who are well trained to perform functions related to street lighting, including familiarity with applicable sections of the National Electric Code.

**a. Excavation**

The Contractor shall perform all excavations for installing underground conduits, cable, boxes and pole bases in whatever substances encountered, to the depths indicated on the drawings or as otherwise approved. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the excavation to avoid slides. All excavated materials not required or unsuitable for backfill shall be removed and wasted on site obtained by the Contractor.

**(1) Rock Excavation and Blasting**

Where solid rock, shale, or similar material is found, the excavation shall be as shown in the plans or as directed by the City Engineer. The areas shall be excavated in accordance with "Rock Excavation and Blasting". ABSOLUTELY NO BLASTING OF ANY KIND WILL BE ALLOWED.

**b. Backfilling**

All areas excavated shall be backfilled and compacted in accordance "Compaction of Earthwork". After backfilling, all disturbed areas shall be kept well filled and maintained in a smooth and well-drained condition until permanent repairs are made.

**c. Replacing Damaged Improvements**

Improvements such as sidewalks, curbs, gutters, Portland Cement concrete and asphaltic concrete pavement, bituminous surfacing base material and any other improvements removed, broken or damaged by the Contractor shall be replaced or reconstructed with the same kind of materials as found on the work or with materials of equal quality. The new work shall be left in a serviceable condition satisfactory to the City Engineer. Whenever a part of a square or slab of existing concrete sidewalk, driveway or pavement is broken or damaged, the entire square or slab shall be removed and the concrete reconstructed as above specified.

**d. Screw-In Foundation Anchors**

Screw-in foundation anchors shall be of the size and type required for the pole. The anchors shall be screwed into the ground. Pre-drilling of holes for the anchor is not allowed. During installation the foundation shall be plumbed with a level. The foundation shall be screwed straight into the ground and the base plate shall be level.

Minor leveling adjustments on poles with breakaway connectors shall be made with the connectors. On other poles, minor leveling adjustments may be made with the use of leveling shims or washers. Shims and washers shall be galvanized or cadmium-plated steel no more than 1/4 inch thick. Only one shim or washer will be allowed at any one anchor bolt with a maximum of two on any pole.

If screw-in foundation anchors are not able to be used for any reason, concrete foundations shall be installed at the contractor's expense.

**e. Concrete Foundations**

All concrete used for concrete foundations shall meet the requirements of "Concrete Construction" and shall be KCMMB4K concrete.

The bottom of the concrete foundations shall rest on firm ground; foundations shall be poured monolithic. The exposed portions shall be formed to present a neat appearance. Forms shall be true to line and grade. Top of footing for standards, except special foundations, shall be finished to curb, or sidewalk grade or as directed by the City Engineer. Forms shall be rigid and securely braced in place. Conduit ends and anchor bolts shall be placed in proper position, to proper heights, and held in place by means of a template until the concrete sets. Anchor bolts shall be provided with hex head nut, flat washer and lock washer. Both forms and ground which will contact the concrete shall be thoroughly moistened before placing concrete.

Concrete shall not be placed until forms and reinforcing steel have been checked and approved by the City Engineer. Placement of concrete shall be witnessed by the City Engineer.

Concrete foundations shall be consolidated by an internal type vibrator. The vibrator shall operate at frequencies of vibration not less than 4,500 cycles per minute under load. The amplitude of vibration shall be adequate to consolidate concrete properly. The concrete shall be cured with an approved moisture barrier such as wet burlap, polyethylene, etc., for a period of seventy-two (72) hours. Cold weather curing shall be such that the concrete temperature shall be maintained above freezing for the entire curing period. Forms shall not be removed until the concrete is thoroughly set.

Control center foundations shall have four conduits for exiting cable. The direction of the exiting conduit and the orientation of the control center shall be determined by the City Engineer.

**f. Conduit**

It shall be the privilege of the Contractor at his own expense to use larger size conduit if desired; and where larger size conduit is used, it shall be for the entire length of the run from outlet to outlet. No reducing couplings will be permitted.

The location of all conduits installed or used in this project shall be marked by aluminum markers placed in the face of curb, gutter, or wall, directly above the conduit. The City will provide the markers.

The location of conduit runs shown on the plans are for bidding purposes only and may be changed with permission of the City Engineer in charge of construction to avoid underground obstructions. The conduit shall be installed continuous between the light poles, junction boxes, controllers, etc. and between all street lighting appurtenances generally within an area behind the back of curb and the right-of-way or within the street light easements. Snaking the conduit under the road will not be permitted. Continuous conduit shall be installed under all pavement crossings between street lighting appurtenances.

The conduit installed under all roadway surfaces shall be placed a minimum of forty-eight (48) inches below the top of curb elevation; under drives at a depth of between twenty-four (24) and thirty-six (36) inches below top of pavement; and within shoulders or park areas at a depth of between twenty-four (24) and thirty-six (36) inches below finished grade. Street lighting conduit may be installed in the same trench with traffic signal or fiber optic conduit as long as the minimum depth requirements are met

according to the standard details and a minimum of twelve (12) inches of vertical separation between the top of one conduit and the bottom of the other is maintained.

Conduit set in standard bases shall extend approximately three (3) inches above the foundation vertically. Conduit entering through the bottom of a junction box shall be located near the ends to leave the major portion of the box clear. Conduit entering service boxes shall terminate two (2) inches inside the box wall and shall be sloped to facilitate pulling of cable. At all outlets, conduit shall enter from the direction of the run.

Existing underground conduit to be incorporated into a new system shall be cleaned with a mandrel and blown out with compressed air.

(1) PVC Conduit

Conduit installed or used on this project between the street lighting control center and the Kansas City Power and Light Company service point shall be PVC and shall be made continuous. All joints in PVC conduit shall be glued. Connections from PVC conduit to HDPE conduit shall be by approved HDPE connectors as specified in section B "HDPE Conduit" and by the City Engineer. A factory 90° PVC conduit elbow shall be used for installation into a control center. At a light pole or junction box, a factory 90° PVC elbow may be used at the approval of the Streetlighting Inspector.

All PVC conduits shall be installed by the trenching method. Directional boring of PVC conduit will not be permitted.

(2) HDPE Conduit

It is desirable that the conduit be directional bored to minimize disruption to the existing improvements. Conduit shall be placed under existing pavement by approved boring methods. Pavement shall not be disturbed without the written permission of the City Engineer and then only in the event insurmountable obstructions are encountered. Boring pits shall be kept twenty-four (24) inches clear of the edge of any type of pavement wherever possible. Excessive use of water such that pavement might be undermined, or subgrade softened, will not be permitted.

The conduit entering equipment shall be continuous from outlet (junction box, light pole or control center) to outlet or as otherwise shown on the plans. A factory 90° PVC conduit elbow shall be used for installation into a control center. At a light pole or junction box, a factory 90° PVC elbow may be used or be "swept" into the junction box/light pole at the approval of the Streetlighting Inspector. Conduit bends or sweeps shall have a radius of not less than six (6) times the inside diameter of the conduit. Conduit bends shall be made without crimping or flattening, using the longest radius practicable.

An approved factory coupling shall be used for connection of the HDPE conduit to a 90° factory PVC elbow or between two lengths of HDPE conduit. The coupling shall be of high-density polyethylene. The coupling shall have individual reverse-locking threads with a built-in center stop. The ends of the conduit shall be grooved with a grooving tool to match the reverse-locking threads of the coupling to provide for greater pull-out resistance. The coupling shall be installed with a factory recommended coupling tool to ensure an airtight and watertight lock. No couplings or joints will be allowed at intermediate points unless approved by the City Engineer in charge of construction. All joints in HDPE conduit, if approved, shall be PNA E-Loc couplings or approved equal. Electrofusion splices are approved as an alternative to the E-Loc couplings.

The ends of all conduits shall be well reamed to remove burrs and rough edges. Field cuts shall be made square and true so that the ends will butt or come together for the full diameter thereof.

**g. Service and Junction Boxes**

Service and junction boxes shall be installed at the locations shown on the plans. The Contractor may install, at his own expense, such additional boxes as may be desired to facilitate the work upon approval of the City Engineer.

Service and junction boxes shall be installed on eighteen (18) and eight (8) inches of crushed rock respectively as shown on the plans or as directed by the City Engineer. Boxes shall be installed so that the

covers are level with the curb or sidewalk grade or level with the surrounding ground when no grade is established.

**h. Wiring**

The roadway lighting conductor system shall be installed in HDPE conduit, wired and installed as a 240 volt system where indicated and as required. Wiring shall conform to the appropriate articles of the National Electric Code. Wiring shall be continuous from street lighting appurtenance to street lighting appurtenance. No splices of cable will be permitted in conduit or outside of service boxes, junction boxes or pole bases.

Powdered soapstone, talc or other approved lubricant shall be used when inserting conductors in conduit. All cable to be installed in one conduit shall be pulled by the Contractor in one operation, and all ends shall be taped to exclude moisture and shall be so kept until the splices are made or terminal appliances attached. Ends of spare conductors shall be taped.

All splices in junction boxes and service boxes shall be made with appropriate split bolt connectors and/or 4 AWG copper crimp butt connectors. Such splices shall be carefully wrapped with three successive layers of linerless rubber splicing tape and then wrapped with three layers of electrical tape. The total diameter of the taped splice shall be approximately 1 ½ times the diameter of the spliced conductor covering.

One foot of slack shall be left at all control centers, junction boxes and service boxes for splicing and connecting wires. Wiring within boxes shall be neatly arranged and laced up. Wires shall be color-coded (Black = hot, green = ground) and circuits permanently identified in accordance with designations used on the plans.

All distribution cable connections inside the base of the light pole shall be made with multiple tap connectors provided with a slipover plastic boot. In-line waterproof, breakaway fused and non-fused disconnects, provided with slipover plastic boots, shall be installed in each light pole base. Two disconnects for each hot lead (fused) and one disconnect for the ground ("dummy fuse") shall be used. Two additional disconnects for the hot leads shall be provided for twin luminaire poles (ground disconnect is shared). Fuses shall be 8-amp high interrupting type. The multiple tap connectors and fuseholders shall be installed convenient to the handhole at the base of the pole. Surplus distribution cable shall be installed at the base of each pole such that, when extended upward, the multiple tap connectors are no less than 2" and no more than 5" above the top of the hand hole cover located at the base of the pole. A 12" to 14" cable surplus in each of the 1c#10 AWG pole and bracket cables is to be provided from the multiple tap connector to the line side of the fuse holder. The length of wire from the load side of the fuseholder to the luminaire shall have 18" of slack. The connectors for the ground shall be installed with the male end of the connector on the line side. The ground wire shall be fastened to the factory installed ground lug in the base of the light pole by a 3/8" ring terminal and 3/8" - 16 x 3/4" long hex bolt.

Luminaires not equipped with terminal blocks (post-top) shall be connected to the pole wiring with approved butt connectors.

**i. Grounding**

All poles shall be bonded to form a continuous system. At each multiple service point, a ground electrode shall be installed. The electrode shall be a copper rod not less than one half (1/2) inch in diameter and ten (10) feet in length, unless otherwise noted on the plans, driven to a depth so the top is six (6) inches below the surface of the ground. The service equipment shall be bonded to the driven ground rod by a No. 4 A.W.G. copper wire enclosed in a one (1) inch diameter conduit. If a single ground rod is used and its resistance exceeds 25 ohms, it must be augmented by one additional ground rod located no less than six feet from the original ground rod.

**j. Location**

Unless otherwise noted on the plans, or physical obstructions exist, equipment installed on this project shall be located as follows:

- (1) Conduit shall be kept a minimum of one foot behind the back of curb.
- (2) Street light poles shall be installed at least three feet behind the back of curb (to center of pole).
- (3) Junction boxes shall be installed at least two feet behind the back of curb (to center of box) and no closer than two feet to any street light pole.
- (4) Control centers shall be located in accordance with the applicable City Ordinances.

**k. Street Lighting Completion Time**

The street lights shall be installed in time to insure that they will be on and functioning no later than one week after the placing of the final street surface course. The contractor shall not delay the installation of the surface course to comply with this requirement.

## **38 - TRAFFIC SIGNAL INSTALLATION**

### **38.1 DESCRIPTION**

This work shall consist of furnishing all labor, materials and equipment to complete in place the traffic signal work as shown on the plans (including standard details), as specified in the following specifications, as directed by the Engineer, and in those sections of the standard specifications of the City of Overland Park, Kansas, and the Kansas Department of Transportation, that are either directly or by reference included herewith.

Whenever these specifications conflict with the plans, the General Specifications or the Kansas Department of Transportation Standard Specifications for State Road and Bridge Construction, current edition, (hereinafter referred to as "Standard Specifications") these traffic signal specifications shall govern.

**a. Replacing Damaged Improvements**

Improvements such as sidewalks, curbs, driveways, roadway pavements and any other improvements removed, broken or damaged by the Contractor shall be replaced or reconstructed with the same kind of materials found on the work or with materials of equal quality. The new work shall be left in a serviceable condition satisfactory to the Traffic Engineer. Whenever a part of a square or slab of existing concrete sidewalk, driveway or pavement is broken or damaged, the entire square or slab shall be removed and the concrete reconstructed.

**b. Traffic Signal Improvement Policies**

The work included in this project may involve modification of existing traffic signal equipment at locations which are presently controlled by operating traffic signals. If portions of the existing traffic signal installations are to be incorporated in the proposed signal installations, the following policies are to be observed during the installation of the proposed modifications and improvements:

The existing signal controls shall be kept in operation as long as practicable during installation of the proposed signal modifications and improvements, except for shutdowns, to allow for alterations as required for installation of the proposed improvements.

Some periods of disruption of existing signal operations can be tolerated during installation of the proposed improvements; however, the Contractor shall coordinate planned disruptions of signal operations with the Traffic Engineer, or his authorized representative, a reasonable time in advance of such disruption of operations.

All existing wiring within existing controller cabinets shall be identified by the Contractor and each conductor properly labeled prior to de-energizing the existing controller to install the proposed modifications and improvements.

Planned disruptions of signal operations shall be limited to the hours between 9:00 a.m. and 4:00 p.m., unless authorized otherwise by the Traffic Engineer. The signal controls shall be operable during all other periods.

## **38.2 MATERIALS**

All materials used in the fabrication or assembly of the items listed below shall comply with the applicable parts of Section 1703, "Electric Lighting and Traffic Signal Equipment" of the "Standard Specifications" with the additions as stated herein. Unless specifically noted otherwise, all signalization equipment shall be new and similar to the best grade of this type of equipment, and shall be approved by the Traffic Engineer.

The Contractor shall install all of the equipment and wiring necessary for intersection signalization as indicated on the plan and in accordance with this specification. The traffic signal system shall be complete, and the Contractor shall furnish and install all equipment necessary for the satisfactory operation of electrical apparatus and for the complete operation of the traffic signal system whether specifically mentioned or not

### **a. Approved Manufacturer's List**

All material for traffic signals used by the Contractor shall be from the City's approved list of vendors. It is important that users be completely knowledgeable of all application requirements and procedures prior to product application. It is the responsibility of the installer to contact the supplier of all materials if questions regarding application procedures or conditions arise.

### **b. Signal Heads**

Each signal head shall be a weather tight assembly of one or more signal faces of the expansible, adjustable, LED type, together with all brackets and fittings necessary for proper mounting with the type of signal support designated on the plans.

#### **(1) Vehicle Signal Heads**

Each signal face shall consist of one or more signal sections, rigidly and securely fastened together, capable of being positively positioned to control the movement of one direction of traffic. Each signal section shall be a self-contained assembly consisting of an optical unit with housing, housing door, and visor. Tie rods shall not be used to fasten signal sections together to form a signal face. All signal heads on a project shall be the product of one manufacturer. Terminal blocks of suitable size shall be placed in the bottom section of the signal head, except in the case of mast arm suspended signal heads wherein the terminal block shall be placed in the top section.

The housing for each signal section shall be made of a durable polycarbonate and shall be yellow in color, unless otherwise specified in the plans. It shall be clean, smooth and free from flaws, cracks, blowholes, and other imperfections. It shall be designed as a self-contained unit capable of separate mounting or inclusion in a signal face containing two or more signal sections rigidly and securely fastened together. It shall be equipped with round openings in the top and bottom so that it may be rotated between waterproof supporting brackets and thus be capable of being directed at any angle in the horizontal plane. It shall be equipped with positive locking devices to maintain a specific angle of direction when in place. The doors shall be black in color and suitably hinged and held securely to the body of the housing by simple stainless steel locking devices. All other door parts, such as hinge pins, lens clips, screws, etc., shall also be of stainless steel material. Neoprene gaskets shall be used between the lenses and reflectors to exclude dust and moisture.

The visors for each signal section shall be durable polycarbonate, black in color, not less than 0.05" in thickness. It shall be designed to fit tightly against the door, and shall not permit any perceptible filtration of light between it and the housing door. Visors shall be at least 9" long for 12" diameter signals, shall angle slightly downward, and shall be of the type specified on the plans.

The optical unit and visor shall be designed as a whole so as to eliminate the return of outside rays entering the unit from above the horizontal. Nominal 12" diameter signal LED's shall be furnished, unless otherwise shown on the plans.

#### **(2) Pedestrian Signal Heads**

The single-section pedestrian signal head unit shall be flat black door and yellow housing, without the standard Z-Crate visor, and with clamshell 2 mounting (Model 4805).

### **c. LED Kits**

The vehicular traffic signal heads shall be equipped with LED kits for all solid ball indications and single arrow indications. The pedestrian signal head shall be equipped with a LED kit for the don't walk "Hand Symbol", walking "Man" symbol and countdown timer indications.

The LED kit (including but not limited to LED's, circuit board, lens, 16 or 18 AWG wire leads with strain relief and insulation rated at 105 C, conductors, electronic switching module, rigid housing and neoprene one-piece gasket) shall conform to the following specifications.

Electrical components shall meet all applicable codes including Institute of Transportation Engineers (ITE) and nationally recognized electrical testing laboratories. They shall meet current ITE standards for intensity and spatial distribution after 30 minute warm-up of continuous operation. All signals shall comply with ITE standards for LED signals, including color.

The number of LED's per signal head shall be sufficient to achieve intensity to meet ITE photometric test criteria in "Vehicle Traffic Control Signal Heads". The LED's shall be arranged uniformly through the signal head and in an appropriate number of parallel strings to insure no string accounts for more than 6% of the total. LED's shall be in multiple series circuits connecting no more than 6% of the total LED's in any single circuit, or the failure of any single circuit shall not result in more than a 6% reduction in total luminous intensity.

All LED's shall be "AllnGap" Technology or equal for the Red, Yellow and Portland Orange products and "InGaN" Technology or equal for Green and White products (AlGaAs Technology is not acceptable), and rated for 100,000 hours or more (@ 25 C and 30 MA). Operating voltage shall be between 92 and 135 VAC, 60 HZ +/- 3. Operating temperatures shall be between -40 F and +165 F. Candlepower distribution shall meet ITE specifications. Brightness shall be maintained in the event of voltage fluctuations or surge, within 30% across the operating voltage and temperature range.

Control circuitry shall prevent current flow through the LED's in the off state to avoid false indication in daylight and evening hours. Beam spread shall meet all aspects of the ITE specifications. Lighting intensity shall not vary (nor flicker) by more than 30% over the allowable voltage and temperature range. Operating current measured across each LED shall not exceed an average of 30 milliamps. Transient voltage suppression of 1500 volts for 1 millisecond and fusing with a maximum rating of 2 amps are required.

Lenses shall be non-polycarbonate convex, minimum of 1/8" thick and free of flaws, bubbles, and imperfections. They shall meet the ITE color standards and 3 foot drop test. Chromaticity shall be measured in accordance with ITE standards at 44 points, meeting specifications after 30 minutes warm up.

The light output shall have a dominate wavelength of 620-635 nm for red and 596-610 nm for Portland Orange. Lens may be tinted or colored as long as the chromaticity of the lens matches that of the LED's and that luminous intensity is not reduced.

The LED units shall be field replaceable requiring no special tools or sealants for replacement and shall be smooth on the outside. Lead wires shall be a minimum of 18 inches with NEMA "Spade" type terminals for connection to existing terminal block. Pedestrian signals shall have a screw-in base and shall not use transformers. Enclosure shall be dust and water resistant.

The Bi-Modal LED Green/Yellow Arrow Kit shall display alternate legends consisting of a green or yellow directional arrow. The signal shall be the appropriate model for the type of mounting as indicated on the plans. The legend shall be clearly legible under any lighting conditions without the use of a visor and shall be visible at full intensity anywhere within a 20 degree cone centered about the optical axis. Provisions shall be made to help balance the intensity between the colors by supplying approximately 50% more light to the lenses when the green arrow is being displayed than to the yellow arrow display. All parts of the LED unit shall be mounted on a 12" diameter aluminum front panel to replace the lens in the case and shall be mounted on the door of the signal head. All components shall be readily accessible when the door is open. All screws, washers, nuts and bolts shall be corrosion-resistant.



#### **d. Signal Backplates**

Where shown on plans, 5" backplates shall be furnished and attached to the signal faces to provide a dark background for signal indications. Backplates shall be constructed of one piece durable black plastic capable of withstanding a 100 mph wind.

#### **e. Signal Head Mounting Brackets**

Bracket mounted signal heads, as shown on the plans, shall be supported by a one-piece mounting bracket watertight assembly made entirely of a durable polycarbonate and be yellow in color, unless otherwise specified in the plans. Each bracket shall be either plumb or level, symmetrically arranged and securely assembled. Each bracket shall have serrations for positioning traffic signals in increments of 5 degrees. Construction shall be such that all conductors are concealed within the assembly.

Signal heads shall not be installed at any intersection until all other signal equipment, including the controller, is in place and ready for operation at that intersection, except that the signal heads may be mounted if the heads are covered. The signal heads at a new signalized intersection shall be covered with an orange opaque (unless otherwise noted) signal head cover that is wind and weather resistant, and that is easily installed and removed. The color of the covering at a location where a previous traffic signal was installed shall be black.

Mast arm signal head assemblies shall be rigidly mounted utilizing a suitable assembly consisting of both top and bottom brackets and easily adjustable in both horizontal and vertical planes.

#### **f. Steel Traffic Signal Poles and Mast Arms**

Steel traffic signal poles and mast arms shall conform to Section 1608 of the "Standard Specification," the 1994 AASHTO Standard Specifications for Structural Supports for Signs, Luminaires and Traffic Signals, and the requirements on the plans. The poles and arms shall be round, tapered monotube made poles of one length of the best grade, structural steel sheet of not less than #7 Manufacturing Standard Gauge. Only one longitudinal weld, and no transverse welds, shall be permitted in the fabrication of the shaft or arm.

The steel anchor base of adequate strength, shape and size shall be secured to the lower end of the shaft by welding in such manner as to develop the full strength of the adjacent shaft section to resist bending action. The steel poles shall be galvanized to ASTM A-123 standards.

The tapered steel shaft shall include high strength anchor bolts and nuts, conforming to Section 1615, Type II of the "Standard Specifications." It should also include bolt covers, a handhole and cover, cast pole top, a J-hook wire support, and a suitable bolt on type device for attaching mast arm to the shaft as shown on detail sheet. The tapered steel arm shall include a removable end cap.

Where a combination lighting/signal pole is specified on the plans, the above applies with the luminaire arm to be mounted in the same vertical plane as the signal arm, except where otherwise noted on the plans. An approved pole extension shall be used for the luminaire support.

All traffic signal poles shall be detailed on shop drawings by the manufacturer indicating pole and arm dimensions and attachment method along with signal weight, projected areas, and type of mounting that it is designed to accommodate.

#### **g. Aluminum Pedestal Bases and Shaft**

Aluminum pedestal bases shall consist of aluminum, die cast or sand cast base and a shaft for mounting vertical signal or standard controller cabinet capable of withstanding wind loadings of 100 mph.

The cast aluminum bases should meet the requirements of Section 1626.2(b) ASTM B26, S.G.70A-T6, S5A.F. or ASTM B108, S.G.70A-T6 of the "Standard Specifications." The base and post shall be joined by a threaded connection. Welded connections will not be accepted. The threaded post shall be easily and fully screwed into the threaded pedestal base without lubricant and be secured to the base by means of a threaded set screw.

The shaft shall be spun from one piece of seamless tubing, meeting the requirements of Section 1626.2(b) ASTM B210, having a minimum nominal 0.125" wall thickness. The shaft shall have no

longitudinal welds, nor circumferential welds. The shaft shall have a uniform polished finish. Each shaft shall be tire-wrapped with a heavy water-resistant paper for protection during shipment and installation.

#### **h. Loop Detectors**

The term "inductive loop detector" applies to a complete installation consisting of a conductor loop or group of loops installed in the roadway, lead-in cable, and a sensor unit with power supply installed in a traffic signal controller cabinet.

##### **(1) Sensor Unit**

Sensor units mounted in the controller cabinet will be considered as part of the fully equipped cabinet. Sensor units which will be remote to the controller cabinet shall be solid state digital, providing two or four detection channels as indicated in the plans, with an inductance range of 0 to 2000 microhenries. Power failure shall result in a continuous call indication.

#### **i. Electrical Cable**

All electrical cable as called out for in the plans shall be new and shall meet the following specifications.

##### **(1) Detector Loop Wire**

The detector loop wire shall be #14 A.W.G., stranded, type THHN/THWN, 1-conductor cable with 15 mil wall black polyvinyl chloride / 4 mill wall of clear nylon insulation housed in black polyvinyl chloride tubing meeting IMSA specification 51-5. The polyvinyl chloride tubing shall be ULFR-1 rated 105 degrees C with a 0.030" wall thickness plus or minus 0.005".

##### **(2) Detector Lead-In Cable**

The 600 volt detector lead-in cable shall be composed of 2c #14 AWG stranded, tinned copper conductors insulated with 30 mil wall of low density color coded (one black and one clear) polyethylene. The conductors shall be wrapped with an aluminum bonded to polyester film with the foil facing out along with a #16 AWG tinned copper drain wire. The cable shall be provided in a jacket of 30 mil wall black low density polyethylene and constructed per IMSA 50-2 in a 3" left hand lay. The cable shall have identifying markings showing the manufacturer's name, IMSA 50-2, 600V and the year of manufacture.

##### **(3) Multi-Conductor Cable**

All conductor cable for intersection signalization and intersection interconnection shall be multi-conductor cable for operation on a 600 volt maximum, and suitable for use at conductor temperatures not exceeding 75 degrees C. Material, construction, and tests shall be in accordance with the applicable requirements of the Insulated Power Cable Engineers Association standard S-61-402 "Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy."

Conductors shall be stranded, annealed uncoated copper or annealed coated copper. Copper wire before insulating or stranding shall meet the requirements of the latest edition of ASTM B-33 (for coated wire) or ASTM B-3 (for uncoated wire). Stranding shall be Class B in accordance with the latest edition of ASTM B-8.

Insulation for the individual conductors shall consist of a 20 mil thickness of polyethylene, and an insulation covering a polyvinyl chloride compound with a 10 mil thickness. The polyethylene insulation shall meet the requirements of paragraph 3.9 of I.P.C.E.A. standard S-61-402 before application to the conductor, and paragraph 3.9.1 after application to the conductor. The polyvinyl chloride insulation covering shall meet the requirements of paragraph 4.3.1 of I.P.C.E.A. standard S-61-402, and shall be color coded in accordance with method 1 or 3, part 5 of I.P.C.E.A. standard S-61-402.

The overall cable jacket shall consist of a polyvinyl chloride compound which will provide a tough, heat, moisture, ozone, and flame resistant covering meeting the requirements of paragraph 4.3.1 of I.P.C.E.A. standard S-61-402. The overall jacket thickness shall be in accordance with Table 18, part 4, I.P.C.E.A. standard S-61-402. As an acceptable alternate, the Contractor may use multi-conductor, stranded, cable meeting the requirements of International Municipal Signal Association, Inc. Specification 19-1 (1967) for Polyethylene-Insulated, Polyvinyl Chloride Jacketed Signal Cable.

(4) Power Lead-In Cable

Power lead-in cable shall be of the sizes and number of conductors as shown on the plans. The cable shall be for operation on a 600 volt maximum and suitable for use at conductor temperatures not exceeding 75 degrees C. Material, construction, and tests shall be in accordance with the applicable requirements of the I.P.C.E.A. standard S-66-524 "Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy."

Conductors shall be stranded, annealed coated copper. Copper wire, before insulating or stranding, shall meet the requirements of the latest edition of A.S.T.M. B-33 (for coated wire). Stranding shall be Class B, in accordance with the latest edition of A.S.T.M. B-8.

Insulation shall consist of cross-linked thermosetting polyethylene, meeting the requirements of column B of I.P.C.E.A., and listed by U.L. as type U.S.E. RHW-75 degrees C.

**j. Service Circuit Breakers**

The contractor shall provide circuit breakers as shown on the plans for secondary power drop. The circuit breakers shall be single pole, molded case breakers of the size and trip rating shown on the plans and shall be manufactured by GE or Westinghouse. The circuit breakers shall be provided in a combination meter can/breaker box, rain-tight enclosure provided with a hasp for a padlock and shall be a Meyers MES1-SE or approved equal. Padlocks will be provided by others.

**k. Conduit**

Conduit shall be of the material type and size as specified in the plans or standard details.

(1) HDPE Traffic Signal Conduit

The conduit shall exhibit good workmanship and be free from holes, blisters, inclusions, cracks, and homogenous throughout. There should not be any foreign particles embedded in the plastic as a result of the extrusion process. There should not be any surface distortions that penetrate either internally or externally into the conduit wall greater than 10% of the minimum wall thickness. The conduit shall be constructed of polymeric materials which are lightweight, flexible, corrosion resistant and nonconductive. The base material shall be clean, virgin grade high-density polyethylene (HDPE) which conforms to ASTM D3350, most recent edition, Type III. Any regrind material shall be non-wide specification, reworked from the same virgin material from the same manufacturer as the original conduit. The conduit shall have a controlled outside diameter with the cross-sectional dimensions meeting SDR 13.5 manufactured to ASTM D3035 specifications and having a minimum ASTM cell classification 334480EB. The conduit shall be smooth walled inside and out with a minimum coefficient of friction of 0.35. The conduit shall meet the following minimum requirements:

Density	> 0.940 g/cc	ASTM D-1505
Melt Index	< 0.4 gm/10 min.	ASTM D-1238(E)
Flexural Modulus	> 80,000 psi	ASTMD-790
Tensile Strength	> 3,000 psi	ASTM D-638
Slow Crack Growth		
ESCR (Bell Test)	10% Igepal	ASTM D-1693
Test Duration	192 hours minimum	ASTM D-1693
Failure	10% max	ASTM D-1693
Molded Plaque	3	ASTM D-1693
Hydrostatic Strength Class	NPR	ASTM D-2837
Color and UV Stabilizer	E > 2%	ASTM D-3350
Ultimate Elongation	>400 %	ASTM D-638

Minimum wall thickness shall be in accordance with the following table:

<u>Diameter</u>	<u>Wall Thickness</u>
1 ½" SDR 13.5	0.141"
2" SDR 13.5	0.176"
3" SDR 13.5	0.259"
4" SDR 13.5	0.333"

Traffic Signal conduit shall be sized according to the plans for 1 ½", 2", 3" and/or 4" in diameter. The conduit shall be pigmented throughout the entire cross-section so as to produce a uniform red color, forming an integral part of the product. It shall be extruded with three longitudinal white identifying stripes along its entire length. All colors shall be produced from light stabilized pigments, which are further protected from ultra-violet (UV) degradation by the incorporation of Hindered Amine Light Stabilizers (HALS) allowing protection for up to two years of outside storage. The conduit shall be sequentially marked and identified along its outer length in contrasting color and with a print of at least 0.125" height. The print interval shall not exceed five feet and shall include: 1) Manufacturer's name, 2) Product name/number, 3) Production code and 4) Length of Conduit (in feet).

The conduit coming off the reel shall return to a circular shape upon the release of tension when it is unreel. The conduit ovality as defined in ASTM D-2122 shall not exceed the percentage listed in the following table per ASTM F-2160:

<u>Diameter</u>	<u>% Ovality</u>
1 ½"	7%
2"	7%
3"	10%
4"	15%

When conduit 3" or above in diameter exceeds 10% ovality, it may be used if the contractor uses re-rounding equipment until 10% ovality or less is achieved. The mean elongation defined as the change in length divided by the original length, multiplied by 100 at a given load shall not be more than 10%. The conduit shall recover to a minimum of 95% of its original outer diameter upon release of a 200 pound load or shall not deflect to more than 5% of its original inside diameter within 10 minutes after removal of the compressive load.

(2) HDPE Conduit Fittings:

An approved factory coupling as listed in the Overland Park Approved Equipment List shall be used for connection of the HDPE conduit to a 90° factory PVC elbow or between two lengths of HDPE conduit.

**38.3 CONSTRUCTION REQUIREMENTS**

The contractor shall only use qualified laborers who are well trained to perform functions related to traffic signals, including familiarity with applicable sections of the National Electric Code. The "Standard Specifications" shall be amended by the addition of the following:

**a. Service Boxes**

Service boxes shall be installed at the locations shown on the plans and at such additional points as the Contractor, at his own expense, may desire to facilitate the work. All service boxes are to be provided with cable hooks as detailed on the plans. Service boxes shall be fiberglass reinforced polymer concrete.

### **b. Junction Boxes**

Junction boxes located in non-traffic areas (such as in inland areas and behind the curb) shall be installed at the locations shown on the plans and at such additional points as the Contractor, at his own expense, may desire to facilitate the work. Junction boxes furnished shall be fiberglass reinforced polymer concrete of a size as indicated in the plans.

Junction boxes subject to traffic (located in the street) have been denoted "traffic-rated junction box" on the plans and shall be installed at the locations shown on the plans and at such other locations as the Contractor, at his own expense, may desire to facilitate the work. Traffic-rated junction boxes shall be furnished and installed as detailed on the plans.

### **c. HDPE Conduit**

The location of conduit runs shown on the plans are for bidding purposes only and may be changed with permission of the Engineer in charge of construction to avoid underground obstructions. Installation shall conform to the appropriate articles of the National Electrical Safety Code. The conduit shall be installed continuous from outlet (service box, or junction box) to outlet or as otherwise shown on the plans. No couplings or joints will be allowed at intermediate points unless approved by the Engineer in charge of construction. The conduit may be directional bored to minimize disruption to the existing improvements, or trenched.

Boring pits shall be kept two (2) feet clear of the edge of any type of pavement wherever possible. Excessive use of water such that pavement might be undermined, or subgrade softened, will not be permitted.

Conduit entering equipment shall be continuous into the service box, junction box, and control center. A factory 90° PVC conduit elbow shall be used for installation into concrete control center foundations or signal foundations.

A ½" x 8' ground rod and ground rod clamp shall be installed in each type FO service box and traffic signal service box for attachment of the #10 AWG THHN stranded copper locating/ground cable. See the standard details for additional information.

The ends of the conduit shall be grooved with a grooving tool to match the reverse-locking threads of the coupling to provide for greater pull-out resistance. The coupling shall be installed with a factory recommended coupling tool to ensure an airtight and watertight lock. The ends of all conduit shall be well reamed to remove burrs and rough edges. Field cuts shall be made square and true so that the ends will butt or come together for the full diameter thereof.

Conduit set in standard concrete foundations shall extend approximately three (3) inches above the foundation vertically. Conduit shall enter from the direction of the run. It shall be the privilege of the Contractor at his own expense to use larger size conduit if desired; and where larger size conduit is used, it shall be for the entire length of the run from outlet to outlet. No reducing couplings will be permitted.

The location of ends of all conduit installed or used in this project shall be marked by aluminum markers placed in the face of curb, gutter, or wall, directly above the conduit. The markers will be provided by the City.

### **d. Wiring**

Where practical, color codes shall be followed so that the red insulated conductor connects to the red indication terminal, yellow to yellow, and green to green. Circuits shall be properly labeled in all service boxes and at the controller by permanent plastic identification tags appropriately attached to the cables by an approved method. Metal identification tags are not allowed. Information on the tags shall identify equipment served by the conductor cable in accordance with designations used on the plans.

### **e. Bonding and Grounding**

All conduit, steel poles and pedestals shall be bonded to form a continuous system, and effectively grounded. Bonding jumpers shall be No. 6 A.W.G. bare, solid copper wire or equal connected by approved clamps. Grounding of conduit and neutral at service point shall be accomplished as required by the National Electric Safety Code, except bonding jumpers shall be No. 6 A.W.G. or equal. Ground electrodes

shall be provided at each signal pole and pedestal and at the controller as detailed on the plans. If a single ground rod is used and its resistance exceeds 25 Ohms, it must be augmented by one additional ground rod located no less than 6 feet from the original ground rod.

**f. Detector Loops**

Installation shall conform to the details and notes shown on the plans. Loop wire shall be one continuous wire with each partial loop to be in the configuration detailed on the plans. All loop conductors shall be wound in the same direction with the start and end clearly marked on the conductors at the junction or service box. Conductors of all loops to be operated shall be run continuous to the nearest junction or service box. The loop conductors for each loop shall be spliced in the junction or service box to a detector lead-in cable running from the box to a sensor unit mounted in the controller cabinet

Saw cuts for loop wires shall be made with a self-propelled, water cooled power saw. The water is used to cool and lubricate the blade and eliminate blowing saw dust. All jagged edges or sharp corners and protrusions shall be removed using a small chisel and hammer. The saw cut shall be cleaned of cutting dust, grit, oil and other contaminates. The saw cut shall be flushed clean with water and dried with compressed dry air immediately after cutting. Care shall be taken during the cutting and cleaning operation to avoid blowing debris at passing pedestrians and vehicles or onto private property.

After conductors are installed in the slots cut in the pavement, the slots shall be filled with epoxy sealant for concrete, or an approved asphalt sealer for a bituminous surface, to within 1/8" of the pavement surface. The sealant shall be between 2" and 3" thick above the top conductor in the saw cut as determined by the saw cut depth and as indicated in the plans. Before setting, surplus sealant shall be removed from the adjacent road surfaces without the use of solvents. Sand or other absorbent material shall be spread over the sealant if traffic is allowed over the loop before the sealant is completely set.

## **39 - FIBER OPTIC COMMUNICATION SYSTEM INSTALLATION**

### **39.1 DESCRIPTION**

This specification covers the furnishing and installation of fiber optic communication system infrastructure as shown on the plans. Work under this item shall consist of furnishing and installing fiber optic conduit and cable, removal and reinstallation of existing fiber optic cable, furnishing and installing fiber optic Ethernet switches, performing fiber optic terminations, and communication system testing.

The work provided for in these Specifications shall consist of furnishing all labor, materials, appliances, and equipment, and performing all work and operations in connection with the construction of fiber optic communication system items and all other incidental and related work as set forth in these Specifications and as directed by the Engineer to make a complete and finished job.

### **39.2 MATERIALS**

Unless specifically noted otherwise, all fiber optic materials and equipment shall be new and similar to the best grade of this type of equipment, and shall be approved by the Traffic Engineer.

The Contractor shall install all of the equipment and cabling necessary for the communication system as indicated on the plan and in accordance with this specification. The fiber optic communication system shall be complete, and the Contractor shall furnish and install all equipment necessary for the satisfactory operation of the system whether specifically mentioned or not.

**a. Approved Manufacturer's List**

All material for street lighting used by the Contractor shall be from the City's approved list of vendors. It is important that users be completely knowledgeable of all application requirements and procedures prior to product application. It is the responsibility of the installer to contact the supplier of all dynamic message sign materials if questions regarding application procedures or conditions arise.

**b. HDPE Conduit and Couplings**

The conduit shall exhibit good workmanship and be free from holes, blisters, inclusions, cracks, and homogenous throughout. There should not be any foreign particles embedded in the plastic as a result of the extrusion process. There should not be any surface distortions that penetrate either internally or externally into the conduit wall greater than 10% of the minimum wall thickness. The conduit shall be constructed of polymeric materials which are lightweight, flexible, corrosion resistant and nonconductive. The base material shall be clean, virgin grade high-density polyethylene (HDPE) which conforms to ASTM D3350, most recent edition, Type III. Any regrind material shall be non-wide specification, reworked from the same virgin material from the same manufacturer as the original conduit. The conduit shall have a controlled outside diameter with the cross-sectional dimensions meeting SDR 13.5 manufactured to ASTM D3035 specifications and having a minimum ASTM cell classification 334480EB. The conduit shall be smooth walled inside and out with a minimum coefficient of friction of 0.35. The conduit shall meet the following minimum requirements:

Density	> 0.940 g/cc	ASTM D-1505
Melt Index	< 0.4 gm/10 min.	ASTM D-1238(E)
Flexural Modulus	> 80,000 psi	ASTMD-790
Tensile Strength	> 3,000 psi	ASTM D-638
Slow Crack Growth		
ESCR (Bell Test)	10% Igepal	ASTM D-1693
Test Duration	192 hours minimum	ASTM D-1693
Failure	10% max	ASTM D-1693
Molded Plaque	3	ASTM D-1693
Hydrostatic Strength Class	NPR	ASTM D-2837
Color and UV Stabilizer	E > 2%	ASTM D-3350
Ultimate Elongation	>400 %	ASTM D-638

Minimum wall thickness shall be in accordance with the following table:

<u>Diameter</u>	<u>Wall Thickness</u>
2" SDR 13.5	0.176"
3" SDR 13.5	0.259"

Fiber optic conduit shall be sized according to the plans for 2" or 3" in diameter. The conduit shall be pigmented throughout the entire cross-section so as to produce a uniform orange color, forming an integral part of the product. All colors shall be produced from light stabilized pigments, which are further protected from ultra-violet (UV) degradation by the incorporation of Hindered Amine Light Stabilizers (HALS) allowing protection for up to two years of outside storage. The conduit shall be sequentially marked and identified along its outer length in contrasting color and with a print of at least 0.125" height. The print interval shall not exceed five feet and shall include: 1) Manufacturer's name, 2) Product name/number, 3) Production code and 4) Length of Conduit (in feet).

The conduit coming off the reel shall return to a circular shape upon the release of tension when it is unreeled. The conduit ovality as defined in ASTM D-2122 shall not exceed the percentage listed in the following table per ASTM F-2160:

<u>Diameter</u>	<u>% Ovality</u>
2"	7%
3"	10%

When conduit 3" or above in diameter exceeds 10% ovality, it may be used if the contractor uses re-rounding equipment until 10% ovality or less is achieved. The mean elongation defined as the change in length divided by the original length, multiplied by 100 at a given load shall not be more than 10%. The conduit shall recover to a minimum of 95% of its original outer diameter upon release of a 200 pound load or shall not deflect to more than 5% of its original inside diameter within 10 minutes after removal of the compressive load.

Fiber Optic conduit shall be equipped with a #10 AWG stranded THHN/THWN copper locating cable. The locating cable insulation shall be colored red.

(1) HDPE Conduit Fittings:

An approved factory coupling as listed in the Overland Park Approved Equipment List shall be used for connection of the HDPE conduit to a 90° factory PVC elbow or between two lengths of HDPE conduit.

**c. Tracer Wire / Ground Rods**

The locating cable shall be single conductor cable with minimum 600 volt rating and shall be and a #10 AWG THHN/THWN stranded annealed copper. The locating cable insulation shall be colored red. The polyethylene insulation shall meet the requirements of paragraph 3.9 of I.P.C.E.A. standard S-61-402 before application to the conductor, and paragraph 3.9.1 after application to the conductor. The locating cable shall be pulled through the installed conduit by use of a polyester/polypropylene pull rope. Caution should be taken as to not burn or tear the conduit ends or conduit body.

A 1/2" x 8 ground rod with ground rod clamp shall be installed in each fiber optic service box for attachment of the #10 AWG THHN/THWN stranded copper locating cable. See the standard details for additional information. The locating cable shall be bonded to the ground rod so as to provide a continuous locating system throughout the limits of the project.

**d. Fiber Optic Service Box**

The fiber optic service box shall be constructed of a polymer concrete consisting of graded aggregate of sand and gravel bound together with a polymer resin system and reinforced with continuous woven glass strands. The use of chopped fiberglass strands applied with a "chopper gun" or the use of high density polyethylene or high density polystyrene is prohibited. To assure consistent production from part to part, only matched metal tooling is to be used to manufacture the product. The material must have the following mechanical properties:

Compressive Strength	11,000 psi	ASTM C-109
Tensile Strength	1,700 psi	ASTM C-496
Flexural Strength	7,500 psi	ASTM D-790

The boxes and covers shall be gray and shall be of the approximate size shown on the plans or details. The box shall contain cleanout holes beneath the cover bolt sleeves for ease of cleaning accumulated debris. Covers shall be skid resistant with "FIBER OPTIC" logo permanently recessed in the cover. The cover shall be provided with stainless steel bolts.

**e. Fiber Optic Cable**

Work under this item shall consist of furnishing and installing 6, 12, 36, and 72 Count Fiber Optic Communications Cable as shown on the Plans, and as hereinafter provided.

Fiber Optic Cable shall meet the following minimum requirements:



(1) Fiber Characteristics

All fibers in the cable must be usable fibers and meet required specifications. Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding. The fiber shall be matched clad design.

Core Diameter	8.3 micron.
Cladding Diameter	125.0 +/- 1.0 micron.
Core-to-Cladding Offset	< 0.8 micron.
Cladding Non-Circularity	< 1.0%.
Coating Diameter	245 +/- micron.
Colored Fiber Diameter	Nominal 250 micron.
Attenuation Uniformity	No point discontinuity > 0.10 dB at either 1310 or 1550 nm.
Attenuation at the Water Peak	The attenuation at 1383 nm shall not exceed 2.1 dB/km.
Cutoff Wavelength	< 1260 nm
Mode-Field Diameter	9.30 +/- micron at 1310 nm, 10.50 +/- 1.00 micron at 1550 nm

The coating shall be a dual layered, UV-cured acrylate applied by the fiber manufacturer, and shall be mechanically strippable.

(2) Fiber Parameters

All fibers in the cable must meet the following required parameters:

Fiber Type	Single Mode
Required Fiber Grade- Maximum Individual Fiber Attenuation	The maximum dispersion shall be < 3.2 ps/(nm * km) from 1285 nm to 1330 nm and < 18 ps/(nm * km) at 1550 nm
Required Minimum Load	100 kpsi

The fiber manufacturer shall proof-test 100% of the optical fiber to verify that the cable is capable of sustaining a minimum load of 100 kpsi.

(3) Fiber Construction

Optical fibers shall be placed inside a loose buffer tube. The fibers shall not adhere to the inside of the buffer tube. Each buffer tube and fiber shall be distinguishable by means of color coding according to the TIA/EIA-598 Specifications, "Optical Fiber Cable Color Coding." Buffer tubes containing fibers shall be color-coded with distinct and recognizable colors according to the above references specification.

In buffer tubes containing multiple fibers, the colors shall be stable across the specified storage and operating temperature range and not subject to fading or smearing onto each other or into the gel filling material. Colors shall not cause fibers to stick together.

Buffer tubes shall be kink resistant within the specified minimum bend radius.

Fillers may be included in the cable core to lend symmetry to the cable cross-section where needed.

The central anti-buckling member shall consist of a glass reinforced plastic rod. The purpose of the central member is to prevent buckling of the cable.

Each buffer tube shall be filled with a non-hygroscopic, non-nutritive to fungus, electrically non-conductive, homogenous gel. The gel shall be free from dirt and foreign matter. The gel shall be readily removable with conventional nontoxic solvents. Buffer tubes shall be stranded around a central member using the reverse oscillation, or "S-Z", stranding process.

The cable core shall contain a water-blocking material. The water blocking material shall be non-nutritive to fungus, electrically non-conductive and homogenous. It shall also be free from dirt and foreign matter and shall be readily removable with conventional (nontoxic) solvents.

Binders shall be applied with sufficient tension to secure the buffer tubes to the central member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking and dielectric with low shrinkage. The cable shall contain at least one ripcord under the sheath for easy sheath removal. Tensile strength shall be provided by a combination of high tensile strength dielectric yarns. The high tensile strength dielectric yarns shall be helically stranded evenly around the cable core.

All-dielectric cables (with no armoring) shall be sheathed with medium density polyethylene (MDPE). The minimum nominal jacket thickness shall be 1.4 mm. Jacketing material shall be applied directly over the tensile strength members and water blocking material. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

The jacket or sheath shall be free of holes, splits, and blisters. The cable jacket shall contain no metal elements and shall be of a consistent thickness. Cable jackets shall be marked with the Manufacturer's Name, Optical Cable-Year, Telephone Handset Symbol, (as required by Section 350G of the National Electrical Safety Code).

The cable length shall also be marked every meter. The actual length of the cable shall be within  $-0/+1\%$  of the length markings. Cable marking shall be in contrasting color to the cable jacket. The height of the marking shall be approximately 2.5 mm.

The maximum pulling tension shall be 600 lbf during installation (short term) and 200 lbf long term installed

The shipping, storage, and operating temperature range of the cable shall be -40 degrees C to +70 degrees C. The installation temperature range of the cable shall be -30 degrees C to +70 degrees C.

When tested in accordance with FOTP-3, "Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components," the average change in attenuation at extreme operational temperatures (-40 degrees C to +70 degrees C) shall not exceed 0.05 dB/km at 1550 nm for single-mode fiber. The magnitude of the maximum attenuation change of each individual fiber shall not be greater than 0.15 dB/km at 1550 nm.

#### (4) General Cable Performance Specifications

When a one-meter static head or equivalent continuous pressure is applied at one end of a one-meter length of unaged cable for 24 hours, no water shall leak through the open cable end. When a one-meter static head or equivalent continuous pressure is applied at one end of a one-meter length of aged cable for one hour, no water shall leak through the open cable end. The aging cycle is defined as exposing the cable to +85E " 2E C for 168 hours and two cycles of -40 degrees C to +70 degrees C with cable held at these temperatures for 24 hours. At the end of this cycle, the cable will be decreased to +23 degrees C and held for 24 hours. The water penetration test is completed at the end of the 24-hour hold. Testing shall be performed in accordance with the industry standard test, FOTP-82, "Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable."

When tested in accordance with FOTP-81, "Compound Flow (Drip) Test for Filled Fiber Optic Cable", the cable shall exhibit no flow (drip or leak) of filling and/or flooding material at +65 degrees C.

The cable shall withstand a minimum compressive load of 250 lbf/in for armored cables and 125 lbf/in for non-armored cables applied uniformly over the length of the compression plate. The cable shall be tested in accordance with FOTP-41, "Compressive Loading Resistance of Fiber Optic Cables," except that the load shall be applied at the rate of 1/8" to 3/4" per minute and maintained for ten minutes. The magnitude of the attenuation change shall be within the repeatability of the measurement system for 90% of the test fibers. The remaining 10% of the fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm (SM). The repeatability of the measurement system is typically 0.05 dB or less. No fibers shall exhibit a measurable change in attenuation after load removal.

When tested in accordance with FOTP-104, "Fiber Optic Cable Cyclic Flexing Test," the cable shall withstand 25 mechanical flexing cycles at a rate of 30 cycles per minute around a sheave diameter not greater than 20 times the cable diameter. The magnitude of the attenuation change shall be within the repeatability of the measurement system for 90% of the test fibers. The remaining 10% of the fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm (SM). The repeatability of the measurement system is typically 0.05 dB or less. For armored cables, the inside or outside of the armor surface shall be inspected for fractures. Any visible cracks causing separation of the armor shall not have propagated more than 3/16". The outer cable jacket shall not exhibit evidence of cracking or splitting when observed under 5x magnification.

When tested in accordance with FOTP-25, "Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies," the cable shall withstand 25 impact cycles. The magnitude of the attenuation change shall be within the repeatability of the measurement system for 90% of the test fibers. The remaining 10% of the fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm (SM). The repeatability of the measurement system is typically 0.05 dB or less. The cable jacket shall not exhibit evidence of cracking or splitting at the completion of the test.

When tested in accordance with FOTP-33, "Fiber Optic Cable Tensile Loading and Bending Test," using a maximum mandrel and sheave diameter of 560 mm, the cable shall withstand a tensile load of 600 lbf applied for one hour (using "Test Condition II" of the procedure). In addition, the cable sample, while subjected to a minimum load of 600 lbf, shall be able to withstand a twist of 360 degrees in a length of less than 10 feet. The magnitude of the attenuation change shall be within the repeatability of the measurement system for 90% of the test fibers. The remaining 10% of the fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm (SM). The repeatability of the measurement system is typically 0.05 dB or less. The cable shall not experience a measurable increase in attenuation when subjected to the rated residual tensile load, 200 lbf.

When tested in accordance with FOTP-85, "Fiber Optic Cable Twist Test," a length of cable no greater than 2 meters will withstand 10 cycles of mechanical twisting. The magnitude of the attenuation change will be within the repeatability of the measurement system for 90% of the test fibers. The remaining 10% of the fibers will not experience an attenuation change greater than 0.1 dB at 1550 nm. The repeatability of the measurement system is typically 0.05 dB or less. The average increase in attenuation for the fibers shall be < 0.40 dB at 1300 nm. The cable jacket will exhibit no cracking or splitting when observed under 5X magnification after completion of the test.

When tested in accordance with FOTP-181, "Lightning Damage Susceptibility Test for Optic Cables with Metallic Components," the cable shall withstand a simulated lightning strike with a peak value of the current pulse equal to 105 kA. A damped oscillatory test current shall be used with a maximum time-to-peak value of 15 Fs (which corresponds to a minimum frequency of 16.7 kHz) and a maximum frequency of 30 kHz. The time to half-value of the waveform envelope shall be from 40 - 70 Fs.

#### (5) Certification

It is the responsibility of the Contractor to insure that all of the above tests have been performed by the manufacturer or an independent testing laboratory, and the appropriate documentation has been submitted to the Engineer. Manufacturer certification is necessary for the model of closure to the actual tests described herein.

#### (6) Quality Assurance Provision

All cabled optical fibers greater than 3,300 feet in length shall be 100% attenuation tested. The attenuation of each fiber shall be provided with each cable reel. The Contractor shall provide all attenuation test results by each reel prior to installation of any cable from said reel. The cable manufacturer shall be ISO 9001 registered. The cable manufacturer shall provide installation procedures and technical support concerning the items contained in this specification. The Manufacturer shall certify that the supplied cable meets all requirements of these specifications.

(7) Packaging

The completed cable shall be packaged for shipment on non-returnable wooden reels. Top and bottom ends of the cable shall be available for testing. Both ends of the cable shall be sealed to prevent the ingress of moisture. Each reel shall have a weatherproof reel tag attached identifying the reel and cable.

A cable data sheet shall accompany each cable. The following information shall be included:

- CABLE NUMBER
- FACTORY ORDER NUMBER
- CUSTOMER PURCHASE ORDER NUMBER
- MEASURED ATTENUATION OF EACH FIBER (FOR LENGTHS > 3,300 Ft)
- ORDERED LENGTH
- ACTUAL SHIPPED LENGTH

All cables installed shall be pulled into the conduit, multi-cell or otherwise, using a flat woven pull tape. The Contractor shall not use a single of pull tape for more than a single cable pull. The Contractor shall install the pull tape and fiber optic cables in accordance with the testing procedures completed for this project and the pull tape and cable manufacturer’s recommendations.

**f. ITS Termination Drop Cable**

The ITS termination drop cable shall be a factory terminated patch panel that is compact, durable and secure as detailed in the standard details and as specified herein.

(1) ITS Patch Panel Design

The ITS termination patch panel shall be a factory terminated design with a plug-in feature eliminating the need for on site terminations. It shall be pre-terminated and pre-tested. It shall be available as single-mode fiber in either a 6-count or 12-count as specified in the plans with ST connectors that are factory tested and labeled to insure proper installation. The termination panel shall have a stair-step design with mounting holes for rack mounting and shall include stainless steel hardware. The housing shall be ABS plastic and potted with epoxy with a strain relief grommet at the housing exit. All terminations shall come equipped with removable dust caps.

(2) Distribution Lead-in Cable Design

The distribution lead-in cable shall be an OFNR-rated, all-dielectric cable that is UV-resistant and is fully water-blocked for both indoor and outdoor use. It shall have a 3.0 mm buffer-tube containing six to twelve color-coded fibers as indicated in the plans for a minimum installed bend radius of 2.8”. The patch panel shall be equipped with a pigtail length of cable long enough to run from the splice enclosure continuous to the traffic signal controller cabinet, including slack coil length, with the required length as specified in the plans.

(3) Technical Specifications

Test:	Characteristics
Insertion Loss	0.15 typical
Reflectance	< -40 dB SPC
Durability	1000 rematings <0.20 dB change
Tensile Strength	50 lbs (220 N) < 0.20 dB change
Temperature Cycling	-40 degrees C + 70 degrees C, 40 cycles <0.20 dB change
Inside Polishing	Super Physical Contact (SPC)
Ferrule Material	Ceramic
Housing Material	ABS Plastic

### **g. Fiber Optic Ethernet Switch**

The fiber optic Ethernet switch shall consist of a switch, a power supply and two small form-factor pluggable transceivers (SFP).

#### (1) General Characteristics

General Characteristics

DIN-Rail Mount

5-year limited warranty

#### (2) Connectors

8 - Ethernet 10/100 copper ports (RJ45)

2 - dual-purpose uplink ports (dual purpose ports supports one active copper 10/100/1000 or SFP

Fiber)

#### (3) Power Supply

Support 110/220VAC and 88-300VDC input

24VDC/2.1 Amp Output

DIN-Rail Mount

#### (4) Small form-factor pluggable transceivers (SFP)

Operating temperatures -40 to 185° F

1310 Wavelength

Single Mode Fiber

10 km cable distance

LC connectors

#### (5) Electrical & Environmental Characteristics

Operating Temperature of -34 to +60 degrees C

120VAC External Universal Power Supply (2A, 15W)

MTBF > 300,000 hours

#### (6) Network Management

Console port access via RS-232 cable

Telnet Remote Access

Web browser support (HTTP)

SNMP v2 (RFC 1157)

MIB I (RFC 1757)

MIB II (RFC 2918)

Bridge MIB (RFC 1493)

IGMP MIB (RFC 2933)

RMON 1 MIB (RFC 2918)

Java applet-based MIB browser

TFTP software-upgrade capability

#### (7) LED Indication

Per Unit - Power status

Per Port - 100/TX, 10/RX, FDX/COL (3 LEDs)

(8) Functional / Misc. Characteristics

Layer 2 switching required but shall be capable of layer 3 switching

256 VLANs

8000 MAC Addresses

2 MB buffer memory

Forwarding rates wire speed of 14,880 pps @ 10Mbps

Forwarding rates wire speed of 148,800 pps @ 100Mbps

Minimum rerouting time of 500 milliseconds when configured in a ring installation

**h. Fiber Optic Patch Cables**

Fiber Patch Cords, 6 Feet, shall meet or exceed the following specifications:

(1) General

6 Feet long

Single Mode Duplex Fiber

(2) Connectors

ST-LC connectors for patch cables interconnecting termination panels to fiber optic Ethernet switches.

(3) Environmental

Temperature: 32 F to 113 F

Storage Temperature: - 25 F to +165 F

Relative Humidity: Up to 90%, non-condensing

**i. Fiber Optic Fusion Splices**

The fiber optic splice enclosures shall be designed for use under the most severe conditions such as moisture, vibration, impact, cable stress and flex temperature extremes as demonstrated by successfully passing the factory test procedures and minimum specifications listed below:

In the event that the Contractor is performing fiber optic fusion splices in existing splice enclosures where an insufficient number of splice trays are present, the Contractor shall provide splice trays for installation in the existing splice enclosure. Splice organizer trays shall accept mechanical, fusion, or multi-fiber array splices, and shall be re-enterable.

**j. Splice Enclosures**

Fiber optic splice enclosures shall meet or exceed the following specifications.

(1) Physical Requirements

The splice enclosure shall be a “bell” type enclosure to ensure that it shall prevent the intrusion of water without the use of encapsulates. No “clam” type enclosures shall be allowed. The enclosure must handle up to four cables in a butt configuration. A butt adapter may be used to increase capacity to six cables.

The enclosure shall prevent the intrusion of water without the use of encapsulates and be capable of accommodating splice organizer trays that accept mechanical, fusion, or multi-fiber array splices. The splice enclosure shall have provisions for storing fiber splices in an orderly manner, mountings for splice organizer assemblies, and space for excess or unspliced fiber. Splice organizers shall be re-enterable. Splice cases shall hold a sufficient number of splice trays to hold up to 96 splices. The splice case shall be UL rated.

Enclosure re-entry and subsequent reassemble shall not require specialized tools or equipment. Further, these operations shall not require the use of additional parts.

The splice enclosure shall have provisions for controlling the fiber bend radius to a minimum of 38 mm.

(2) Factory Testing:

The enclosure shall be able to meet the following testing requirements.

(a) Compression Test

The enclosure shall not deform more than 10% in its largest cross-sectional dimension when subjected to a uniformly distributed load of 300 lbf at a temperature of 0°F and 100°F. The test shall be performed after stabilizing at the required temperature for a minimum of two hours. It shall consist of placing an assembled enclosure between two flat paralleled surfaces, with the longest enclosure dimension parallel to the surfaces. The weight shall be placed on the upper surface for a minimum of 15 minutes. The measurement shall then be taken with weight in place.

(b) Impact Test

The assembled enclosure shall be capable of withstanding an impact of 20 ft-lbf at temperatures of 0 °F and 100 °F. The test shall be performed after stabilizing the enclosure at the required temperature for a minimum of 2 hours. The test fixture shall consist of 20 lb cylindrical steel impacting head with a 2 inch spherical radius at the point where it contacts the enclosure. It shall be dropped from a height of 12 inches. The enclosure shall not exhibit any cracks or fractures to the housing that would preclude it from passing the water immersion test. There shall be no permanent deformation to the original diameter or characteristic vertical dimension by more than 5%.

(c) Cable Gripping and Sealing Testing

The cable gripping and sealing hardware shall not cause an increase in fiber attenuation in excess of 0.05 dB/fiber @ 1550 nm when attached to the cables and the enclosure assembly. The test shall consist of measurements from six fibers, one from each buffer tube or channel, or randomly selected in the case of a single fiber bundle. The measurements shall be taken from the test fibers, before and after assembly to determine the effects of the cable gripping and sealing hardware on the optical transmission of the fibers.

(d) Vibration Test

The splice organizers shall securely hold the fiber splices and store the excess fiber. The fiber splice organizers and splice retaining hardware shall be tested per EIA Standard FOP-II, Test Condition I. The individual fibers shall not show an increase in attenuation in excess of 0.1 dB/fiber.

(e) Water Immersion Test

The enclosure shall be capable of preventing a 10 foot waterhead from intruding into the splice compartment for a period of 7 days. Testing of splice enclosure is to be accomplished by the placing of the enclosure into a pressure vessel and filling the vessel with tap water to cover the enclosure. Apply continuous pressure to the vessel to maintain a hydrostatic head equivalent to 3 meters on the enclosure and cable. This process shall be continued for 30 days. Remove the enclosure and open to check for the presence of water. Any intrusion of water in the compartment containing the splices constitutes a failure.

(f) Certification

It is the responsibility of the Contractor to insure that all of the above tests have been performed by either the manufacturer, or an independent testing laboratory, and the appropriate documentation has been submitted to the Department. Manufacturer certification is necessary for the model of enclosure supplied. It is not necessary to subject each supplied enclosure to the actual tests described herein.

### 39.3 CONSTRUCTION REQUIREMENTS

The "Standard Specifications" shall be amended by the addition of the following:

**a. HDPE Conduit**

Conduit installation shall conform to the appropriate articles of the National Electrical Safety Code. The location of conduit runs shown on the plans are for bidding purposes only and may be changed with permission of the Engineer in charge of construction to avoid underground obstructions. The conduit shall generally be installed parallel to the street lighting or signal direct buried cable/conduit if applicable. Installation in the same trench is acceptable as long as the fiber optic conduit is installed deeper than the other facilities.

The conduit may be directional bored to minimize disruption to the existing improvements, or trenched. Boring pits shall be kept 24 inches clear of the edge of any type of pavement wherever possible.

Excessive use of water such that pavement might be undermined, or subgrade softened, will not be permitted.

The conduit shall be installed under streets at a depth of 48 inches below the bottom of the pavement or at a depth of between 36 to 48 inches below finished grade of drives or within shoulders or park areas. Any conduit installed under existing pavement shall be bored.

Conduit entering equipment shall be continuous into the service box, type FO service box and control center or as otherwise shown on the plans. No couplings or joints will be allowed at intermediate points unless approved by the Engineer in charge of construction. At a traffic signal service box or type FO service box, the conduit shall enter and exit the sides of the service box tangentially such that the cable can enter, be coiled, and exit without exceeding an 8 inch bending radius. For straight through connections, the conduit shall enter and exit the same side of the service box. For changes in direction, the conduit shall enter tangentially and exit tangentially at a 90° angle to the entrance.

An approved factory coupling shall be used for connection of the HDPE conduit between two lengths of HDPE conduit. The coupling shall have individual reverse-locking threads with a built-in center stop. The ends of the conduit shall be grooved with a grooving tool to match the reverse-locking threads of the coupling to provide for greater pull-out resistance. The coupling shall be installed with a factory recommended coupling tool to ensure an airtight and watertight lock.

The ends of all conduit shall be well reamed to remove burrs and rough edges. Field cuts shall be made square and true so that the ends will butt or come together for the full diameter thereof.

Conduit in the bottom of the fiber optic service box shall extend approximately 3 inches vertically above the aggregate backfill. Conduit shall enter from the direction of the run.

It shall be the privilege of the Contractor at his own expense to use larger size conduit if desired; and where larger size conduit is used, it shall be for the entire length of the run from outlet to outlet. No reducing couplings will be permitted.

The location of ends of all conduit installed or used in this project shall be marked by aluminum markers placed in the face of curb, gutter, or wall, directly above the conduit. The markers will be provided by the City.

#### (1) Directional Bore Installations

Directional bore installations shall be completed at locations as shown on the plans. At these locations the Contractor shall be responsible for determining all existing utility locations, both laterally and depth. The Contractor shall use this information to plan and execute the directional bore to insure against damage to any existing utilities and/or facilities within the work area. The Contractor shall be responsible for all damage to any existing utilities and/or facilities in the process of the directional boring the conduit.

#### **b. Tracer Wire / Ground Rods**

The locating cable shall be pulled through the installed conduit by use of a polyester/polypropylene pull rope. Caution should be taken as to not burn or tear the conduit ends or conduit body.

A 1/2" x 8' ground rod with ground rod clamp shall be installed in each fiber optic service box for attachment of the #10 AWG THHN/THWN stranded copper locating cable. See the standard details for additional information. The locating cable shall be bonded to the ground rod so as to provide a continuous locating system throughout the limits of the project.

#### **c. Fiber Optic Service Box**

Fiber optic service boxes shall be installed at the locations shown on the plans and at such additional points as the Contractor, at his own expense, may desire to facilitate the work.

The excavated opening outside the pull box shall be wide enough to allow compaction of the backfill material. Cinders, broken concrete, broken rock or other hard or undesirable material shall not be used for backfilling. The backfill material shall be placed in layers not to exceed 6 inches deep and each layer shall be thoroughly compacted before the next layer is placed.



The fiber optic service boxes shall be installed approximately 1 inch above earth or sodded areas and match the slope of the existing ground line. A minimum of 18 inch layer of 1/2" clean, crushed rock shall be constructed below the fiber optic service box for drainage purposes.

**d. Fiber Optic Cable**

All cable shall be installed as per Siecor Recommended Procedure 005-011 "Fiber Optic Cable Placing B Duct". These general procedures will be followed regardless of the manufacturer of the cable. If the cable manufacturer recommends an operation in conflict with these procedures, a request for installation procedure change shall be submitted for approval to the Department. The maximum pulling tension shall be 600 lbs during installation (short term) and 200 lbs long term installed.

If the total loss exceeds the specifications as documented under the item "Communication System Testing", the Contractor shall replace or repair that cable run at the Contractor's expense, both labor and materials. Elevated attenuation due to exceeding the pulling tension during installation will require the replacement of the cable run at the Contractor's expense, both labor and materials.

**e. ITS Termination Drop Cable**

The distribution lead-in cable shall be spliced to the trunk fiber in the specified splice enclosure. Sufficient slack shall be coiled in the fiber optic service boxes as indicated on the plans. The patch panel shall be installed in the traffic signal cabinet with the appropriate hardware. The cable shall be tied with plastic cable ties to hold it out of the way of door hinges, etc. and other devices that may cause damage to the cable. All dust covers shall be installed on all terminals that are not being utilized.

**f. Fiber Optic Ethernet Switch**

Each fiber optic switch shall be set up and programmed prior to being installed in the field. The Contractor shall program the switches with IP addresses as directed by the Engineer.

The contractor shall furnish the Ethernet switch, external power supply unit and rack mount adapter to the City and the City will provide the configuration and installation into the traffic signal cabinets. The placement of the switch inside the cabinet shall be in a secure location, and the power supply unit shall be secured to the switch. The power cord shall be run and tied to existing cable runs within the cabinet or as directed by the Engineer.

Fiber optic patch cables shall be installed connected to the switch.

**g. Fiber Optic Termination Panel (6-ct)**

The contractor shall securely install the termination panel in existing traffic signal cabinets by securing the panel to the existing 19-inch rack, and in a manner as approved by the City.

**h. Fiber Optic Patch Cables**

The Contractor shall install the fiber optic patch cords between fiber optic termination panels and equipment at locations as shown on the plans.

**i. Fiber Optic Fusion Splices**

All fiber optic splicing shall be fusion spliced, unless otherwise indicated in the plans and bill of materials. Mechanical splices will not be permitted.

The splice enclosure shall be installed according to the manufacturer's recommended guidelines. For the mainline splice, the cables shall be end-to-end fusion spliced. If the plans indicate the contractor will not splice the fiber cable, the splice enclosure shall be provided to the City.

End-to-End splicing shall be performed as per manufacturer instructions for the supplied splice Enclosure units.

Mid-span splicing (drop splice) shall be performed for each device location at locations shown on the plans. Splicing shall be performed as per Corning Recommended Procedure SRP-004-013, "Mid-span access of Fiber Optic Cable (Cable slack present)", or appropriate manufacturer instructions. All mid-span splices shall be contained within enclosures.

**j. Testing Requirements**

"Certified Technicians" shall perform all testing under this item. Certified Technicians are considered telecommunications professionals who meet the following requirements:

1 YEAR OF DOCUMENTED EXPERIENCE WITHIN THE LAST 3 YEARS IN THE  
INSTALLATION AND TESTING OF FIBER OPTIC COMMUNICATION SYSTEMS

THE TECHNICIAN SHALL HAVE ATTENDED AND SUCCESSFULLY COMPLETED AT  
LEAST ONE FOUR-DAY "INSTALLATION OF FIBER OPTIC PRODUCTS" COURSE. A MAJOR  
MANUFACTURER OF FIBER OPTIC PRODUCTS, SUCH AS AT&T OR SIECOR, SHALL HAVE  
CONDUCTED THE COURSE.

The Contractor shall provide the date, time and location of any tests required by this specification  
to the Engineer at least 3 working days prior to performing the test.

(1) Pre-Construction Testing Requirements

The Contractor shall test all fiber cable that is to be removed and reinstalled under this contract to  
form a baseline of fiber optic system performance prior to the removal / reinstallation of fiber optic cable.

A Certified Technician utilizing an Optical Time Domain Reflectometer (OTDR) and Optical  
Source/Power Meter must conduct the installation test. The Technician is directed to conduct the test using  
the Standard Operating Procedure as defined by the manufacturer of the test equipment.

The method of connectivity between the OTDR and the cable shall be a factory patch cord of a  
length equal to the "dead zone" of the OTDR. Optionally, the Technician can use a factory "fiber box" of  
100 meters minimum with no splices within the box. The test shall adhere to the following:

TESTS SHALL BE CONDUCTED AT BOTH 1310 NM AND 1550 NM FOR ALL CABLE  
AND SHALL BE BI-DIRECTIONAL

At the completion of the test, the Contractor shall provide two copies of documentation of the test  
results to the Project Engineer. The test documentation shall be bound and include the following:

CABLE & FIBER IDENTIFICATION

CABLE ID

CABLE LOCATION - BEGIN AND END POINT

FIBER ID, INCLUDING TUBE AND FIBER COLOR

OPERATOR NAME

DATE & TIME

SETUP PARAMETERS

WAVELENGTH

PULSE WIDTH (OTDR)

REFRACTORY INDEX (OTDR)

RANGE (OTDR)

SCALE (OTDR)

TEST RESULTS

The testing points shall be as follows:

At Sanders Justice Center:

Test fibers 1 through 36 to the south at the Sanders Justice Center

Fibers 1 to 18 transmit to the Fire Training Center (1-18).

Fibers 19 to 36 transmit to the South Maintenance Facility (1-18).

At Fire Training Center:

Test fibers 1 through 36 to the south at the Fire Training Center.

Fibers 1 to 18 transmit to the Sanders Justice Center (1-18).

Fibers 19 to 36 transmit to the intersection of 135th/Antioch (1-18)

At South Maintenance Facility:

Test fibers 1 through 36 to the south at the South Maintenance Facility.

Fibers 1 to 18 transmit to the Sanders Justice Center (19-36).

Fibers 19 to 36 transmit to the intersection of 135th/Antioch (19-36).

(2) Post-Installation Testing Requirements

Upon notification of the test date, the City shall provide the contractor with test points where existing termination panels (or panels installed by the Contractor) are present. In the event that one end of the cable is not terminated (due to either an existing condition or a contractual requirement), the bi-directional testing requirement stated herein shall be waived.

Upon completion of the cable installation, splicing, and termination, the Contractor shall test all fibers for continuity, events losses, and total attenuation of the cable. The test procedure is as follows:

A Certified Technician utilizing an Optical Time Domain Reflectometer (OTDR) and Optical Source/Power Meter must conduct the installation test. The Technician is directed to conduct the test using the Standard Operating Procedure as defined by the manufacturer of the test equipment.

The method of connectivity between the OTDR and the cable shall be a factory patch cord of a length equal to the "dead zone" of the OTDR. Optionally, the Technician can use a factory "fiber box" of 100 meters minimum with no splices within the box. The test shall adhere to the following:

TESTS SHALL BE CONDUCTED AT BOTH 1310 NM AND 1550 NM FOR ALL CABLE AND SHALL BE BI-DIRECTIONAL

At the completion of the test, the Contractor shall provide two copies of documentation of the test results to the Project Engineer. The test documentation shall be bound and include the following:

- CABLE & FIBER IDENTIFICATION
- CABLE ID
- CABLE LOCATION - BEGIN AND END POINT
- FIBER ID, INCLUDING TUBE AND FIBER COLOR
- OPERATOR NAME
- DATE & TIME
- SETUP PARAMETERS
- WAVELENGTH
- PULSE WIDTH (OTDR)
- REFRACTORY INDEX (OTDR)
- RANGE (OTDR)
- SCALE (OTDR)
- TEST RESULTS

**k. OTDR Test**

The following is a list of information that shall be measured during the OTDR test and prior to fiber optic cable acceptance:

- TOTAL FIBER TRACE
- SPLICE LOSS/GAIN
- EVENT LOSS
- MEASURED LENGTH (CABLE MARKING)
- TOTAL LENGTH (OTDR)

The Contractor shall provide copies of the fiber cable traces taken during the OTDR test to the City Engineer on diskette for review.

**l. Optical Source/Power Meter**

The following is a list of additional test measurements that shall be performed prior to fiber optic cable acceptance:

- TOTAL ATTENUATION

ATTENUATION (DB/KM)

The Contractor shall provide copies of these results in tabular form for review to the City Engineer.

**m. Fiber Optic Cable Acceptance**

The following shall be the criteria for the acceptance of the cable:

The test results shall demonstrate that the dB/km loss does not to exceed +3% of the factory test or 1% of the cable's published production loss. The error rate for the test equipment will be considered.

Event losses shall be considered an average of each direction of test, and shall be limited to the following:

Event Type	Allowable Loss
Fusion Splicing	0.05 dB
ST-Connector (factory assembled)	0.50 dB
ST-Connector (field installed)	0.70 dB

The total dB loss of the cable, less events, shall not exceed the manufacturer's production specifications as follows: .40 dB/km at 1310 and 0.30 at 1550 nm.

If the total loss exceeds these specifications, the Contractor shall replace or repair that cable run at the Contractor's expense, both labor and materials. Elevated attenuation due to exceeding the pulling tension during installation will require the replacement of the cable run at the Contractor's expense, both labor and materials.

**n. System Corrections**

In the event that any component is found to be defective or below the standards of these specifications, the Contractor shall repair and/or replace the defective components at no cost to the City. Upon completion of the repair and/or equipment replacement, the Contractor shall conduct a new system test and provide the appropriate documentation to the City.

**o. Test Documentation**

The Contractor shall provide test documentation for all test functions described under this item. The test documentation shall adequately address each test function.

**p. Replacing Damaged Improvements**

Improvements such as sidewalks, curbs, driveways, roadway pavements and any other improvements removed, broken or damaged by the Contractor shall be replaced or reconstructed with the same kind of materials found on the work or with materials of equal quality. The new work shall be left in a serviceable condition satisfactory to the Traffic Engineer. Whenever a part of a square or slab of existing concrete sidewalk, driveway or pavement is broken or damaged, the entire square or slab shall be removed and the concrete reconstructed.

**40 - LOOP DETECTOR**

**40.1 DESCRIPTION**

The work provided for in these Specifications shall consist of furnishing all labor, materials and equipment and performing all work necessary to accomplish Traffic Signal Loop Replacement on existing asphalt street surfaces, together with other incidental and related work including all loop lead-in and hookup to existing detector feeder cable. These loops are replacements for loops that could be damaged during the construction as indicated in the plans.

The term "inductive loop detector" applies to a complete installation consisting of a conductor loop or group of loops installed in the roadway, lead-in cable, and a sensor unit with power supply installed in a traffic signal controller cabinet.

## **40.2 MATERIALS**

### **a. Detector Loop Wire**

The detector loop wire shall be #14 A.W.G., stranded, type THHN, 1-conductor cable housed in PVC tubing. The PVC tubing shall meet the following minimum requirements:

- (1) PVC tubing ULFR-1 rated 105 degrees C;
- (2) .031" wall thickness plus or minus .003";
- (3) .182" minimum to .198" maximum inside diameter.

### **b. Detector Lead-In Cable**

The detector lead-in cable shall be #14 A.W.G., 2-conductor, stranded and shielded cable. The conductor and drain wires shall be tinned copper wires, with conductors shielded by a layer of aluminum bonded to polyester film. All wires shall be insulated with cross linked polypropylene or polyethylene and provided a vinyl jacket.

### **c. Connectors**

All electrical connections of loop detector wire to existing detector lead-in cable shall be made watertight by an approved method.

### **d. Loop Sealants**

The following lists loop sealants approved for use on this project:

- (1) Crafc0 P.N. 221
- (2) Triram PR 26-HA
- (3) 3M Brand
- (4) Bondo E-709

## **40.3 CONSTRUCTION REQUIREMENTS**

Installation shall conform to the details and notes shown on the plans. Loop wire shall be one continuous wire with each partial loop to be in the configuration detailed on the plans. All loop conductors shall be wound in the same direction with the start and end clearly marked on the conductors at the junction or service box. Conductors of all loops to be operated shall be run continuous to the nearest junction or service box. The loop conductors for each loop shall be spliced in the junction or service box to a detector lead-in cable running from the box to a sensor unit mounted in the controller cabinet Existing Presence Loops (Type A) that are being replaced with a Transverse Loop (Type B) are shown on the plan. The location is approximate, the exact location will be determined in the field. If a type B loop is replacing a Type A loop, Type B loop may be located farther away from the junction box which will required additional sawing, wiring, etc. If an existing junction or service box is not present, a new box shall be installed as shown on the plans at the contract unit price per each. Metallic conduit shall be installed in the existing curb as shown on the plans and connected to the junction or service box, or to the existing conduit.

Saw cuts for loop wires shall be made with a self-propelled, water cooled power saw. The water is used to cool and lubricate the blade and eliminate blowing saw dust. All jagged edges or sharp corners and protrusions shall be removed using a small chisel and hammer. The saw cut shall be cleaned of cutting dust, grit, oil and other contaminates. The saw cut shall be flushed clean with water and dried with compressed dry air immediately after cutting. Care shall be taken during the cutting and cleaning operation to avoid blowing debris at passing pedestrians and vehicles or onto private property.

Inspection shall be made on all loop installations prior to the sealant operation. After conductors are installed in the slots and inspected, the slots shall be filled with epoxy sealant for concrete, or an approved asphalt sealer for a bituminous surface, to within 1/8 inch of the pavement surface. The sealant

shall be between 2 inches and 3 inches thick above the top conductor in the saw cut as determined by the saw cut depth and as indicated in the plans. Before setting, surplus sealant shall be removed from the adjacent road surfaces without the use of solvents. Sand or other absorbent material shall be spread over the sealant if traffic is allowed over the loop before the sealant is completely set.

## **41 - PERMANENT TRAFFIC CONTROL SIGNING**

### **41.1 DESCRIPTION**

The Contractor shall furnish and install permanent traffic control signing materials at the locations shown on the plans, in conformance with the details, and the material specifications included herein. Permanent traffic control signing materials shall include, but not be limited to, sign sheeting, aluminum sign blanks, sign posts, breakaway base assemblies, mounting brackets and hardware.

The permanent traffic control signing shall be installed before the roadway is open to construction unless prior approval is received by the Engineer or City Inspector. The installation of all regulatory signs is the first priority. If the permanent signs cannot be installed and thus the roadway would be unsigned overnight, temporary regulatory signs shall be installed and remain until the permanent signs can be installed. The contractor shall make every possible effort to remove the temporary signs and install permanent signs within 48 hours. Only under extreme circumstances and at the approval of the signing inspector or the engineer, will the duration of the temporary signs be extended. All temporary and permanent traffic control signs shall be in conformance with the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD) Part II. The temporary signs shall be removed prior to installation of the permanent signs.

### **41.2 MATERIALS**

The material for permanent traffic control signs shall be in accordance with this specification.

#### **a. Applicable Documents**

The following documents form a part of this specification to the extent specified herein:

ASTM B209 Specification for Aluminum and Aluminum Alloy Sheet and Plate

ASTM D523 Standard Method for Test for Specular Gloss

ASTM D4956-09 Standard Specification for Retroreflective Sheeting for Traffic Control

ASTM E284 Terminology of Appearance

ASTM E308 Practice of Computing the Colors of Objects by Using the CIE System

ASTM E810 Test Method for Coefficient of Retroreflection of Retroreflective Sheeting Utilizing the Coplanar Geometry

ASTM E1164 Practice for Obtaining Spectrophotometric Data for Object-Color Evaluation

CIE Publication Number 39-2 Recommendation for Surface Colours for Visual Signaling

FP-03 Standard Specifications for Construction of Roads and Bridges on Federal Highway

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#### **b. Approved Manufacturer's List**

All material for permanent traffic control signs used by the Contractor shall be from the City's approved list of vendors. It is important that users be completely knowledgeable of all application requirements and procedures prior to product application. It is the responsibility of the installer to contact the supplier of all permanent traffic control sign materials if questions regarding application procedures or conditions arise.

#### **c. Super-High Efficiency Full Cube Retroreflective Sign Sheeting**

This specification covers flexible white or colored, Super-High Efficiency Full Cube Retroreflective Sheeting, tape and related processing materials designed to enhance nighttime visibility of traffic control signs and objects. The sheeting shall consist of full cube prismatic lens elements with a

distinctive interlocking diamond or hexagonal seal pattern visible from the face of a smooth surface. The sheeting shall have a pre-coated adhesive protected by an easily removable liner. This sheeting shall be used for all permanent traffic control signs as listed in the "Sign Information Table" on the Overland Park Standard Details.

(1) Classification and Conformance

The sheeting shall conform to ASTM D 4956-09 as modified by this specification for a Type XI classification.

(2) Colors

The manufacturer of the sheeting shall manufacture and offer a single line of standard traffic colors recommended for the sheeting to meet the performance requirements of this specification.

No process color inks, or silk screenings are allowed. All signs shall be made from a combination retroreflective sheeting background with electronic cuttable film applied to the surface..

(3) Test Panels and Test Conditions

Unless otherwise specified herein, sheeting shall be applied to test panels in accordance with ASTM D 4956-09, section 7.2 and test conditions shall conform to ASTM D 4956-09 section 7.1.

(4) Color Requirements

Color shall be as specified and shall conform to the requirements of ASTM D 4956-09, Table 11. Luminance factors shall conform to ASTM Type XI.

(5) Color Processing

The sheeting shall be heat resistant and permit force curing without staining of applied or unapplied sheeting at temperatures recommended by the sheeting manufacturer.

(6) Shrinkage

The retroreflective sheeting shall comply with the shrinkage requirements contained in ASTM D 4956-09 section 6.6.

(7) Adhesive

The retroreflective sheeting shall comply with the liner removal and adhesion requirements contained in ASTM D 4956-09 sections 6.8 and 6.9 respectively.

(8) Coefficient of Retroreflection

Conformance to minimum requirements for Retroreflectance is determined as follows:

(a) Three 8 in. x 8 in. samples spaced evenly across and down a representative piece of sheeting shall be taken. The Coefficient of Retroreflection shall be determined for each of the three samples per ASTM E810. The average of the three values shall comply with the stated minimum table value and no single sample shall be less than 80% of the table value.

(b) The observation angles shall be 0.2°, 0.5°, 1.0°. The entrance angles shall be -4° and 30°. For transparent colored overlay films on white sheeting, the coefficients of retroreflection shall not be less than the minimum requirements of ASTM D 4956-09 Table 10.

(9) Fungus resistance

The retroreflective sheeting shall comply with the supplementary requirements contained in section S1 of ASTM D 4956-09.

(10) General Characteristics and Packaging

The retroreflective sheeting as supplied shall be of good appearance, free from ragged edges, cracks and extraneous materials and shall be furnished in either rolls or sheets.

When furnished in continuous rolls, the number of splices shall not be more than two per 50 yards (45.7 m) of material, with a maximum of three pieces in any 50-yard (45.7 m) length. Splices shall be butted or overlapped and shall be suitable for continuous application as furnished.

The sheeting shall be packaged in accordance with commercially accepted standards. Each carton shall clearly stipulate the brand, quantity, size, lot or run number, color and type adhesive. Stored under

normal conditions the retroreflective sheeting as furnished shall be suitable for use for a minimum period of one year.

(11) Durability

The retroreflective sheeting shall comply with the supplementary requirements contained in section S3 of ASTM D 4956-09. It shall be weather resistant and show no appreciable cracking, scaling, pitting, blistering, edge lifting or curling when tested in accordance with section 7.6 of ASTM D4956-09, and shall meet the minimum coefficient of retroreflection after weathering as specified in ASTM D 4956-09 Table 12.

(12) Certifications

The sheeting manufacturer shall submit with each lot or shipment, a certification that states the material supplied will meet all the requirements listed herein.

(13) Field Performance Requirements for Permanent Signing – Ordinary Colors

(a) Sheeting manufactured of standard colors and processed and applied to sign blank materials in accordance with sheeting manufacturer's recommendations, shall perform effectively for at least 12 years. The retroreflective sheeting will be considered unsatisfactory if it has deteriorated due to natural causes to the extent that: (1) the sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions; or (2) the coefficient of retroreflection is less than the minimum specified for that sheeting during that period listed as follows:

80% of values listed in ASTM D 4956-09 Table 10 up to 7 years and  
70% of values listed in ASTM D 4956-09 Table 10 up to 12 years

(b) Failure of overlay films provided and/or sold for use on recommended sheeting shall constitute a failure of entire sign and shall be replaced.

(c) For transparent colored overlay films on white sheeting, the coefficients of retroreflection shall not be less than 70% of the values for the corresponding integral color. All measurements shall be made after sign cleaning according to sheeting manufacturer's recommendations.

(d) Natural causes include effects of exposure to weather. Natural causes exclude (without limitation) damage from exposure to chemicals, abrasion and other mechanical damage (such as from fasteners used to mount the sign, collisions or mishandling), vandalism, or malicious mischief.

(14) Field Performance Requirements for Permanent Signing – Fluorescent Colors

(a) Fluorescent colored sheeting processed and applied to sign blank materials in accordance with sheeting manufacturer's recommendations shall perform effectively for at least 10 years. The retroreflective sheeting will be considered unsatisfactory if it has deteriorated due to natural causes to the extent that: (1) the sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions; or (2) the coefficient of retroreflection is less than the minimum specified for that sheeting during that period listed as follows:

80% of values listed in ASTM D 4956-09 Table 10 up to 7 years and  
70% of values listed in ASTM D 4956-09 Table 10 up to 10 years

(b) Failure of overlay films provided and/or sold for use on recommended sheeting shall constitute a failure of entire sign and shall be replaced. All measurements shall be made after sign cleaning according to sheeting manufacturer's recommendations.

(c) Natural causes include effects of exposure to weather. Natural causes exclude (without limitation) damage from exposure to chemicals, abrasion and other mechanical damage (such



as from fasteners used to mount the sign, collisions or mishandling), vandalism, or malicious mischief.

(15) Sheeting Manufacturer's Replacement Obligation for Ordinary Colors

(a) Where it can be shown that retroreflective signs, supplied and used according to the sheeting manufacturer's recommendations, have not met the field performance requirements as indicated above, the sheeting manufacturer shall cover restoration costs as follows for sheetings shown to be unsatisfactory:

(b) For the entire 12 years, the sheeting manufacturer will replace the sheeting required to restore the sign surface to its original effectiveness. In addition, during the first seven years the sheeting manufacturer will cover the cost of restoration of the sign surface to its original effectiveness at no cost to the City of Overland Park for materials and labor. Replacement sheeting shall carry the unexpired warranty of the sheeting it replaces.

(16) Sheeting Manufacturer's Replacement Obligation for Fluorescent Colors

(a) Where it can be shown that retroreflective signs, supplied and used according to the sheeting manufacturer's recommendations, have not met the field performance requirements as indicated above, the sheeting manufacturer shall cover restoration costs as follows for sheetings shown to be unsatisfactory:

(b) If the failure occurs within the first 7 years from the date of fabrication, the sheeting manufacturer shall, at its expense, restore the sign surface to its original effectiveness. If the failure occurs in the 8<sup>th</sup> through the 10<sup>th</sup> year from the date of fabrication, the sheeting manufacturer will furnish the necessary amount of sheeting to restore the sign surface to its original effectiveness. Replacement sheeting shall carry the unexpired warranty of the sheeting it replaces.

(17) City of Overland Park Obligation

The City of Overland Park shall be responsible for requiring the dating of all signs at the time of application. That date constitutes the start of the field performance obligation period.

**d. Electronic Cuttable Film**

This specification covers flexible, transparent, durable, acrylic films designed to be applied to retroreflective materials for the creation of traffic control signs and devices. The electronic cuttable film shall have a match component warranty equivalent to the retroreflective sheeting and be from the same manufacturer. Mixing one electronic cuttable film product with another manufacturer's retroreflective sheeting shall not be allowed.

(1) Description

Electronic cuttable films shall consist of transparent, durable, acrylic, colored films coated with a transparent pressure sensitive adhesive protected by a removable liner. The films are designed to be cut on knife over roll (sprocket fed or friction fed) and flat bed electronic cutting machines. The films shall be available in standard traffic colors, be dimensionally stable, and be designed to optimally cut, weed, lift, and transfer. Use of electronic cuttable films will not release any volatile organic compounds.

(2) Test Conditions

Unless otherwise specified herein, all applied and unapplied test samples and specimens shall be conditioned at the standard conditions of  $73^{\circ} \pm 3^{\circ}\text{F}$  ( $23^{\circ} \pm 1.5^{\circ}\text{C}$ ) and  $50 \pm 5\%$  relative humidity for 24 hours prior to testing.

(3) Test Panels

Unless otherwise specified herein, when tests are to be performed using test panels, the specimens of retroreflective and / or overlay films shall be applied to smooth aluminum cut from ASTM B-209 Alloy 5052-H36, 5052-H38, 5154-H38, or 6061-T6 sheets on 0.020 inch (0.051cm), 0.040 inch (0.102cm) or 0.063 inch (0.160cm) thicknesses. The aluminum shall be degreased and lightly acid etched before the specimens are applied. The specimens shall be applied in accordance with the recommendations of the reflective sheeting and electronic cuttable film manufacturer.

#### (4) Color Requirements

When electronic cuttable film is applied to retroreflective sheeting, the resulting color of the composite sheeting will conform to Federal Specification FP-03, Section 718.01 and ASTM D 4956.

#### (5) Color Test

Conformance to color requirements shall be determined by instrumental method in accordance with ASTM E1164 on sheeting applied to aluminum test panels. The values shall be determined on a HunterLab Labscan 6000 0/45 Spectrocolorimeter with option CMR 559. Computations shall be done in accordance with ASTM E308 for the 2 degree observer

#### (6) Coefficient of Retroreflection

When electronic cuttable film is applied to retroreflective sheeting, the composite will conform to the percentage retained of the minimum coefficient of retroreflection specified by these specifications and the manufacturer for the retroreflective sheeting when the retroreflective sheeting is screen processed. The coefficient of retroreflection shall be determined in accordance with ASTM E810.

Coefficients of retroreflection shall be specified in units of candelas per foot candle per square foot (candelas per lux per square meter). The observation angles shall be 0.2° and 0.5° unless otherwise specified. The entrance angles shall be -4° and 30° unless otherwise specified. Retroreflective sheetings with datum marks shall be tested in the orientation specified by the manufacturer. If no datum mark is supplied, the sheeting shall be rotated to determine the minimum coefficient of retroreflection which shall be reported without averaging.

#### (7) Specular Gloss

The electronic cuttable film shall have an 85° specular gloss of not less than 50 when tested in accordance with ASTM D523.

#### (8) Processing and Cuttability

The electronic cuttable film shall permit cutting, weeding, masking with transfer tape, lifting, and application to retroreflective sheeting when used in accordance with manufacturer's recommendations at temperatures between 65° and 95°F (18.3° and 35.0°C) and relative humidities between 30% and 70%. The film shall lay flat with minimal edge curl and be dimensionally stable.

#### (9) Adhesive Liner

The protective liner attached to the adhesive shall be removable by peeling without soaking in water or other solutions, without breaking, tearing, or removing any adhesive from the electronic cuttable film. The liner shall have a controlled release from the adhesive coated film sufficient to allow cutting without the film popping off from the liner while still allowing the liner to easily be peeled from the film. Film with punched edges for use on sprocket fed knife over roll cutters shall be edge scored and weeded to remove film in the punched area as a means of eliminating adhesive build up on the sprockets.

#### (10) Resistance to Accelerated Outdoor Weathering

When electronic cuttable film is applied to retroreflective sheeting, the surface of the film shall be weather resistant and show no appreciable cracking, blistering, crazing, or dimensional change after 2 years unprotected outdoor exposure, facing the equator and inclined 45° from the vertical. Following weather exposure, panels shall be washed in a 5% HCl solution for 45 seconds, rinsed thoroughly with clean water, blotted dry with a soft clean cloth and brought to equilibrium at standard conditions. After cleaning, the coefficient of retroreflection shall not be less than the value specified for the retroreflective sheeting when the retroreflective sheeting is screen processed.

It shall show no appreciable evidence of cracking, scaling, pitting, blistering, edge lifting or curling or more than 1/32" (0.08cm) shrinkage or expansion. It shall show good color fastness or better when tested as in S-1.2.4.11. The retained reflectivity shall be the same as that specified for screen processed retroreflective sheeting of the type being tested. The film shall not be removable from the retroreflective sheeting without damage.

Retroreflective performance measurements made after weather exposure shall be made only at angles of 0.2° observation and -4° entrance. Where more than one panel of a color is measured, the coefficient of retroreflection shall be the average of all determinations.

(11) Colorfastness

One specimen, exposed and prepared as specified herein shall be wet cut with a mild detergent and water solution and compared with a similarly treated unexposed specimen under natural daylight or artificial daylight having a color temperature of 7600°K. The colorfastness shall be evaluated as follows:

- Excellent - No perceptible change in color
- Good - Perceptible but no appreciable change in color
- Fair - Appreciable change in color

Appreciable change in color means a change that is immediately noticeable in comparing the exposed specimen with the original comparison specimen. If closer inspection or a change of angle of light is required to make apparent a slight change in color, the change is not appreciable.

(12) General Characteristics and Packaging

When supplied as roll goods, the electronic cuttable film shall be of good appearance, free from ragged edges, cracks and extraneous materials. The maximum number of splices in each roll shall be three per 50 yards of material. Splices shall be butted. The sheeting shall be packed snugly in corrugated fiberboard cartons, in accordance with commercially accepted standards. Each carton shall clearly stipulate the brand, quantity, size, lot or run number, and color. Stored under normal conditions, the film shall be suitable for use for a minimum period of one year.

When supplied as a finished sign face or mounted sign, the sign face, made of electronic cuttable film and retroreflective sheeting, shall comply with the appearance, specification, and good workmanship for sign faces constructed of a screen processed retroreflective sheeting of the same type.

(13) Certification

The film manufacturer shall, upon request, submit with each lot or shipment, a certification which states that the material supplied will meet all of the requirements listed herein.

(14) Field Performance Requirements

The electronic cuttable film applied to retroreflective sheeting, both materials applied in accordance with the manufacturer's recommendations, shall as a composite perform with the same effective performance life as specified for that type of retroreflective sheeting when screen processed. The composite sign will be considered unsatisfactory if it has deteriorated due to natural causes to the extent that: (1) the sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions; or (2) the coefficient of retroreflection is less than the minimum specified for that sheeting when screen processed.

**e. Aluminum Sign Blanks**

This specification covers aluminum sign blanks for flat sheet signs for permanent traffic control signs.

(1) Material

Sign blanks shall be manufactured from aluminum ASTM B209(H) alloy 6061-T6 or 5052-H38. The aluminum blank shall be degreased and lightly acid etched.

(2) Thickness

All sign blanks for overhead street name signs shall be 0.125" thick. All other traffic control signs shall be 0.08" thick unless otherwise specified in the standard details.

(3) Mounting Holes

Mounting holes in the sign blanks shall be the size and location as stipulated in the standard detail drawings.

**f. Steel Sign Posts**

This specification covers steel sign posts, post anchors, and breakaway anchor sleeves in accordance with the standard details.

(1) Material

Steel posts shall conform to the standard specification for hot rolled carbon sheet steel, structural quality, ASTM designation A570, Grade 50. Yield strength after cold-forming is 60,000 psi minimum.

(2) Shape

The cross section of the sign post shall be square tube formed of 12 gauge (0.105` U.S.S. gauge) steel. The cross section of the post anchor and anchor sleeve shall be square tube formed of 12 gauge (0.105 U.S.S. gauge) steel. All posts, post anchors and anchor sleeves shall be carefully rolled to size and shall be welded directly in the corner by high frequency resistance welding and externally scarfed to agree with corner radii. All ends shall be cut square.

(3) Finish

Sign posts, post anchors and anchor sleeves shall be manufactured from hot-dipped galvanized steel conforming to ASTM A653, G90, Structural Quality, Grade 50, Class 1. The corner weld is zinc coated after scarfing operation. The steel is also coated with a chromate conversion coating and a clear organic polymer topcoat. Both the interior and the exterior of the post shall be galvanized.

(4) Cross Section

Perforated sign posts, post anchors and anchor sleeves shall be of the following sizes:

Description	Size	U.S.S. Gauge	Weight (lbs./foot)
Sign Post	1 3/4" x 1 3/4"	12	2.06
Post Anchor	2" x 2"	12	2.42
Anchor Sleeve	2 1/4" x 2 1/4"	12	2.77

(5) Telescoping Properties

The finished posts, post anchor and anchor sleeve shall be straight and have a smooth, uniform finish. It shall be possible to telescope all consecutive sizes of square tubes freely and for not less than ten feet of their length without the necessity of matching any particular face to any other face.

(6) Tolerances

Tolerances shall be as indicated in the following table:

Tolerance Description	1 3/4" x 1 3/4"	2" x 2"	2 1/4" x 2 1/4"
Outside Tolerances at Sides at Corners <sup>1</sup>	± 0.008"	± 0.008"	± 0.010"
Wall Thickness Tolerances	± 0.0011", -0.005	+ 0.011", -0.005	+ 0.011", -0.005
Convexity and Concavity Tolerances <sup>2</sup>	± 0.010"	± 0.010"	± 0.010"
Squareness of Sides Tolerances <sup>3</sup>	± 0.010"	± 0.012"	± 0.014"
Permissible Twist in 3' Length	0.062"	0.062"	0.062"
Straightness Tolerances in 3' Length	1/16"	1/16"	1/16"
Corner Radii	5/32" ± 1/64"	5/32" ± 1/64"	5/32" ± 1/64"

Notes:

<sup>1</sup>Measurements from outside dimensions shall be made at least 2 inches from the end of tube.

<sup>2</sup>Measured in the center of the flat sides determined at the corner.

<sup>3</sup>A sample shall be considered to fail if its sides are not 90 degrees to each other within the squareness tolerance listed above.

(7) Holes

Holes shall be 7/16" ± 1/64" in diameter on one inch centers on all four sides down the entire length of the post, post anchor and anchor sleeve. Holes shall be on centerline of each side in true alignment and opposite each other directly and diagonally. All holes shall be drilled or punched and all welds, cuts, burrs, and sharp edges are to be smoothed off before application of finish.

(8) Post Length

Posts shall be ordered in 2' increments and cut to length. One single sign post long enough to support all signs shall be installed. Two separate lengths of post joined with a sleeve to achieve the necessary post length shall not be allowed.

(9) Breakaway Performance

The breakaway base design shall meet the requirements of the National Cooperative Highway Research Program Report (NCHRP) No. 350.

**g. Mounting Brackets, Hardware and Banding**

This specification covers various mounting brackets, hardware and banding for sign installation as indicated by the standard details.

(1) Steel Banding, Brackets and Buckles on Tubular Supports

Banding for signs mounted on tubular posts shall be ¾" wide by 0.030" Type 201 stainless steel. Buckles shall also be Type 201 stainless steel with ear-lock design and teeth for maximum clamping strength.

The mounting bracket shall be stainless steel with a flared leg, supplied with stainless steel hex head bolt and stainless steel washer. The bracket shall be fully threaded and shall require no nuts to fasten. A flat, plastic washer shall be installed contacting the sign face prior to the installation of the stainless steel washer.

(2) Hardware for Steel Post Mounted Signs

Bolts for fastening the telescoping sign post, post anchor and anchor sleeve shall be a stainless steel corner bolt with hex head jam nut and zinc plated flat washers as dimensioned in the standard details. The corner bolt is designed to prevent distortion of the opposite wall of the sign posts which can occur when conventional through-bolts are over-tightened.

Bolts for fastening the sign to the 1 ¾" x 1 ¾" sign post shall be a straight stainless steel hex head bolt with stainless steel washer and hex head jam nut. A flat, plastic washer shall be installed contacting the sign face prior to the installation of the stainless steel washer.

All bolts, nuts, and washers shall comply with section 1616 of the Kansas Department of Transportation Standard Specifications for State Road and Bridge Construction (current edition).

(3) Astro Sign-Brac

The Astro Sign-Brac cable mount system shall be used to mount R10 Series MUTCD designated signs to signal pole mast arms. It shall consist of a high tensile aluminum alloy clamp kit, 5/16"-18 U-bolts, 1 ½" Schedule 10 aluminum tube (length based on sign length) and saddle, and high strength galvanized aircraft cable and stainless steel swaged fittings. It shall be supplied complete with all necessary attaching hardware including 5/16"-18 x 1" stainless steel hex head bolt, hex nut, split lock washer and flat washer.

(4) Tubular Support Street Name Sign Wing Bracket

The wing bracket shall be used to mount street name signs to tubular supports such as light poles. The bracket shall be a single piece L-shaped cantilever of T-beam frame made from 380-3 aluminum alloy construction as indicated in the standard details. The length shall be as specified in the standard details based on the length of the sign. The mounting plate shall have set screws for sign attachment.

**41.3 CONSTRUCTION REQUIREMENTS**

The proposed permanent traffic control signs shall be fabricated and installed by the contractor in conformance to the plans, standard details and these specifications. The signs shall meet all applicable requirements of the "Manual on Uniform Traffic Control Devices for Streets and Highways," U.S. Department of Transportation, Federal Highway Administration, latest revision as adopted, hereinafter referred to as "MUTCD", except as modified on the Plans and as described herein.

### **a. Preparation of Aluminum Sign Blanks**

This specification covers the preparation of aluminum sign blanks prior to application of retroreflective sheeting.

#### (1) Size and Tolerances

Signs shall be of the length and width as specified on the plans or standard details. The tolerance for the length and width of the sign blank shall be within  $\pm 1/8$ " from that shown on the plans or standard details. The sign blanks shall be free from buckles, warp, dents, cockles, burrs and other defects caused by fabrication.

#### (2) Cleaning

Following fabrication, the aluminum to which the sheeting is to be applied shall be cleaned of all aluminum oxide and prepared with a class 2 chromate conversion coating as outlined in ASTM B449, "Standard Recommended Practice for Chromate Treatments on Aluminum" or ASTM B-921 to resist corrosion and aluminum oxide. It should be a consistent weight (nominally 10-35 mg/sq ft.) and no darker than pale yellow. The coating should be well bonded to the metal and coherent within itself showing no dusting of the surface.

#### (3) Etching

Etching shall be performed using specially designed chemical conversion tanks and either an acidic or alkaline etch solution. Time, temperature, and concentration may vary depending on the type of solution. Contact the solution manufacturer for details. Always rinse thoroughly using a high pressure wash with clean water and allow complete drying.

#### (4) Blank Handling

The aluminum shall not be handled except by a mechanical device or with clean canvas gloves between the cleaning and etching operation and the application of retroreflective sheeting. There shall be no opportunity for the aluminum to come in contact with greases, oils, or other contaminants prior to the application of sheeting or film. Immediately prior to the application of the sheeting, should it be necessary to remove any residue wipe the surface of the substrate with a solvent in the following manner

(a) Saturate a clean cloth with an alcohol based solvent, mineral spirits, or a similar commercial solvent making sure the solvent is absolutely clean. Continual use from the same solvent container can result in contamination.

(b) Wipe the surface thoroughly, including areas near the edges where handling occurs.

(c) With a dry, clean, lint-free cloth wipe the surface clean before the solvent evaporates.

#### (5) Cleanliness Tests

There are two types of tests to verify that the aluminum substrate has not become soiled during handling prior to application of the sheeting. The tests should be conducted as follows:

(a) Tape Snap Test — Press onto the surface a 3"- 5" length of common transparent self-adhesive tape. After several seconds, lift it off quickly at a right angle and inspect for evidence of transferred material or indications of a contaminated surface for metal substrates.

(b) Water-Break Test — Minute traces of grease, oil or wax can be detected by pouring clean water onto the surface. On a clean surface, water tends to hold a uniform film. On a contaminated surface, the water beads up into many small droplets.

### **b. Application of Sheeting**

(1) Retroreflective sheeting shall not be applied when the ambient air temperature, the temperature of the aluminum sign blank and the sheeting is below 65° F (18.3°C).

#### (2) Pressure Sensitive Adhesive

The retroreflective sheeting material shall be applied according to the manufacturer's recommendations. The sheeting shall be applied to the sign substrate by mechanical squeeze roll applicator, hand squeeze roll applicator or hand application.

#### (3) Screen Processing

Screen processed signs are not allowable.

#### (4) Electronic Cuttable Film

Cutting of film and fabrication of the sign shall conform to manufacturer's recommended practices. The film may be applied to the sheeting either before or after the sheeting has been applied to the substrate. Use of a hand squeeze roll laminator is recommended to ensure satisfactory results. Use the "split liner method" starting in the middle of the sheet and remove half the liner to ensure proper alignment.

#### **c. Sign Installation**

This specification covers the field installation of permanent traffic control signs, consisting of retroreflective sheeting mounted on an aluminum substrate. Signs will either be installed on a square, steel, breakaway sign post assembly as herein specified or streetlight or traffic signal pole or mast arm according to the plans.

##### (1) General Requirements

(a) The Contractor shall locate the signs in the field in accordance with the Plans, the Manual on Uniform Traffic Control Devices (latest edition), and subject to the approval of the Engineer. Dimensions on the detailed drawings on the Plans shall take precedence. The Contractor will be responsible for orientation, elevation, offset and level of all signs erected. All sign posts shall be plumb. Any post that is leaning shall be replaced. The Contractor shall verify, prior to erecting any sign, that underground utilities will not be damaged as a result of placing the sign post.

(b) Ground mounted signs shall be erected so the sign face is truly vertical and at 93 degrees away from the center of the lane(s) which the sign serves, and the direction of travel unless otherwise shown on the Plans or directed by the Engineer. Signs mounted on the mast arm of a traffic signal pole shall be angled down 3 degrees toward the pavement surface.

(c) The height of the sign, measured from the finished ground surface or pavement to the bottom of a single sign, shall be 7'-0" unless otherwise indicated in the standard details. Exceptions would be for object markers which should be mounted 4'-0" above the finished ground surface or pavement to the bottom of the sign. If a secondary sign is mounted below another sign, the height, measured from the finished ground surface to the bottom of the secondary sign may be 6'-0". In the case where a sign is located in a pedestrian walkway or the sign face extends more than 4'-0" into a pedestrian walkway, the height to the bottom of the lowest mounted sign shall not be less than 80" measured from the finished surface of the walkway.

##### (2) Sign Installation on a Square, Steel, Breakaway Sign Post

(a) The sign post anchor shall be driven partially into the ground using a drive cap with sledge hammer or power equipment. The method of driving shall not substantially alter the cross-sectional dimensions of the posts or materially damage the coating. All areas where the galvanizing has been removed or damaged shall be cleaned and painted with zinc rich paint. Battered tops will not be permitted. The anchor sleeve shall then be slipped over the anchor and driven into the ground together with the sign post anchor. The sign post should then be slipped into the post anchor and bolted in place using the corner bolt as indicated in the detail drawings. The first hole above the finished grade level in all three post components shall be lined up in order to correctly insert the corner bolt. One single sign post long enough to support all signs shall be installed. Two separate lengths of post joined with a sleeve to achieve the necessary post length shall not be allowed.

(b) The sign shall generally be installed on the post with the top of the sign one inch above the top of the sign post. Exceptions to this would be when street name signs are installed above the traffic sign as indicated in the standard details. The mounting holes in the sign shall be located 3" in from the top and bottom of the sign face. Signs should be mounted on the square post with a hex head bolt extending through the entire post cross section and fastened with a

stainless steel washer and hex head jam nut as indicated in the standard details. Signs shall require both a flat plastic washer and a stainless steel washer with the plastic washer being placed against the sign face

(3) Sign Installation on Round Signal or Streetlight Poles

(a) Signs located on signal poles or streetlight poles shall be attached with flared leg stand-off brackets and 3/4" stainless steel banding and buckle as indicated in the standard details. The number of brackets and banding is based on the size of the sign. Refer to the standard details for more information. The mounting holes in the sign face for attachment to the mounting brackets shall be offset from the edge of the sign a minimum of 2". Exceptions for ground mounted street name signs and overhead mounted street name signs are indicated in the following section. Signs located on the mast arm of traffic signal poles shall have the holes in the sign face located such that the sign is level.

(b) All R10 series signs as designated by the MUTCD shall be mounted to mast arms with cable mount AstroBrac sign brackets as detailed in the standard details and specified herein. Signs shall require both a flat plastic washer and a stainless steel washer with the plastic washer being placed against the sign face. The sign mounting hardware on the back side of the sign shall include a flat stainless steel washer, stainless steel lock washer and stainless steel hex head lock nut.

(4) Installation of Overhead Street Name Signs

(a) Overhead street name signs shall be attached to traffic signal mast arms with two or three flared leg stand-off brackets depending on the length of sign. Overhead street name signs shall have mounting holes placed along the horizontal dimension of the sign blank. Holes should be located at least 12" in from the edge of the sign and placed such that the sign, when mounted on a mast arm with an upward rake, is level with the horizon. For signs longer than 60", an additional mounting hole shall be mounted along the horizontal dimension of the sign blank at the midpoint of the sign.

(b) Overhead street name signs shall generally be located on the mast arm between the vertical pole shaft and the first through vehicle signal head on the mast arm, according to the standard details. The location of the overhead street name sign and the vehicle pre-emption device shall be coordinated during construction such that the pre-emption device is not located behind the sign.

(5) Installation of Ground Mounted Street Name Signs

(a) Ground mounted street name signs shall be attached either to square steel tubular posts or round street light poles as indicated in the plans and according to the standard details. The street name sign for the major street shall be mounted above the street name sign for the minor street.

(b) When installed on square, steel tubular posts, two signs shall be provided and mounted on opposite sides of the post and be fastened with a hex head bolt that extends through the post and both signs and terminated with a hex head jam nut. A stainless steel washer and a flat plastic washer shall be installed on each side of the post with the flat plastic washer installed adjacent to the finished sign face. The mounting holes shall be located at the center of the sign and placed 1" from the top and bottom edge of the sign. Holes shall also be located on each end of the sign 1/2" in from the edge of the sign for a tubular PVC spacer and aluminum pop rivet to provide stability for the dual sign blanks. At skewed intersections, the contractor shall install two "round to square" post couplers and indicated in the standard details and orient the signs at the appropriate angle to match each street. The minimum mounting height, measured from the finished ground surface to the bottom of the lowest street name sign shall be 8'-0" or as indicated in the standard details. One single sign post long enough to support all signs shall



be installed. Two separate lengths of post joined with a sleeve to achieve the necessary post length shall not be allowed.

(c) When installed on a round street light pole, the sign blank shall be fabricated with sheeting on both sides and installed with a L-shaped wing bracket as indicated in the standard details. The wing bracket shall be mounted to the round pole by two ¾" stainless steel bands and buckles. One wing bracket shall be installed per each sign. Cross brackets shall not be permitted.

**d. Existing Signs**

The Contractor shall preserve all existing traffic control signs in useful condition so as to provide traffic control during construction. All existing signs shall be maintained in order to provide proper warning, guidance or regulatory information to the traveling public until new signs are erected according to the plans. All existing traffic signs except those signs to be removed shall be reused and relocated, as shown on the plans, after construction. All existing signs that are to be removed after construction shall be carefully protected and shall be returned to the City according to the "Instructions for Disassembly and Return of Traffic Sign Equipment" as listed in the standard details. There will be no direct measurement or payment for this work.

**e. Pre-Qualification**

Manufacturers interested in pre-qualifying material under this specification shall submit a sample of the material along with a complete materials specification for each item to be considered. The sample will be reviewed for compliance with all requirements of this specification. No material shall be used unless the material has been pre-qualified. A complete list of pre-qualified materials is maintained by the Traffic Engineering Division of the Department of Public Works.

**42 - ILLUMINATED OVERHEAD STREET NAME SIGNS**

**42.1 GENERAL**

The Contractor shall furnish all labor, equipment and materials to install illuminated overhead street name signs and all equipment and wiring necessary for sign installation at the locations shown on the plans, in conformance with the details, and the material specifications included herein. Unless specifically noted otherwise, all equipment shall be new and similar to the best grade of this type of equipment, and shall be approved by the Engineer.

**a. Plans**

The plans that accompany these specifications shall be considered a part thereof. Whenever any part of the plans shall be in conflict with any other part or parts of the plans, or any part of these specifications shall be in conflict with any other part or parts of these specifications or any of the items proposed to be constructed shall appear to be impracticable, or impossible to construct, then the matter shall be immediately brought to the attention of the Engineer or his agent. The Engineer's decision in the matter shall be final, and the Contractor shall follow his directions to avoid any such conflict in the plans or specifications.

All incidental parts which are not shown on the plans or specified herein and which are necessary to complete illuminated overhead street name signs shall be furnished and installed as though such parts were shown on the plans or specified herein. All systems shall be complete and in operation to the satisfaction of the Engineer at the time of acceptance of the work.

**b. References**

City of Overland Park specification for "Permanent Traffic Control Signing" is hereby referenced.

**c. Sign Requirements**

The sign shall:

- (1) Require no tools to open sign or replace lens.
- (2) Be designed to withstand 110 mph wind.
- (3) Contain a radiant high temperature fail-safe circuit for LED to prevent premature burn out in extreme temperatures.
- (4) Be UL listed

**42.2 MATERIAL**

The material for illuminated overhead street name signs shall be in accordance with this specification.

**a. Approved Manufacturer’s List**

All material for illuminated overhead street name signs used by the Contractor shall be from the City’s approved list of vendors. It is important that users be completely knowledgeable of all application requirements and procedures prior to product application. It is the responsibility of the installer to contact the supplier of all illuminated overhead street name sign materials if questions regarding application procedures or conditions arise.

**b. Illuminated Overhead Street Name Sign**

(1) Sign Body

Each sign body shall be constructed from 5052 H32 .125” thick aluminum. Single face signs shall be one piece construction and all seams shall be continuously welded to ensure a water resistant seal. There shall be two pre-cut round holes in the top and the bottom of the sign housing for connection of the mounting brackets. Standard mounting pattern shall be a Tri-stud pattern on top and bottom of the sign body.

Sign lenses shall fit firmly inside door panels free from the use of clips, bolts, screws or brackets. 1/4” holes shall be incorporated in the bottom of the enclosure to prevent possible buildup of condensation. Signs with single street name text shall be 19” in height with a tapered body depth of 8” at the top to 5 3/8” at the bottom. Signs with two rows of street name sign text shall be 24” in height with a tapered body depth of 9 3/8” at the top to 5 3/8” at the bottom. The standard lengths of the signs shall be 4 feet, 6 feet or 8 feet. The exposed lens dimensions of the sign shall be in accordance with Table 1 below:

<b>TABLE 1: LENS DIMENSIONS</b>	
<b>Sign Dimensions:</b>	<b>Lens Dimensions:</b>
4 ft x 19”	44.5” x 15.125”
4 ft x 24”	44.5” x 20.125”
6 ft x 19”	68.5” x 15.125”
6 ft x 24”	68.5” x 20.125”
8 ft x 19”	92.5” x 15.125”
8 ft x 24”	92.5” x 20.125”

(2) Gasketing

All signs shall use a UL approved neoprene gasket strip to provide a watertight seal between the body, lens and door.

(3) Lens Requirements

Lenses shall be impact resistant, 0.118” thick UL approved clear polycarbonate. Sign film shall be ultraviolet (UV) resistant electro-cuttable (EC) film over a white translucent retroreflective sheeting conforming to ASTM D 4956-04 and proposed amendments to include ASTM Type XI micro-encapsulated, prismatic backing. Different sign film colors shall be available and specified at time of order.

Reference should be made to the specification for “Permanent Traffic Control Signing” for additional material specifications on the sign sheeting and EC film.

(4) Hardware

Door latches and keepers shall be turn-lock style devices made from stainless steel securing the door to the body. A full length continuous stainless steel piano hinge shall be used on the door to the body opening in a downward motion for ease of accessibility. The hinge shall be attached with stainless steel screws and nuts.

Provision for photoelectric cell mounting shall be available on all signs compatible with both Intermatic model K4221C and Tork 2001 which can control four signs per intersection. However, signs shall be ordered without photo electric cells unless specifically called out for in the plans.

(5) Finish

The sign bodies and doors shall be polyester powder coated for durability using a satin black finish to the external aluminum surfaces. Other colors, other than black, may be specified as indicated in the plans.

(6) Electrical Requirements

(a) General

Each sign type shall consist of an electrical/electronics package consisting of a power supply, Light Engine, and fuse. The power supply shall be a 120-240V self sensing unit to operate. All LED’s shall be mounted onto a circuit board which is mounted onto a 0.125” thick aluminum heat sink. Individual Light Engine electrical characteristics shall be:

	LED
Ballast (P/s) Model	OT75/120-277/24E
Dimensions	9.5" L x 1.63" W x 1.18" H
Connections	Input: 9" (18AWG solid wire) black & white Output: 9" (18AWG solid wire) red+ & blue
Nominal Input Voltage (VAC)	120-277
Nominal Input Current (Amps)	.75@120v / .32@277v
Input Watts	90@120
Power Factor @ 120v	0.99
Max Output Power (W)	75w
Max Line Ripple (V)	+/-0.2v
Location Rating	Dry & Damp
Input Frequency (Hz)	50/60
Ambient Temp Range	-25°C through +60°C
Max Case Temp	90°C
UL Class	Class 2, UL 1310, UL48
Light Engine(s) (Bulbs) driven	≤ 8 Rebel LED Light strips

(b) LED Light Engine

The LED drive current shall be regulated using a pulse width modulated 24v DC drive and limited to approximately 300ma through the LED chain at normal room temperature providing for a stable light intensity under varying voltage conditions.

LED’s within the light engine shall be series wired for increased efficiency and incorporate fault tolerant design. An LED bypass shall isolate a failure to that particular LED and will allow the remaining LED’s to operate normally. The constant current regulator shall readjust the drive current to prevent

overdriving the remaining operable LED's in the chain. LED strips shall be two feet in length containing six LED's per strip and replaceable by removing three Phillips screws.

Thermal monitoring shall provide temperature protection to the LED chain. As the heat sink temperature increases, the LED drive current shall be reduced along with LED intensity, helping to limit the junction temperature and contributing to the long LED lifespan. The current reduction shall follow a non-linear curve that is high temperature biased (greatest reduction occurs at the higher temperature). Thermal regulation of the drive current shall begin at ~ 40°C and continue until a complete shutdown occurs at ~ 100°C. An onboard display LED shall indicate when an overheat shutdown is present. Recovery shall occur automatically with a reduction in the heat sink temperature.

(c) AC Loading Matrix

The AC loading matrix for all sign types shall be as follows:

		Sign Type	LED		
		Sign Faces	Single		
		Sign Width	4	6	8
		# Light Engines	2	3	4
Power Engine	V AC	Min / Max	120		
	Freq Hz	Min / Max	50		
	Temp Deg C	Min / Max	-20		
AC Load @ 120v AC		Amp Typical	0.2	0.3	0.3
		Watt Typical	21	28	36

(7) Warranty

Manufacturer shall certify that each sign meets these specifications. Further the manufacturer shall warrant the product for minimum of 3 years and shall warrant the light engine for a minimum of 5 years.

**c. Cable**

Electrical cable from the sign to the point of connection to the energized electrical system shall be 14 gauge three conductor (1-3c #14 AWG) stranded copper conductors. The cable shall be for operation on a 600 volt maximum and suitable for use at conductor temperatures not exceeding 75 degrees C in accordance with IMSA 19-1. The three bare copper conductors shall be color coded green, black and white with polyethylene insulation and shall be wrapped with mylar within a black PVC outer jacket. The cable shall have the full manufacturer's line code printed on the outer jacket consisting of manufacturer's name or UL E-file, IMSA specification number, the year of manufacturer and the footage.

**d. Mounting Brackets**

The Astro Sign-Brac cable mount system shall be used to mount the illuminated overhead street name signs to signal pole mast arms. It shall consist of a high tensile aluminum alloy clamp kit, 5/16"-18 U-bolts, 1 1/2" Schedule 10 aluminum tube (length based on sign height) and saddle, and high strength galvanized aircraft cable and stainless steel swaged fittings. It shall be supplied complete with all necessary attaching hardware including 5/16"-18 x 1" stainless steel hex head bolt, hex nut, split lock washer and flat washer.

**42.3 CONSTRUCTION REQUIREMENTS**

The illuminated overhead street name sign and components shall be installed in accordance with manufacturer's requirements to provide a complete and operational system.

**a. Illuminated Overhead Street Name Sign Installation**

Illuminated overhead street name signs shall be attached to traffic signal mast arms with two Astro sign braces as indicated in the standard details. Overhead street name signs shall generally be located on the mast arm between the vertical pole shaft and the first through vehicle signal head on the mast arm, according to the standard details. The location of the overhead street name sign and the vehicle pre-

emption device or radar detection units shall be coordinated during construction such that the pre-emption device and/or the radar detection unit is not located behind the sign.

The sign shall be rigid mounted with the sign centered approximately vertically on the mast arm, not mounted hanging below it, and leveled horizontally.

**b. Wiring**

Color codes shall be followed so that the black insulated conductor connects to the black power terminal, white to white, and green to green located in the electrical access panel on the sign housing. The contractor shall drill a hole in the bottom of the mast arm and insert a rubber grommet to protect the cable from cuts and abrasions during the pulling operation. The cable shall run continuously through the mast arm and the signal pole to the designated connection point as indicated in the plans. A cable drip loop shall be provided at the point where the cable enters the bottom of the mast arm. Signs shall be connected to street lighting circuits with breakaway fused and un-fused fuse holders and multi-tap connectors as indicated in the standard details.

**43 - PERMANENT PAVEMENT MARKINGS**

**43.1 DESCRIPTION**

The Contractor shall furnish and install white and yellow permanent retro-reflectORIZED pavement marking materials at the locations shown on the plans, in conformance with the details, and the material specifications included herein.

The permanent pavement markings shall be installed immediately after overlaying unless prior approval is received by the Engineer or City Inspector. The installation of the yellow markings (as required) is the first priority. If the permanent markings cannot be installed and thus the roadway would be unmarked overnight, interim removable markings shall be installed and remain until the permanent markings can be installed. The contractor shall make every possible effort to remove the interim pavement markings and install permanent pavement markings within 48 hours. Only under extreme circumstances and at the approval of the pavement marking inspector or the engineer, will the duration of the interim pavement markings be extended. Under no circumstance should the interim pavement markings be in place for more than 2 weeks. If permanent markings cannot be installed within the specified time then temporary markings shall be installed following the guide lines as set forth in the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD) Part VI, Sections 6F.78 and 6G.02. The interim removable markings shall be removed prior to installation of the permanent markings.

**43.2 MATERIALS**

The material for permanent pavement markings shall be in accordance with this specification. All material for permanent pavement marking material used by the Contractor shall be from the City's approved list of vendors. It is important that users be completely knowledgeable of all application requirements and procedures prior to product application. It is the responsibility of the installer to contact the supplier of all permanent pavement marking materials if questions regarding application procedures or conditions arise.

**a. Pre-Qualification**

Manufacturers interested in pre-qualifying material under this specification shall submit a sample of the material along with a complete materials specification for each color of marking material to be considered. The sample will be reviewed for compliance with all requirements of this specification. No material shall be used unless the material has been pre-qualified. A complete list of pre-qualified materials is maintained by the Traffic Engineering Division of the Department of Public Works.

**b. Pre-Mix Glass Spheres**

Pre-mix glass spheres shall be uncoated and conform to AASHTO M247 Type 1. The glass spheres used in the formulation shall be lustrous, free from film, scratches, and pits. The glass spheres shall also meet the following requirements:

(1) Roundness

The roundness of the spheres shall be minimum of 70% when tested in accordance with A.STM. D-1155.

(2) Gradation

The gradation when tested in accordance with the method provided in A.S.T.M. D-1214 (by use of U.S. Standard Sieves) shall be:

Size of Sieve	Mass % Passing
1.18 mm (No. 16)	100
0.85 mm (No. 20)	95-100
0.60 mm (No. 30)	75-95
0.30 mm (No. 50)	15-35
0.15 mm (No. 100)	0-5

(3) Refractive Index

When tested by a liquid immersion method at 25 degrees C (77 degrees F), the refractive index of the spheres shall be a minimum of 1.50.

**c. Drop-On Glass Spheres**

The spheres shall be manufactured from glass of a composition designed to be highly resistant to traffic wear and to the effects of weathering. The particles shall be spherical in shape, containing not more than thirty percent (30%) of irregularly shaped particles. They shall be essentially free of sharp angular particles, and particles showing milkiness or surface scoring or scratching. They shall meet the requirements of AASHTO M247 Type 1.

(1) Gradation

The gradation when tested in accordance with the method provided in A.S.T.M. D-1214 (by use of U.S. Standard Sieves) shall be that as specified above for AASHTO M247 Type 1.

(2) Refractive Index

When tested by a liquid immersion method at 25 degrees C (77 degrees F), the refractive index of the spheres shall be within the range of 1.50 to 1.60.

(3) Moisture Proof Requirements

The spheres shall show no tendency to absorb moisture in storage and shall remain free of clusters and hard lumps. The spheres shall flow freely from dispensing equipment at any time when surface and atmospheric conditions are satisfactory for application.

**d. Thermoplastic Pavement Markings**

This specification covers a white and yellow thermoplastic reflectorized pavement marking material of a type that is applied to asphalt road surfaces. The material shall be applied in a molten state by mechanical means to receive a surface application of glass spheres, and which upon cooling to normal pavement temperature, produces an adherent reflectorized stripe of specified thickness and width and is capable of resisting deformation.

(1) Characteristics

The material shall not exude fumes that are toxic, obnoxious or injurious to person or property, when it is heated to the temperature range specified by the manufacturer for application. It shall remain

stable when held for 4 hours at this temperature, or when subject to 3 reheatings after cooling to ambient temperature. The temperature-viscosity characteristics of the plastic material shall remain constant throughout repeated reheatings, and shall show like characteristics from batch to batch. There shall be no obvious change in color of the material neither as a result of repeated reheatings nor from batch to batch.

The thermoplastic material shall easily extrude from the equipment to produce a cross-section of line 90 to 125 mil thick, which shall be continuous and uniform in shape, and have clear and sharp dimensions.

(2) Serviceability

The compound shall resist deterioration by contact with sodium chloride, calcium chloride or other chemicals used to prevent roadway ice, or because of the oil content of pavement materials or from oil droppings or other effects of traffic. The markings shall remain intact under normal traffic conditions at temperatures below 60 degrees C (140 degrees F).

(3) Specific Gravity

The material's specific gravity shall not be less than 1.8 nor exceed 2.15 referred to water at 25 degrees C (77 degrees F) when determined by a water displacement method at 25 degrees C (77 degrees F).

(4) Set Time

When applied at the specified temperature and thickness, the material shall set to bear traffic in not more than 2 minutes when the air temperature is  $10 \pm 2$  degrees C ( $50 \pm 3$  degrees F) and not more than 10 minutes when the air temperature is  $32 \pm 2$  degrees C ( $90 \pm 3$  degrees F).

(5) Composition

The thermoplastic pavement marking material shall be homogeneously composed of pigment, filler, resin binder and glass reflectorizing spheres. The solid resin shall be a "maleic-modified glycerol ester resin" (alkyd binder) comprising at least one-third of the binder compositions and be no less than eight (8) percent by weight of the entire material formulation. The alkyd binder shall consist of a mixture of synthetic resins (at least one of which is solid at room temperature), and high boiling point plasticizers. The material shall not contain any petroleum derived ingredients. Yellow pigment shall be heat stabilized encapsulated lead chromate. The thermoplastic pavement marking material shall contain the following ingredients:

INGREDIENT (Percent by Weight)	WHITE	YELLOW
Binder (See Note A below)	18.0 min.	18.0 min.
Titanium Dioxide	10.0 min.	--
Glass Spheres	20.0-50.0	20.0-50.0.
Lead Chromate	--	2.0-4.5
Inert Fillers	42.0 max.	50.0 max.

The material shall be thoroughly mixed and furnished in a free flowing granular form. The material shall meet the requirements of this specification for a period of one year. The material shall readily melt in a uniform mixture. The material shall be free from all skins, dirt, and foreign objects. It shall be of such composition that it will not bleed, stain or discolor when applied to bituminous pavement. The manufacturer shall replace material not meeting the above requirements.

(6) Color

The color of the thermoplastic material after heating for 4 hours  $\pm 5$  minutes at  $218 \pm 2$  degrees C ( $425 \pm 3$  degrees F) and cooled to  $25 \pm 2$  degrees C ( $77 \pm 3$  degrees F) shall conform to the following when tested by Federal Test Method Standard 141 Method 4252:

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White: Federal Color Chip No. 17875 (Fed. Std. No. 595)

Yellow: Federal Color Chip No. 13538 (Fed. Std. No. 595)

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(7) Reflectance

The daylight luminous reflectance of the white material shall be not less than 75% when tested according to A.S.T.M. E1347. The yellow shall have a minimum brightness of 45% relative to magnesium oxide, and shall be within the green and red tolerance of the "Standard Color Chips for Highway Signs (January 1939)" obtainable from the United States Bureau of Public Roads, Washington, D.C. (TT-P-115a).

(8) Softening Point

After heating the thermoplastic material for 4 hours  $\pm$  5 minutes at  $218 \pm 2$  degrees C ( $425 \pm 3$  degrees F) and testing in accordance with ASTM D36, the material shall have a softening point  $102 \pm 9.5$  degrees C ( $215 \pm 15$  degrees F).

(9) Flowability

After heating the thermoplastic material for 4 hours  $\pm$  5 minutes at  $218 \pm 2$  degrees C ( $425 \pm 3$  degrees F) and testing for flowability, the white thermoplastic shall have a minimum percent residue of 18 percent and the yellow thermoplastic shall have a maximum residue of 21 percent.

After heating the thermoplastic material for 8.5 hours  $\pm$  5 minutes at  $218 \pm 1.4$  degrees C ( $425 \pm 3$  degrees F) and testing for flowability, the thermoplastic shall have a maximum percent residue of 28 percent.

(10) Indentation Resistance

Hardness shall be measured by a Shore Durometer, Type A2, as described in A.S.T.M. D-2240, except that the Durometer and the panel shall be at 25 degrees C (77 degrees F), and a 2 kg (4.4 lb.) load applied. After 15 seconds, the reading shall be not less than 55.

(11) Abrasion Resistance

The material shall not show a maximum loss of 0.5 g (0.02 ounces) subjected to 200 revolutions on a Taber Abraser at 25 degrees C (77 degrees F), using H-22 calibrate wheels, weighted to 500 g (17.6 ounces). The wearing surface should be kept wet with distilled water throughout the test. The panel for this test shall be prepared by forming a representative lot of material at a thickness of 3 mm (125 mil) on a 100 mm (4") square panel (thickness  $1.3 \pm 0.025$  mm) [thickness  $0.050 \pm 0.001$  inch] on which a suitable primer has been previously applied.

(12) Low Temperature Impact Resistance

The materials shall not fracture when subjected to an impact of 7.23 N-m at  $-20$  degrees C (64 inch pounds at  $-4$  degrees F), for at least 3 hours. The panel is then placed in an instrument also maintained at  $-20$  degrees C ( $-4$  degrees F), consisting of a 4.7 kg (10.5 pound) freely falling weight controlled to drop vertically for 150 mm (6") onto the surface of the panel, which it strikes with a hemispherical indent or having a radius of 7 mm (0.28 inches).

(13) Water Absorption

Materials shall have a maximum of 0.5 percent by weight of retained water when tested by ASTM designation D-570, "Water Absorption of Plastics", procedure (A).

(14) Yellowness Index

The white thermoplastic material shall not exceed a yellowness index of 0.12.

(15) Flash Point

The thermoplastic material shall have a flash point not less than 475 degrees F when tested in accordance with ASTM D92.

(16) Cracking Resistance

After heating the thermoplastic material for 4 hours  $\pm$  5 minutes at  $218 \pm 2$  degrees C ( $425 \pm 3$  degrees F); applying to concrete blocks, and cooling  $-9.4 \pm 1.7$  degrees C ( $15 \pm 3$  degrees F), the material shall show no cracks. Properly applied, the material shall show less than six stress cracks per three lineal



meters (ten lineal feet) of markings independent of pavement fracturing and faulting, for at least six months.

**e. Preformed Thermoplastic Pavement Markings**

This specification is for the furnishing of retroreflective preformed thermoplastic pavement marking materials that can be adhered to asphalt pavements by means of heat fusion. The applied markings shall be very durable, oil and grease impervious and provide immediate and continuing retroreflectivity.

(1) Characteristics

The preformed marking material shall consist of a resilient white and yellow polymer thermoplastic with uniformly distributed glass spheres throughout its entire cross section.

Preformed words and symbols shall conform to the applicable shapes and sizes as prescribed in the latest revision of the Manual on Uniform Traffic Control Devices for Streets and Highways.

The preformed markings shall be fusible to asphalt concrete by means of the normal heat of a propane type of torch. No adhesives, primers or sealers shall be used prior to the preformed marking application when applying to asphalt concrete pavements.

The preformed markings shall conform to pavement contours, breaks and faults through the action of traffic at normal pavement temperatures. The markings shall have resealing characteristics and be capable of fusing to itself and previously applied worn hydrocarbon and/or alkyd thermoplastic pavement markings.

The preformed markings shall be capable of application on new, dense and open graded asphalt concrete wearing courses during the paving operation in accordance with the manufacturer's instructions. After application, the markings shall be immediately ready for traffic. The preformed markings shall be suitable for use for one year after the date of receipt when stored in accordance with the manufacturer's recommendations.

The preformed thermoplastic markings shall not be brittle and must be sufficiently cohesive and flexible at temperatures exceeding 10 degrees C (50 degrees F) for one person to carry without the danger of fracturing the material prior to application.

(2) Composition

The retroreflective pliant polymer thermoplastic pavement markings shall consist of a homogeneous mixture of high quality polymeric thermoplastic binders, pigments, fillers and glass spheres. The thermoplastic material must conform to AASHTO designation M-249 with the exception of the relevant differences due to the material being supplied in a preformed state.

(3) Glass Spheres

The markings shall contain 30% glass spheres which shall conform to AASHTO M247 Type 1, except that glass spheres shall have a minimum of 70% true spheres on each sieve and 80% true spheres overall.

The glass spheres must be homogeneously blended throughout the material with a securely bonded protruding exposed layer of spheres that provide immediate and continuous retroreflectivity; no additional glass spheres shall be dropped on the material during application. Curved arrows must be available without protruding glass spheres if reversibility is needed.

(4) Retroreflectivity

The preformed marking shall upon application, exhibit uniform adequate nighttime retroreflectivity when tested in accordance to ASTM E1710-97. The applied material must have an initial minimum intensity reading of 375 millicandelas for white and 175 millicandelas for yellow as measured with an LTL-2000 Retroreflectometer with a 1.05 degree observation angle, 88.76 degree entrance angle and 30 meter geometry (viewing distance).

(5) Abrasion Resistance

Using a Taber Abraser with an H-18 wheel and a 125 g (4.4 ounce) load, the sample shall be inspected at 200 cycles, under a microscope, to observe the extent and type of bead failure. No more than

15% of the beads shall be lost due to popout and the predominant mode of failure shall be “wear down” of the beads.

(6) Color and Luminosity Characteristics

The thermoplastic material without glass spheres shall meet the following:

White:	Daylight reflectance at 45-degree/ 0 degree of 80% minimum
Yellow:	Daylight reflectance at 45-degree/ 0 degree of 45% minimum.

The daylight reflectance shall not change significantly when the preformed thermoplastic is properly applied to the roadway surface

For highway use, the white markings shall contain a minimum of 8% by weight of Titanium Dioxide pigment to ensure a color similar to Federal Highway White, Color No. 17886 Standard 595. Yellow color shall reasonably match color chip Number 13538 of Federal Standard number 595 and be lead free.

(7) Skid Resistance

The surface of the preformed thermoplastic markings shall provide a minimum skid resistance value of 45 BPN when tested according to ASTM: E303.

(8) Thickness

The supplied material shall have a minimum average thickness of 90 mils.

(9) Flexibility

The preformed thermoplastic marking material shall have flexibility at 10 degrees C (50 degrees F) such that no cracking occurs in the test sample when a 25 mm by 150 mm (1” by 6”) sample is bent through an arc of 90 degrees at a uniform rate in 10 seconds (9 seconds per degree) over a 25 mm (1”) mandrel. The sample must be conditioned prior to testing at  $10 \pm 0.9$  degrees C ( $50 \pm 2$  degrees F) for a minimum of four hours. At least two specimens tested must meet the flexibility requirements at 10 degrees C (50 degrees F) for a passing result.

(10) Environmental Resistance

The applied markings shall be resistant to deterioration due to exposure to sunlight, water, oil, diesel fuels, gasoline, pavement oil content, salt and adverse weather conditions.

(11) Effective Performance Life

When properly applied, in accordance with the manufacturer’s instructions, the pavement markings shall be neat and durable. The markings shall remain retroreflective and show no fading, lifting, shrinkage, tearing, roll back or other signs of poor adhesion.

**f. Durable Pre-Formed, Patterned Cold Plastic, or Durable Pre-Formed, Contrast Patterned Cold Plastic Pavement Markings**

This specification shall consist of furnishing and installing retroreflective preformed patterned pavement markings, with or without contrast, in accordance with this provision and in conformance to the dimensions and lines shown on the plans or established by the engineer.

(1) Characteristics

The preformed patterned markings shall consist of white or yellow films with clear and/or yellow-tinted microcrystalline ceramic beads incorporated to provide immediate and continuing retroreflection. On concrete pavements, contrast pavement marking tape shall be used and installed in a groove. The contrast tape shall have a black preformed patterned film border, bonded to the edges to form a continuous roll. These films shall be manufactured without the use of lead chromate pigments or other similar, lead-containing chemicals. The total width of the preformed contrast tape shall be an additional three inches wider than the standard width specified. This additional three inch width shall be black non-reflective film with one and a half inches on both sides of the white or yellow film. Preformed words and symbols shall conform to the applicable shapes and sizes as outlined in the “Manual on Uniform Traffic Control Devices for Streets and Highways.”

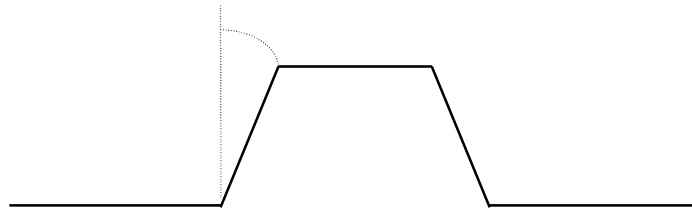
The preformed contrast patterned cold plastic markings shall be capable of being adhered to Portland cement concrete by a pre-coated pressure sensitive adhesive with a surface preparation adhesive may be used to precondition the pavement surface. The cold plastic pavement markings, without contrasting edges, shall be capable of application on new, dense and open-graded asphaltic concrete wearing courses and chip seal wearing surfaces. The preformed markings shall conform to pavement contours by the action of traffic in accordance with the manufacturer's instructions. After application, the markings shall be immediately ready for traffic. The contractor shall identify proper surface preparation adhesives (where necessary) to be applied at the time of application, and all equipment necessary for proper application, and recommendations for application that will assure effective product performance. The preformed markings shall be suitable for use for one year after the date of receipt when stored in accordance with the manufacturer's recommendations.

(2) Requirements

The markings shall be highly durable, retroreflective, pliant polymer materials (with durable matte black with not-reflective polymer borders for concrete pavement applications). The material shall be designed for longitudinal, transverse, and symbol/legend markings subjected to high traffic volumes and severe wear conditions such as shear action from crossover or encroachment on typical longitudinal configurations such as edge lines and lane lines and typical transverse configurations such as stop bars and crosswalks. On concrete pavement, contrast tape shall be installed in a groove.

(a) Composition

The retroreflective pliant polymer pavement markings shall consist of a mixture of high-quality polymeric materials, pigments and glass beads distributed throughout its base cross-sectional area, and an embedded reinforcing net, and a reflective layer of microcrystalline ceramic beads bonded to a durable polyurethane topcoat surface. The patterned surface shall have approximately 50% + or - 15% of the surface area raised and presenting a near vertical face ( $\beta$  angle of  $0^\circ$  to  $60^\circ$ ) to traffic from any direction. (See diagram below.) The channels between the raised areas shall be substantially free of exposed beads or particles.



(3) Retroreflectance

The white and yellow portions of the markings shall have the following initial expected retroreflectance values as measured in accordance with the testing procedures of ASTM D4061. The photometric quantity to be measured shall be the coefficient of retroreflected luminance ( $R_L$ ) and shall be expressed as millicandelas per square foot per foot-candle [ $(\text{mcd} \cdot \text{ft}^{-2}) \cdot \text{fc}^{-1}$ ]. The metric equivalent shall be expressed as millicandelas per square meter per lux [ $(\text{mcd} \cdot \text{m}^{-2}) \cdot \text{lx}^{-1}$ ]. The test distance shall be approximately 100 feet (30 m).

Expected Initial Reflectance		
	White	Yellow
Entrance Angle	88.76°	88.76°
Observation Angle	1.05°	1.05°
Retroreflected Luminance, $R_L$ ( $\text{mcd} \cdot \text{ft}^{-2}) \cdot \text{fc}^{-1}$ *	500	300

\*These retroreflectance values are based on dark room photometric readings per ASTM D4061.  
Note: The test instrument shall use an Entrance Angle of 88.76° and Observation Angle of 1.05° which represent a simulated driver viewing geometry at a 30 meter distance.

#### (4) Bead Index of Refraction

All microcrystalline ceramic beads bonded to the polyurethane-coated, patterned surface of the material shall have a minimum index of refraction of 1.70 when tested using the liquid oil immersion method. The glass beads mixed into the pliant polymer shall have a minimum index of refraction of 1.5 when tested by the liquid oil immersion method.

##### (a) Testing Procedure for Refractive Index of the Beads by Liquid Immersion

###### EQUIPMENT REQUIRED:

- A. Microscope (minimum 100X magnification)
- B. Light source - preferably sodium light or other monochromatic source
- C. Refractive index liquids\*
- D. Microscope slide and slide cover
- E. Mortar and pestle

\*Available from R.P. Cargille Laboratories, Inc., Cedar Grove, NJ.

###### PROCEDURE:

- A. Using the mortar and pestle, crush a few representative beads and place a few of these crushed particles on a microscope slide.
- B. Place a drop of a refractive index liquid, with an index as close to that of the glass as can be estimated, on the particles.
- C. Cover the slide with a microscope slide cover and view the crushed particles by transmitted light normal to the slide surface (illuminated from the bottom).
- D. Adjust the microscope mirror to allow a minimum light intensity for viewing. This is particularly important if sodium light is not used.
- E. Bring a relatively flat and transparent particle into focus.
- F. By slightly raising and lowering the objective (microscope tube), look for one or both of the following:
  - 1. Becke Line - This light line will appear to move either into the particle or away from it. In general, if the objective is raised, the line will move toward the material of higher refractive index; if the objective is lowered, the line will move toward the material of lower index.
  - 2. Variation in Particle Brightness - When raising the object from a sharp focus, the particle will appear to get brighter or darker than the surrounding field. If it becomes brighter, the glass has a higher refractive index than the liquid. If it becomes darker, the glass has a lower refractive index than the liquid. In both cases, the opposite will be true if the object is lowered.
  - 3. This test can be used to confirm that the beads are above or below a specified index. It can also be used to give an accurate determination of the index (+ or - 0.001). This is done by using several refractive index liquids until a match or near match of indices occurs. The index of the glass will equal that of the liquid when no Becke line and no variation in bead brightness can be observed.

The size and quality of the beads shall be such that the performance requirements for the retroreflective pliant polymer shall be met.

(5) Acid Resistance

The beads shall show resistance to corrosion of their surface after exposure to a 1% solution (by weight) of sulfuric acid. The 1% acid solution shall be made by adding 5.7cc of concentrated acid into 1000cc of distilled water. CAUTION: Always add the concentrated acid into the water, not the reverse. The test shall be performed as follows:

Take a 1" x 2" sample, adhere it to the bottom of a glass tray and place just enough acid solution to completely immerse the sample. Cover the tray with a piece of glass to prevent evaporation and allow the sample to be exposed for 24 hours under these conditions. Then decant the acid solution (do not rinse, touch or otherwise disturb the bead surfaces) and dry the sample while adhered to the glass tray in a 150° F. (66° C.) oven for approximately 15 minutes. Microscopic examination (20X) shall show no more than 15% of the beads having a formation of a very distinct opaque white (corroded) layer on their entire surface.

(6) Color

The preformed markings shall consist of white and yellow films with pigments selected and blended to conform to standard highway colors and a black preformed patterned film border for installation on concrete pavement.

The white markings shall contain a minimum of 8% by weight of Titanium Dioxide pigment to ensure a color similar to Federal Highway White, Color No. 17886 Standard 595. Yellow color shall reasonably match color chip Number 13538 of Federal Standard number 595 and be lead free.

(7) Skid Resistance

The patterned surface of the retroreflective pliant polymer shall provide an initial average skid resistance value of 45 BPN when tested according to ASTM E303 except values shall be taken in one direction and then at a 45° angle from that direction. These two values shall then be averaged to find the skid resistance of the patterned surface.

(8) Patchability

The pavement marking material shall be capable of use for patching worn areas of the same type in accordance with manufacturer's instructions.

(9) Thickness

The patterned material without adhesive shall have a minimum caliper of 65 mil (0.065") at the thickest portion of the patterned cross-section and a minimum caliper of 20 mil (0.02") at the thinnest portion of the cross-section.



**g. Temporary Cold Plastic Pavement Markings**

This specification covers a white and yellow pre-formed cold plastic reflectorized pavement marking material of a type that is applied to a road surface as temporary pavement markings by a pre-coated pressure sensitive adhesive that produces an adherent reflectorized stripe of specified thickness and width and is capable of resisting deformation. By definition, temporary cold plastic pavement markings, are markings that meet the full requirement of the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) that will generally be in service for at least 6 months or longer. The application of the markings is intended to be such that they are removable without undue pavement scarring. The markings will be used when it is anticipated that they will be revised for future lane additions or lane use modifications between construction projects or construction seasons.

(1) Characteristics

The material shall be manufactured without the use of lead-chromate pigments or other, similar, lead-containing chemicals.

Glass spheres shall be incorporated to provide immediate and continuing retroreflection. Ceramic skid particles shall be bonded to the top layer to provide a skid-resistant surface.

Preformed word and symbol markings shall conform to the applicable shapes and sizes as outlined in the MUTCD.

The preformed markings shall be capable of being adhered to Portland cement concrete pavements by an inlaid, pre-coated pressure sensitive adhesive. A surface preparation adhesive may be used to precondition the inlay pavement surface.

The preformed marking film shall mold itself to pavement contours by the action of traffic. Following proper inlay application and tamping, the markings shall be immediately ready for traffic.

(2) Composition

The retroreflective pavement marking film shall consist of a mixture of high-quality polymeric materials, pigments and glass spheres distributed throughout its base cross-sectional area. A reflective layer of glass spheres and a layer of skid-resistant ceramic particles shall be bonded to the top urethane wearing surface. The urethane wear surface shall have a nominal thickness of 5 mil (0.005 inches). The film shall have a pre-coated, shear-resistant, pressure sensitive adhesive.

(3) Color

The daytime color of the white film shall provide a minimum initial luminance factor, Y, of 80 and shall conform to the following chromaticity requirements:

WHITE		YELLOW	
X Values	Y Values	X Values	Y Values
0.290	0.315	0.474	0.455
0.0310	0.295	0.491	0.435
0.330	0.360	0.512	0.486
0.350	0.340	0.536	0.463

The daytime color of the yellow film shall provide an initial luminance factor, Y, in a range of 36 to 59 and shall conform to the above chromaticity requirements:

Measurements shall be made in accordance with ASTM E 1349, using illuminant “C” and 0/45 (45/0) geometry. Calculations shall be in accordance with ASTM E308 for the 2-degree observer.

(4) Reflectance

The white and yellow films shall have the following initial minimum reflectance values as measured in accordance with the testing procedures of ASTM D 4061. The photometric quantity to be measured shall be coefficient of retroreflected luminance ( $R_L$ ) and shall be expressed as millicandelas per square meter per lux ( $\text{mcd}\cdot\text{m}^{-2}\cdot\text{lux}^{-1}$ ) (millicandelas per square foot per foot-candle ( $\text{mcd}\cdot\text{ft}^{-2}\cdot\text{fc}^{-1}$ )).

	WHITE			YELLOW		
Entrance Angle	86.0°	86.0°	86.5°	86.0°	86.0°	86.5°
Observation Angle	0.2°	0.5°	1.0°	0.2°	0.5°	1.0°
Retroreflected Luminance $R_L$ ( $\text{mcd}\cdot\text{ft}^{-2}\cdot\text{fc}^{-1}$ )	700	500	400	410	250	175

(5) Skid Resistance

The surface of the retroreflective films shall provide an initial minimum skid resistance value of 55 BPN as measured by the British Portable Skid Tester in accordance with ASTM E303.

The surface of the retroreflective film shall retain an average skid resistance value of 45 BPN, when tested in accordance with ASTM E303, for a period of one year when installed in non-snow removal

areas. The 45 BPN minimum value shall be an average of several readings taken in both the wheel track and non-wheel track areas.

(6) Tensile Strength and Elongation

The film shall have a minimum tensile strength of 7.18 kilopascals (150 lbs. per square inch) of cross-section when measured in the direction of the length of the roll and tested in accordance to ASTM D638-76, except that a sample 150 mm x 25 mm (6" x 1") shall be tested at a temperature between 21.1 degrees and 26.7 degrees C (70 degrees F and 80 degrees F) using a jaw speed of 10 to 12 inches per minute. The sample shall have a maximum elongation of 50% at break when tested by this method.

(7) Reflectivity Retention

The glass spheres must be strongly bonded and not be easily removed by traffic wear. Using a Taber Abraser with an H-18 wheel and a 125 g (4.4-ounce) load, the sample shall be inspected at 200 cycles, under a microscope, to observe the extent and type of sphere failure. No more than 15% of the spheres shall be lost due to popout and the predominant mode of failure shall be "wear down" of the spheres.

(8) Glass Spheres

The size, quality and refractive index of the glass spheres shall be such that the performance requirements for the markings shall be met. The sphere adhesion shall be such that spheres are not easily removed when the material surface is scratched.

The film shall have glass sphere retention qualities such that when a 50 mm x 150 mm (2" x 6") sample is bent over a 12.7 mm (1/2") diameter mandrel, with the 50 mm (2") dimension perpendicular to the mandrel axis, microscopic examination of the area on the mandrel shall show no more than 10% of the spheres with entrapment by the binder of less than 40%.

(9) Thickness

The film, without adhesive, shall have a minimum thickness of 60 mil.

**h. Urethane Acrylate**

The material shall be a reflectorized multi functional urethane acrylate, plural component, durable liquid pavement marking material suitable for application of long line pavement markings on chip seal treated roadways only.

(1) Characteristics

It shall consist of a homogeneous blend of multi functional polyacrylate modified resins, pigments and a top application of retro-reflective beads. Two parts of Part A (resin and pigmentation) shall be mixed with one Part B (curing agent) by volume.

(2) Composition

The composition of the material shall be as follows:

Part A Component	White	Yellow
Pigments % by Weight (ASTM D-476, Type II)		
TiO <sub>2</sub>	24-27%	10-15%
Non-Lead Organic Yellow		7-9%
Resin % by Weight		
Modified Resins	73-76%	76-83%

(3) Color

The materials shall visually match the color chips that correspond to the Federal Standard Number 595B for the following colors:

White	Color 17925
Yellow	Color 13538

The material shall be applied to 3" x 6" steel plates at  $20 \pm 1$  mil thickness without glass beads and exposed per ASTM G-53. The test shall be conducted for 72 hours at 122 degrees F, 4 hours humidity, and 4 hours UV using QUV A-340 bulbs in alternating cycles. The color of the coatings shall be within 5 units of the Federal Standards shown above.

(4) Yellowness index

Test in accordance with ASTM D-1925 by curing the prepared sample for 72 hours. The maximum yellow index reading, XYZ C/2° shall not exceed 6.0 preceding the QUV (ASTM G-53 )or 15.0 after 72 hours of QUV exposure.

(5) Toxicity

Upon heating to the appropriate application temperature, the material shall not exude fumes, which are toxic or injurious to persons or property when handled in accordance with manufacturer specifications. The compositions shall not contain free isocyanate functionality.

(6) No Tracking Time

When mixed in the proper ratio and applied at  $15 \pm 1$  mils wet film thickness with 8 pounds per gallon Type 4 gradation beads and 10 pounds per gallon AASHTO M247 Type I beads, the product shall have a no track time of less than 5 minutes when tested according to ASTM D-711 at  $75^{\circ}\text{F} \pm 2^{\circ}\text{F}$ . When saturated with a double drop of 12 pounds per gallon Type 4 gradation beads and 12 pounds per gallon AASHTO M247 Type I beads and tested under the same conditions as above, it shall have a no track time of 3 minutes or less.

(7) Hardness

The material, when tested according to ASTM D-2240, shall have a Shore D Hardness greater than 75. Samples shall be allowed to cure at  $75^{\circ}\text{F} \pm 2^{\circ}\text{F}$  for a minimum of 72 hours prior to performing the tests indicated.

(8) Flexibility

The material, when tested in accordance with ASTM D-522, shall pass the test at  $\frac{3}{4}$ ". Panels are prepared by casting 5 mil films on 4" x 12" aluminum panels. The test is run after panels are cured for a minimum of 24 hours at  $75^{\circ}\text{F} \pm 2^{\circ}\text{F}$ .

(9) Adhesion to Concrete

The material, when tested according to ASTM D 4541, shall have greater than 600 psi adhesion to the specified concrete surface such that there shall be a 100% concrete failure in the performance of this test. The prepared specimens shall be conditioned at  $75 \pm 2^{\circ}\text{F}$  for a minimum of 72 hours prior to the performance of the test indicated.

(10) Abrasion Resistance

The material, when tested according to ASTM test method D- 4060,using a Taber Abrader with a 1,000 gram load and CS-17 wheels, for 1,000 cycles, shall not have more than 80 mg weight loss. The tests shall be run on cured samples of material (without beads) which have been applied at a film thickness of  $15 \pm 0.5$  mil to code S-16 steel plates. The samples shall be cured at  $75^{\circ}\text{F} \pm 2^{\circ}\text{F}$  for a minimum of 72 hours.

(11) Tensile Strength

When tested according to ASTM D-638, the material shall have an average tensile strength of not less than 6,000 pounds per square inch. The Type IV Specimens shall be pulled at a rate of  $\frac{1}{4}$ " per minute by a suitable dynamic testing machine. The samples shall be cured at  $75^{\circ}\text{F} \pm 2^{\circ}\text{F}$  for a minimum of 72 hours prior to performing the indicated tests.

(12) Compressive Strength

When tested according to ASTM D-695, the material shall have a compressive strength of not less than 12,000 pounds per square inch. The cast sample shall be cured at  $75^{\circ}\text{F} \pm 2^{\circ}\text{F}$  for a minimum of 72 hours. The rate of compression of these samples shall be no more than  $\frac{1}{4}$ " per minute.

**i. Lead-Free, Water-Borne Emulsion Based White and Yellow Traffic Paint**

The pavement marking paint shall be a rapid dry. The traffic paint shall provide optimum adhesion for glass spheres when both binder and glass spheres are applied in the recommended quantities. The paint



shall be well ground and mixed, shall not settle badly or cake in the container or thicken in storage. It shall not change in consistency and shall be readily broken up with a stirrer to a smooth and uniform condition.

(1) Characteristics

The paint shall consist of Dow DT 250NA acrylic resin lead-free pigments, dryers, and water as solvent and sufficient pigment suspending agents to insure soft settlement during storage.

(2) Composition

The formulation for the waterborne paint shall be as follows:

Test Component	White	Yellow
TiO <sub>2</sub> % by Weight	8.5% @ 0.14 gm/cm <sup>3</sup> (1.17 lbs/gal)	1.35% @ 0.04 gm/cm <sup>3</sup> (0.36 lbs/gal)
Pigment – TiO <sub>2</sub>	Enamel Grade ASTM D-476 Type III	Clariant 11-2400 Yellow Pigment
Unit Weight	1.65 gm/cm <sup>3</sup> ± 0.02 (13.8 lbs/gal ± 0.2)	1.63 gm/cm <sup>3</sup> ± 0.02 (13.6 lbs/gal ± 0.2)
Vehicle Solids % by Weight	17%	17.5%
Extender Pigment % by Weight	52%	55%
Calcium Carbonate	ASTM D-1199 Ground and Classified – Dry Brightness 95	ASTM D-1199 Ground and Classified – Dry Brightness 95

(3) Drying Time

When applied at a wet film thickness of 15 mils with a top dressing of 0.70 – 1.20 kg (6-10 pounds) of glass spheres per liter (per gallon) of paint and when the pavement temperature is between 4.4 degrees C and 48.9 degrees C (50 degrees F and 120 degrees F) and the relative humidity doesn't exceed 50%, the binder shall dry to a no-tracking condition in a minimum of 20 seconds and a maximum of 60 seconds. Air flow across the surface of field applied material must be at least 23 meters/minute (75 feet/minute) to qualify material for this requirement.

These dry times shall not be exceeded when the paint is applied with specialized equipment so as to have the pigmented binder at a temperature of 65.5 degrees C to 76.7 degrees C (150 degrees F to 170 degrees F) at the spray gun.

The no-tracking condition shall be determined by passing over the applied line in a simulated passing maneuver with a passenger car traveling 56 KPH (35 MPH). There shall be no visual deposition of the paint to the pavement surface when viewed from a distance of 15.2 meters (50 feet). Furthermore, the pigmented binder, without glass spheres, shall dry to no-tracking condition in 180 seconds or less when tested in accordance with ASTM D-711.

(4) Dry Opacity

The minimum contrast ratio shall be 0.96 when drawing down with a 0.005 bird film applicator on a 2A Leneta Chart or equal and air-dried for 24 hours. Contrast Ratio = Black/White. Dry Opacity will be determined according to Method 4121, Federal Test Method Standard No. 141a. Apply the paint with the above applicator to the chart specified in Section 1.1 of Method 4121.

(5) Flexibility

Apply the paint to aluminum alloy 2024-0, 0.81 ± 0.08 mm (0.032 ± 0.003 inch) thick panels with a 0.005 inch Bird Film Applicator. Air dry 18 hours and bake for 5 hours at a temperature of 105 to 110 degrees C (220 to 230 degrees F). Cool for 15 minutes at 25 degrees C (77 degrees F) and bend over the conical mandrel as specified in ASTM D522. There shall be no cracking of the film at a mandrel diameter of 2.54 cm (1 inch) or larger when examined without magnification.

(6) Abrasion Resistance

When subjected to the Falling Sand Abrasion Resistance Test, the amount of sand required to completely abrade the paint film from an area 4mm (5/32”) in diameter on the panel shall not be less than 70 liters (18.5 gal). The test shall be conducted according to Method 6191 of Federal Test Method Standard No. 141a with the following additions and exceptions:

Fresh, new unused sand shall be used for each test of three panels. Sand shall be measured by weight with 7.9 kg (17.5 lbs) of sand being counted as equivalent to 5 liters (1.3gal).

A test shall be the average liters (gallons) of sand required to abrade the 4mm (5/32") spot on three separate panels. Panels for the test will be prepared as follows:

Apply the paint without reduction to a smooth glass panel with a 0.15mm (0.006 inch) Bird Film Applicator. Air dry for 24 hours and bake for 3 hours at a temperature of 105 to 110 degrees C (220 to 230 degrees F). Condition the panel for 24 hours at a temperature of 21 to 27 degrees C (70 to 80 degrees F) and a relative humidity of 50% to 70% before making the test. The glass panels shall not be less than 200mm (8 inches) long and the abrasion test shall be made on the middle third of the film on the panel.

(7) Water Resistance

Apply a film of the paint with a 0.13mm (0.005 inch) Bird Film Applicator to a smooth glass panel approximately 250 mm (10 inches) long. Allow to dry for 48 to 72 hours and then immerse one end of the panel in a beaker of distilled water to a depth of approximately 125 mm (5 inches). After 24 hours of immersion, remove the panel and examine. After 24 hours of air drying the immersed portion of the film shall be equal in hardness, toughness, gloss, and color adhesion to the portion of the film that was not immersed in water. Adhesion shall be checked using knife blade or spatula on both ends of the film, comparing the ease with which the film can be removed from the glass.

(8) Stability Test

Fill a 0.5 liter (one-pint) friction top paint can with a thoroughly mixed sample to within 25 mm (one inch) of the top). Determine consistency in grams (pounds) according to Method 4281, Federal Test Method Standard No. 141a. Close the can with the lid and shake for 5 minutes. Place the can in an air oven at 60 degrees (140 degrees F) for 18 hours. Remove and cool to room temperature. Open the can and remove any skins and examine the contents. There shall be no livering or other deterioration. Thoroughly mix the paint and again determine the consistency in grams (pounds). The increase in consistency shall not be more than 17 grams (0.6 oz).

(9) Fineness of Grind

When tested according to ASTM D1210, the fineness of grind shall not be less than 3 Hegman units.

(10) Sphere Embedment

Paint shall be applied to a glass panel at a wet film thickness of 0.3mm (0.012 inch) followed immediately by an application of glass spheres dropped on the surface of the paint. After drying for at least 24 hours, observe the amount of sphere embedment with a 30-power microscope. At least 90% of the spheres shall be embedded between 50% and 65%. The glass spheres used for this test must be a moisture resistant silicone treated sphere suitable for use with a water base coating.

(11) Directional Reflectance

The daylight directional reflectance of white pigmented binder (without glass spheres) shall be not less than 85% relative to magnesium oxide when tested in accordance with Federal Test Method Standard No. 141a, Method 6121. If yellow, after drying shall suitably match color 33538 of Federal Standard 595.

The paint for the pavement markings shall contain no lead and/or chromium and shall have volatile organic content conforming to the latest Environmental Protection Agency regulations.

In addition, the paint and/or components shall conform to the American Society for Testing Materials (ASTM) as follows:

- ASTM D93 - Flash Point by Pensky Martens Closed Tester
- ASTM D476 - Titanium Dioxide Pigments, Type II Rutile
- ASTM D562 - Consistency of Paints Using Stormer Viscosimeter
- ASTM D711 - No Pick-Up Time of Traffic Paint
- ASTM D768 - Yellow Iron Oxide

ASTM D868 - Evaluating Degree of Bleeding of Traffic Paint  
 ASTM D969 - Laboratory Test for Degree of Bleeding of Traffic Paint  
 ASTM D1152 -Methyl Alcohol  
 ASTM D1199 -Calcium Carbonate  
 ASTM D1210 -Fineness of Dispersion of Pigment-Vehicle Systems  
 ASTM D1475 -Density of Paint, Varnish, Lacquer, and Related Products  
 ASTM D2243 -Freeze-Thaw Resistance of Waterborne Coatings  
 ASTM D2369 -Volatile Content of Coatings  
 ASTM D2805 -Hiding Power of Paints by Reflectometry  
 ASTM D3723 -Pigment Content of Water Emulsion by Low Temperature Ashing  
 ASTM D3960 -Volatile Organic Content (VOC) of Paints and Related Coatings  
 ASTM D4060 -Abrasion Resistance by Taber Abraser  
 ASTM D4366 -Hardness of Organic Coatings by Pendulum Damping Tests  
 ASTM E70 - pH of Paints and Related Material  
 ASTM E1347 - Standard Test Method for Color and Color-Difference  
 Measurement by Tristimulus (Filter) Colorimetry

The paint shall show no cracking, flaking, blistering, appreciable loss of adhesion, softening, coagulation, discoloration, and have a minimum bleeding ratio of 0.97 when tested in accordance with Federal Specification TT-P-1952B. The paint shall be capable of dilution with water at all levels without curdling or precipitation such that the wet paint can be readily cleaned up with water only.

**j. Epoxy Pavement Marking**

This specification is for the application of epoxy resin and glass beads as reflective pavement markings on Portland cement concrete. The epoxy resin material shall be toxic heavy metal free, two-component, 100% solids, and shall be formulated and tested to perform as a pavement marking material with glass spheres applied to the surface. The two components are an epoxy resin and an amine curing agent. The contractor shall provide complete manufacturer’s specifications and material safety data sheets to the Engineer for all material furnished.

(1) Characteristics

The material shall not exude toxic fumes when heated to application temperature. The material which, when mixed in the proper ratio and applied at 0.14 mil (500 μm) wet film thickness at 74.8 degrees F (23.8 degrees C) with the proper saturation of glass beads, has a no-tracking time of less than 40 minutes for slow curing material and less than 10 minutes for rapid curing material. The material shall be capable of fully curing under a constant surface temperature of 32 degrees F (0 degrees C) or above.

(2) Color

Provide white which complies with Federal Standard 595 17875. Provide yellow which matches the standard shade within the red and green tolerance limits when compared with the Highway Yellow Color Tolerance chart available from the U.S. Department of Transportation, Washington, D.C. (Federal Standard 595 13538).

(3) Abrasion Resistance

Maximum loss should be 0.0028 ounces (80 mg) when tested at  $30 \pm 1.5$  mils ( $750 \pm 38$  μm) and a 72 hour cure and with a CS-17 wheel under a load of 2.2 lbs. (1000 grams) for 1000 cycles

(4) Hardness:

Shore D hardness of 75 minimum.

(5) Adhesion to Concrete

When catalyzed, has such a high degree of adhesion to the specified concrete surface that there is a 100% concrete failure. Apply the material at a film thickness of  $15 \pm 1.5$  mils ( $375\mu\text{m} + 38\mu\text{m}$ ) to concrete with a minimum compressive strength of 4061 psi (28 MPa). Allow the material to cure for 72 hours at 77 degrees F (25 degrees C) before the test is performed.

(6) Yellowness Index

White only. Value after 72 hours in QUV – 30 maximum when tested at 15 ± 1.0 mils (375µm + 25µm) and a 72 hour cure.

(7) Field Evaluation

Field test materials at AASHTO NTPEP regional test facilities, which include both hot and cold weather conditions and are a minimum of six months in duration.

(8) Glass Beads For Drop-On Application (double drop system):

For the first drop, furnish large beads, which are compatible with the epoxy system, and comply with AASHTO M 247 except with the following gradation (FP-96, Type 4):

<u>Sieve Size</u>	<u>Percent Passing</u>
No. 10 (2.00 mm)	100
No. 12 (1.70 mm)	95 – 100
No. 14 (1.40 mm)	80 – 95
No. 16 (1.18 mm)	10 – 40
No. 18 (1.00 mm)	0 – 5
No. 20 (850 µm)	0 – 2

For the second drop, furnish regular beads which are specifically manufactured to be compatible with the epoxy system, and which comply with the requirements of AASHTO M247, Type 1. Both types of beads are to be coated with a moisture resistant coating and an adhesion promoting coating which is compatible with the epoxy system.

(9) Test Methods

ACI 503, Appendix A.1 Adhesion to Concrete

ASTM D2240 Hardness

ASTM C501 Abrasion Resistance

(10) Prequalification

Manufacturers interested in prequalifying material under this specification must provide a one liter sample of each color plus one liter of hardener to the Engineer for laboratory testing. Also include a copy of the quality control test report for each lot of material, an infrared spectroscopy analysis for each component if available, material safety data sheets and a complete set of installation recommendations and instructions. Forward an official copy of the AASHTO NTPEP test report along with evidence that the product in reference is identical to that submitted for prequalification.

The material will be evaluated for compliance with all requirements of this specification, and the manufacturer will be notified of the results. Both component A and component B will be analyzed and "fingerprinted" using infrared spectroscopy for use in screening future verification samples to ensure that materials submitted for use are of an identical formulation as originally approved.

(11) Verification testing

The Engineer will take a one liter verification sample of Part A and Part B of the epoxy from one lot of each color per project. Send the samples to the engineer for testing and evaluation. Lots previously tested will be exempted from testing and may be exempted from sampling if coordinated with the engineer. Samples may be tested using infrared spectroscopy and testing as necessary. Deviations as determined by comparison with the prequalification sample will be cause for removal from the pre-qualified list. The Engineer may also take a 0.5 gallon (2 liter) sample of each type of glass bead used on the project. Forward all samples to the engineer for verification testing

**43.3 CONSTRUCTION REQUIREMENTS**

The proposed permanent markings shall be laid out by the contractor in advance of the marking installation. Markings shall not be applied until the layout and conditions of the surface have been

approved by the City Inspector. If a paint line is used for layout purposes (in lieu of a chalk line or string line) the paint line shall not be wider than ½ inch) in width. If wider, the paint shall be removed following the application of the final permanent marking. New markings shall match existing markings as applicable in areas abutting existing road surfaces. The surface shall be dry and all dust, debris, oil, grease, dirt, temporary markings and other foreign matter shall be removed from the road surface prior to the application of the permanent marking material.

The Contractor shall be responsible for keeping traffic off freshly applied markings until they have set sufficiently to bear traffic. Traffic control is the responsibility of the Contractor and shall conform to the City of Overland Park Traffic Control Handbook. Failure to comply with traffic control guidelines will result in the Pavement Marking Contractor being directed to stop operations and leave the site until proper and approved traffic control has arrived and put in place on site.

**a. Glass Spheres**

The drop on glass spheres shall be applied at a rate of eight to ten pounds per 100 square feet.

**b. Thermoplastic Pavement Markings**

Thermoplastic material shall readily apply to the pavement at temperatures of 400 – 425 degrees F from approved equipment to produce an extruded line that shall be continuous and uniform in shape having clear and sharp dimensions. Application temperatures shall not exceed 450 degrees F.

Thermoplastic markings shall be applied to the pavement surface in a molten state by mechanical means with surface application of glass spheres, and upon cooling to normal pavement temperature, produce an adherent retro-reflectorized stripe of specified thickness and width and capable of resisting deformation.

(1) Equipment

The equipment used to install the thermoplastic shall be as follows:

A self-propelled machine is required in order to fulfill the timing needs of the marking installation for longitudinal lines.

The equipment shall be constructed to provide mixing and agitation of the materials. Conveying parts between the main material reservoir and the shaping die shall be constructed as to prevent accumulation and clogging. The mixing and conveying parts up to and including the shaping die will maintain the materials at a temperature not less than 400 – 450 degrees F. To assure that the material does not fall below the minimum temperature, the shaping die shall be heated by means of a gas-fired infrared heater or a heated, oil-jacketed system. It shall be constructed as to insure continuous uniformity in the dimensions of the stripe. The applicator shall provide a means for cleanly cutting off square stripe ends and shall provide a method of applying “skip” lines. The equipment shall be constructed to be able to provide for varying die widths and to produce varying widths of traffic markings. The use of pans, aprons, or similar appliances with die overruns will not be permitted.

If the plans indicate thermoplastic material for transverse lines, i.e., crosswalks, crosshatching, etc., a push cart shall be used according to the following requirements: Only one pass with the thermoplastic pavement marking equipment shall be allowed in order to provide the required line width according to the plans. Multiple passes of narrower lines with overlaps to provide the required width shall not be allowed. Liquid thermoplastic shall not be used for word or symbol markings.

All conditions apply as stated above for material temperatures, line definition and workmanship when a hand pushcart is used for cross walks. The Inspector will verify measurement. The pushcart shall be equipped with a special kettle for melting and heating the material shall be provided. The kettle shall be equipped with a thermostat so that heating can be done by controlled heat transfer liquid rather than by direct flame so as to provide positive temperature control and prevent overheating of the material. It shall be constructed for a nominal application of 90 – 125 mil thickness. The heater and applicator shall be so equipped and arranged as to meet the requirements of the National Board of Fire Underwriters of the National Fire Protection Association, of the state, and of the local authorities. The pushcart shall be equipped with an automatic glass sphere dispenser attached to the striping machine in such a manner that

the spheres are dispensed almost instantaneously upon the installed line. The glass sphere dispenser shall be equipped with an automatic cut-off control synchronized with the cut-off of the thermoplastic material.

The equipment shall be arranged as to permit preheating of the pavement immediately prior to application of the thermoplastic material, if preheating is recommended by the thermoplastic manufacturer. The applicator shall be capable of containing a minimum of 1000 pounds of molten material (not applicable for hand-liner use). The applicator shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.

The Contractor's striper shall be equipped with electrical foot counters. The counters shall individually tabulate the length of line applied by each gun whether solid or dashed. The Contractor shall determine the accuracy of the foot counters and establish an adjustment factor as required to determine the pay item quantities. The foot counters shall be periodically checked to assure accurate measurements. No thermoplastic shall be applied without the accurate operation of the foot counters. The Contractor shall provide the Engineer with a certified document on these calibrations.

#### (2) Application Over Existing Markings

Existing thermoplastic markings on asphalt road surfaces may be over laid with thermoplastic material providing that the existing markings (thermoplastic) are less than 30 mils thick, and are securely bonded to the substrate. If the thermoplastic is greater than 30 mils, or not securely bonded to the substrate, then it shall be ground to 30 mils, or removed completely if not securely bonded to the road.

Existing solvent based paint on asphalt road surfaces may be over laid with thermoplastic provided that more than 75% of the road surface is exposed, and there is no more than a single coat of paint on the remaining unexposed area. If more than one layer of paint exists, the paint is not securely anchored to the substrate, or there is less than 75% of the road surface exposed, then the paint must be thoroughly removed.

All existing polyester, epoxy, or other type pavement marking paints on asphalt or concrete road surfaces must be completely removed from all road surfaces prior to the installation of thermoplastic material.

#### (3) Application Temperatures

To insure optimum adhesion, the pavement and ambient air temperature shall be 50 degrees F and rising. The thermoplastic material shall be applied in a melted state at a temperature of 400 – 425 degrees F. The temperature of the material within the shaping dies shall be maintained at the manufacturer's recommendations for application temperatures, but in no case shall the temperature fall below 400 degrees F or exceed 450 degrees F.

Where manufacturer's application temperatures differ from those as specified, the manufacturer's temperatures shall apply upon approval of the Engineer.

#### (4) Line Quality

The finished lines shall have well defined edges and be free of waviness. Pavement marking lines shall be straight or of uniform curvature and shall conform with the tangents, curves, and transitions as specified in the pavement marking standards and/or as directed by the Inspector.

#### (5) Line Thickness

The minimum thickness of the lines as viewed from a lateral cross section shall be not less than 90 mil. Drop-on glass spheres shall not be included in the measurement, or if so, then appropriate allowances shall be made for the added mil thickness. A device for gauging the installed material thickness shall be furnished to the City Inspector as requested for use on the project. The gauge shall be easy to read and shall readily indicate excessive variations.

#### (6) Clean Up

The Contractor shall be responsible for removing all pavement markings material spilled upon the roadway surface or adjoining area. The Contractor shall use methods acceptable to the Engineer/Inspector for removing the spilled material.

(7) Line Repair

Any pavement marking which is crossed by a vehicle and tracked shall be replaced and any subsequent marking made by the vehicle shall be removed by methods acceptable to the Inspector at NO additional cost to the City.

**c. Preformed Thermoplastic Pavement Markings**

The markings shall be applied in accordance with the manufacturer's recommendations on clean and dry surfaces.

(1) Asphalt

The materials shall be applied using the propane torch method recommended by the manufacturer. The material must be able to be applied at ambient and road temperatures down to 32 degrees F without any preheating of the pavement to a specific temperature. The pavement shall be clean, dry and free of debris and oil or grease residue. At temperatures below 50 degrees F, the preformed thermoplastic pavement markings shall be kept as warm as possible to maintain flexibility.

Remove pavement surface moisture by holding a propane torch approximately 6" above the section of asphalt using a continuous circular motion. Heat the pavement with the torch upon placing the material to a temperature of 200 degrees F for 90 mil, and up to 300 degrees F for 125 mil materials. Immediately after the road surface has been properly preheated, position the material with exposed sphere side up and heat.

Position the torch approximately 12" over the marking so the flame is extended and heat is evenly applied moving the torch in a circular motion across the marking. When the correct temperature of the marking has been reached, it will turn slightly darker or pale yellow if the material is white. Over heated or burned material shall be removed. After the entire material section has been heated and bonded to the pavement, re-heat the perimeter of the marking and the road surface to bond the edges. If installing reversible arrows, which do not contain a top coating of glass spheres, the glass spheres shall be hand applied on the molten material.

Feather the leading edge of the pavement marking with a putty knife or bevel with the torch. Leading edges are any edge that would be susceptible to snow plow blades approaching from the direction of normal travel. After cooling, use a putty knife to attempt to remove a portion of the material. The material shall not pry off without asphalt embedded to the underside.

**d. Durable Pre-formed, Patterned Cold Plastic, or Durable Pre-Formed, Contrast Patterned Cold Plastic Pavement Markings**

The Contractor shall furnish and install white and yellow permanent retro-reflectorized durable preformed, patterned cold plastic pavement marking material, with or without contrast, at the location shown on the plans, in conformance with the details and material specifications included herein.

(1) Procedure

The markings shall be applied in accordance with the manufacturer's installation instructions.

(2) Road Surface Conditions

(a) Concrete Surfaces

Grooving the pavement surface of a concrete street is the preferred method of installation. All weather conditions for the specific pavement marking product must be met before application into the groove. For longitudinal markings, the typical groove width shall be two inches wider than the pavement marking with one inch on each side of the contrast tape pavement marking. Groove depths shall be a minimum of 100 mils and a maximum of 200 mils per manufacturer's recommendations.

Transverse markings such as crosswalks and stop bars can be grooved into the pavement and recessed by making multiple side-by-side passes with grooving equipment typically used for lone line pavement markings. Cutting grooves with multiple passes should not result in a ridge between each pass. All ridges shall be ground off prior to placing the pavement marking in the recessed groove.

Legends and symbols shall be grooved and recessed by grooving a large square or rectangular shaped area that will fit the pavement marking. Wider cutting blades and more blades gang stacked on the saw auger should be used to reduce the number of ridges formed by multiple passes with the cutting head.

Groove equipment with a free-floating, independent head is recommended. The use of gang stacked cutting blades is strongly recommended for concrete pavement surfaces, especially for older surfaces that show visible signs of deterioration. Diamond cutting blades produce an optimal groove surface.

A single large diameter (12-18 inch saw blades) cutting head, with gang-stacked, 1/8-inch to 1/4-inch wide carbide or diamond tipped cutting blades can also be used for grooving the concrete pavement in lieu of grooving equipment. Spacers shall be placed between the blades to provide a gap for the wider cutting head tips and to decrease the number of blades required for the cutting head. Wider spacing of the blades may result in a heavily “ribbed” or “ridged” pattern that is not recommended for pavement marking applications. Thinner spacers may be used between the blades to prevent an irregular raised pattern in the groove. This will result in a groove with a smoother surface. The height of the ridges shall be no greater than 15 mil above the base of the groove. Grinder-type cutting heads should only be used on newer concrete pavement surfaces in good repair. A slow moving shot blaster, grinder, or sand blaster shall be used to knock down any ridges and create a textured surface after cutting the initial groove with the saw blade cutting head. The textured surface should have an irregular pattern without a ribbed or corduroy pattern. Hydroblasting can also be used, but the groove shall be allowed to dry (24-hour minimum) prior to application of the pavement markings.

New concrete surfaces may contain more fine cement dust after cutting. This dust and any cement residue shall be removed and blown clean from the groove prior to application of the pavement marking. The groove shall be cleaned prior to the pavement marking application using an air compressor with at least 185 cfm air flow and 120 psi air pressure. There should be no more than 50 feet of 3/4-inch (inner diameter) hose from the compressor to the air nozzle and the air nozzle shall be equipped with a moisture and oil trap. When cleaning the groove the air nozzle shall be no more than two feet from the ground. A street sweeper or pick-up broom may also be used, but shall require a pass with the air compressor to completely clean the bottom of the groove.

If cooling water is necessary during the grooving process or rainfall occurs during the grooving process, the groove shall be flushed immediately with a high pressure power washer to remove any build-up of cement dust/water slurry to prevent the slurry from hardening in the groove. Allow the groove to dry for a minimum of 24 hours after cleaning the groove, for removal of excess water prior to pavement marking application. The groove shall be clean and dry for proper application of the pavement marking.

If markings already exist on the roadway, remove markings from the surface by sandblasting, shotblasting, hydroblasting or grinding. At a minimum, 90 percent of the road surface under the existing markings must be exposed prior to tape application.

If existing markings have been removed, the road surface must be blown clean using an air compressor with at least 185 cubic feet per minute air flow and 90 psi air pressure. All road surfaces where tape will be applied should be swept with a broom and cleaned with a high pressure blower. The road surface must also be dry.

#### (b) Chip Seal Surfaces

The surface shall be clean, dry and free of loose material. The markings shall not be installed until after the second sweeping. All remaining loose material shall be cleaned off the area to be striped using an air compressor with at least 185 cfm air flow and 120 psi air pressure. There should be no more than 50 feet of 3/4-inch (inner diameter) hose from the compressor to the air nozzle and the air nozzle shall be equipped with a moisture and oil trap. When cleaning the groove the air nozzle shall be no more than



two feet from the ground. A street sweeper or pick-up broom may also be used, but shall require a pass with the air compressor to completely clean the bottom of the groove.

(3) Application Temperatures

Air temperature and pavement surface temperature shall be a minimum 40 degrees F. The pavement surface must be dry with no precipitation for 24 hours prior to application. If the markings are placed within the seasonal start and end dates (May 1<sup>st</sup> to October 1<sup>st</sup>), the Surface Preparation Adhesive P-50 is not required. If the markings are placed outside of the seasonal start and end dates, the Surface Preparation Adhesive P-50 is required.

(4) Adhesive Application (if applicable)

Read and become familiar with all health and safety information and directions for use regarding the P-50 preparation adhesive. Refer to manufacturer MSDS sheets.

Adhesive should be applied according to the following methods for transverse and longitudinal markings. Allow the P-50 adhesive to dry until it feels tacky but is no longer in liquid form and has a matte finish rather than a glossy wet appearance. P-50 adhesive dries quickly under most circumstances. Typical time for P-50 adhesive to dry is 2 to 3 minutes under optimal conditions of 70 degrees F and medium to low humidity levels. Coverage of the adhesive is approximately 450 lineal ft/gal spraying a 6 inch wide pattern.

(a) Transverse Markings

Evenly apply one coat of P-50 adhesive to the road surface using a solvent-resistant roller with a 3/8-inch nap roller. The coating on the pavement must extend at least 1-inch beyond the premarked area. Allow the adhesive to set to prevent the tape from sliding after application. If the adhesive is not allowed to set, it will not bond properly to the adhesive on the tape and adhesion failure will likely occur. The P-50 adhesive is set when it feels tacky but will not lift or string when touched with fingertips protected with gloves.

(b) Longitudinal Markings

Using a manufacturer approved spray applicator, apply a thin, uniform coat of P-50 adhesive to the pavement. The adhesive should extend at least 1-inch beyond the premarked area where the edges of the tape will be applied. The applicator shall be designed to spray a 6-wide pattern for application of 4-inch wide tape using a size 8004 spray tip nozzle. Adjust the arm of the applicator up or down so that the spray pattern is 6 inches wide. For tape wider than 4 inches, spray multiple passes, overlapping the previous pattern by 1/2-inch. Allow additional time for the overlapped areas to dry.

(5) Application of Markings

Tape should be applied according to the following methods for transverse and longitudinal markings.

(a) Transverse Markings

Apply the tape by hand. When splicing is required, use butt splices. Do not overlap the material. If there is a crack in the road, lay the tape over the crack and then cut the tape 1-inch from each side of the crack. Use this same technique on concrete when the transverse marking is applied over a joint. Tamp the tape thoroughly with a tamper cart with a minimum 200 pound load. Start tamping in the center of the marking and work toward the ends. Do not twist or turn the tamper cart on the tape. Make six passes (three full passes back and forth) over the surface of the tape making sure all edges are firmly adhered.

(b) Longitudinal Markings

Apply the tape using a manual highway tape applicator as approved by the manufacturer. If there is a crack in the pavement or if the tape is to be applied over a bridge expansion joint, lay the tape over the crack or joint, then cut the tape 1-inch away from the crack or joint on each side. Tamp the tape thoroughly with a manufacturer approved tamper cart with a minimum 200 pound load, or slowly drive over the tape three times with a vehicle. The vehicle must be equipped with a pointing device to aid in keeping the vehicle on the tape, making three passes forward over the tape. Use a vehicle tire on long line markings

only. When using the tamper cart, do not twist or turn the tamper cart on the tape. Make six passes (three full passes back and forth) over each part of the tape making sure all edges are firmly adhered.

**e. Temporary Cold Plastic Pavement Markings**

The Contractor shall furnish and install white and yellow permanent retro-reflectorized cold preformed plastic pavement marking material at the location shown on the plans, in conformance with the details and material specifications included herein.

The cold plastic markings shall consist of a homogeneous, extruded, prefabricated material of specified thickness and width which shall contain reflective glass spheres uniformly distributed throughout the cross-section, and shall be applied only to pavement surfaces as temporary markings between construction projects or an interim basis when lane assignments are anticipated in the near future.

(1) Procedure

Apply the tape according to manufacturer's instruction with pre-coated adhesive and pressure.

(2) Road conditions

It is recommended that the tape be installed as soon as practical following tape manufacturer instructions.

Clean the surface of the road using a broom and/or high-pressure air blower. If either of these methods fail to clean the road surface, then high-pressure water wash shall be used. Road surface must be dry and all dust, dirt, debris, oil, grease and foreign material removed before applying tape. If using water-cooling to groove, the groove must be completely dry prior to tape application.

(3) Tape Application

If there is a crack in the pavement, or if the tape is to be applied over a bridge expansion joint, manhole or utility box, lay the tape over the crack joint or fitting, then cut the tape one inch away from the crack or joint on each side. Apply the required surface preparation adhesive and allow to dry completely (5-10 minutes at 70 degrees F), but not over 30 minutes. Butt splices must be used; do not overlap tape ends.

(4) Tamping

Tamp the tape thoroughly with a tamping cart with a minimum 200 pound load, three times back and forth (six passes) over each part of the tape. Start in the center of the marking and work out to the edges removing any trapped air. Do not twist or turn the tamper cart on the tape. Make six passes (three passes back and forth) over each part of the tape (tamping is very important). Make sure all edges are firmly adhered.

(5) Application Conditions

The air temperature shall be 60 degrees F and rising with a surface temperature of 70 degrees F and rising. The overnight air temperature shall not have been below 40 degrees F the night before tape application. The pavement surface must be clean and dry. No rainfall should occur within 24 hours prior to application. Traffic must be kept off of pavement surfaces coated with a surface preparation adhesive prior to tape application (follow manufacturer's instruction regarding the use of surface preparation adhesive)

(6) Surface moisture

Cold preformed plastic tapes will not adhere if moisture is present. Therefore, road surfaces must be dry and above the minimum required temperature for application of all tapes. If rainfall occurs within 24 hours prior to application, a surface moisture test (plastic wrap or roofing paper method as approved by the inspector) must be performed and approval obtained from the inspector. The groove must be visibly dry for a minimum of two hours prior to application. A moisture test shall be completed after the two-hour drying time to ensure no presence of moisture.

**f. Urethane Acrylate**

The Contractor shall furnish and install white and yellow retro-reflectorized pavement marking paint material at the location shown on the plans, in conformance with the details and material specifications included herein.

(1) Application Temperature

Ambient and surface temperature shall be 35°F and rising. The pavement surface temperature and ambient temperature shall be determined and documented before the start of each day of marking operation and at any other time deemed necessary by the inspector.

(2) Surface Preparation

The surface shall be clean and dry. The surface preparation shall include, but not be limited to, cleaning and removal of sealing and curing compound. All permanent and temporary pavement markings shall be at least 90% removed and pavements cleaned free of grease, oil, mud, dust, dirt, grass, loose gravel, loose or flaking paint and other deleterious material.

The pavement surface shall first be power broomed and vacuumed. An additional compressed air operation, separate from the compressed air guns on the striping applicator, shall be used to remove residue and debris resulting from the cleaning work. Compressed air shall also be used during striping application. The prepared pavement surface area shall be wider than the material to be applied, such that a prepared area is on all sides of the material after application. On streets treated with chip seal material, the new markings shall not be installed until after the second sweeping operation. Any existing marking which may interfere with the performance of the material shall be physically removed by approved method except for the use of chemicals.

(3) Equipment

The material shall be applied with equipment utilizing the impingement mix, solvent free, airless spray application system or standard mix tube application equipment. The equipment shall be designed to control the viscosity of the material accurately at the spray gun. This equipment shall have pressure gauges for each proportioning pump. Each vehicle shall be operated by a technician who is an expert in that particular equipment's operation and plural component application techniques.

(4) Application Rate

The material and retro-reflective glass spheres shall be placed according to requirements. The material shall be applied at a rate of 240 feet per gallon based on a minimum of 20 mils applied at a four inch width.

**g. Pavement Marking Paint**

The Contractor shall furnish and install white and yellow retro-reflectORIZED pavement marking paint material at the location shown on the plans, in conformance with the details and material specifications included herein.

(1) Application

The wet thickness and dry thickness of the pavement marking paint shall not be less than 15 mils 12 mils, respectively without glass spheres. Glass spheres shall be applied uniformly over the entire length of line at the rate of 6 to 10 lbs per gallon of paint. The gun tip shall be oriented perpendicular to the centerline to ensure that the beginning and ends of all lines are perpendicular to the centerline and not skewed. The equipment shall be maintained such that the needle can be fully closed when shut as to ensure square cut lines at the beginning and ends.

(2) Application Temperature

Ambient and surface temperature shall be 50° F and rising unless the paint equipment is equipped with heaters that heat the paint. Ambient and surface temperature can drop to 32° F if using heated paint. The paint temperature should be between 100° F and 120° F depending on the need for heat. Never let the temperature of the paint exceed 120° F.

### (3) Surface Preparation

The surface shall be clean and dry. The surface preparation shall include, but not be limited to, cleaning and removal of sealing and curing compound. All permanent and temporary pavement markings shall be at least 90% removed and pavements cleaned free of grease, oil, mud, dust, dirt, grass, loose gravel, loose or flaking paint and other deleterious material.

The pavement surface shall first be power broomed and vacuumed. An additional compressed air operation, separate from the compressed air guns on the striping applicator, shall be used to remove residue and debris resulting from the cleaning work. Compressed air shall also be used during striping application. The prepared pavement surface area shall be wider than the material to be applied, such that a prepared area is on all sides of the material after application. On streets treated with chip seal material, the new markings shall not be installed until after the second sweeping operation. Any existing marking which may interfere with the performance of the material shall be physically removed by approved method except for the use of chemicals.

#### **h. Epoxy Pavement Marking**

The Contractor shall furnish and install white and yellow epoxy markings at the location shown on the plans, in conformance with the details and material specifications included herein.

##### (1) Equipment

Use equipment that is capable of spraying both yellow and white epoxy in the manufacturer's recommended proportions. Provide equipment that will place stripes on the left and right sides, and place two lines simultaneously with either line in a solid or intermittent pattern in yellow or white. All guns must be in full view of operators at all times. If words, symbols, crosswalks, cross-hatching and stop bars are to be of epoxy resin material, equip the truck with a hand spray wand for such application. Mount the equipment on a truck of sufficient size and stability, and with an adequate power source, to produce lines of uniform dimension and prevent application failure. Provide equipment with metering devices to register the accumulated volume dispensed for each material, each day. Additionally, provide individual pressure gauges, clearly visible to the operator, for each pump used.

Provide equipment with two glass bead dispensers (double drop system) that uniformly distributes the glass beads to the surface of the epoxy pavement marking at a rate of at least 25 pounds per gallon. Glass beads may be applied by a pressure gun or controlled free fall.

##### (2) Contractor's Personnel

Assure that at least one employee on the project when pavement markings are being applied holds an American Traffic Safety Services Association (ATSSA) pavement marking certification.

##### (3) Surface Preparation

On existing pavements, remove the existing pavement markings in accordance with these Specifications. Remove the existing markings and prepare the surface according to the manufacturer's recommendations (for the type of markings being installed).

On new Portland cement concrete pavement (PCCP), use shot blasting to remove curing compounds and laitance from the surfaces to which the pavement marking will be applied. Prepare the surfaces of new concrete bridge decks the same as new PCCP.

On aged asphalt pavements, THOROUGHLY remove all dirt, grit, grease, grime, vegetable matter, residue of prior pavement marking application (including such adhesives or primers that may have been used in their application), and any other foreign matter from the roadway surface prior to the application of epoxy pavement markings.

##### (4) Alignment

All layout required in the construction of the pavement marking is the responsibility of the Contractor. Lay out the pavement marking as detailed on the Plans. When the Plans do not provide details, submit a layout plan (conforming to the requirements of the Manual on Uniform Traffic Control Devices (MUTCD)) for the pavement markings to the Engineer for approval. Normally locate longitudinal pavement marking stripes 2 inches from existing longitudinal joints. Provide adequate guide marks

approximately 2 inches by 6 inches at approximately 30 to 50 ft intervals for the application of the pavement markings.

(5) Pavement Marking Application

When no traffic is present, and for edgelines under any condition of traffic, a slower curing epoxy material (40 minutes) may be used. When the application is taking place under traffic, use a fast setting (10 minutes) epoxy material for center lines and skip lines. Apply the epoxy material closely behind the cleaning procedure.

Provide the Project Engineer with a copy of the manufacturer's application instructions. Apply the epoxy pavement markings in accordance with the manufacturer's recommendations. In the absence of manufacturer's recommendations, apply the markings when the ambient and pavement surface temperatures are 40 degrees F and rising. Cease pavement marking operations when the ambient or the pavement surface temperature drops to 40 degrees F.

Before mixing the components of the pavement marking material, heat the individual components to the temperature ranges recommended by the manufacturer of the material. Avoid exceeding the maximum recommended temperature at any time.

Apply the epoxy pavement marking material at a thickness of 20 mils  $\pm$  0.2 mils) on asphalt and PCCP. Immediately apply the glass beads to the epoxy pavement marking at the rate of 25 pounds per gallon of epoxy, equally divided between the large and regular bead gradations. Apply the large beads on the first drop, and the regular beads on the second.

#### 43.4 INSTALLATION PERFORMANCE MEASURES

To ensure total understanding of what is expected in the application of any permanent pavement marking material on new pavement surfaces in the City of Overland Park, the following guidelines shall be followed. On streets receiving a thin surface treatment only, such as micro-surfacing or slurry seal, some of the performance measures may be waived by the inspector.

**a. Thermoplastic Installation Performance Measures**

All thermoplastic lines shall be of uniform thickness, with well-defined edges and squared off beginnings and endings of all lines.

All thermoplastic lines will have minimal dribbles, runs and overlaps. In the event thermoplastic long lines must stop and then continue, the restart shall line up to within 1/2 inch of the existing long line and maintain a totally straight line. Hand pushcarts shall be used when doing crosswalks. When the crosswalk cannot be laid continuous, the startup of the line shall be within 1/4 inch of the initial line.

The application equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.

Thermoplastic pavement marking materials shall not be applied when pavement temperatures are below 50 degrees F, or when the surface of the pavement shall show evidence of moisture. Temperatures should be at least 50 degrees F and rising.

Thermoplastic material will not properly adhere to pavement if moisture is present. Should rainfall occur within 24 hours prior to application, the surface moisture test (plastic wrap or roofing paper method as approved by the inspector) must be performed, and approval obtained from the Inspector.

**Lack of specified thickness:** The full unit price bid per meter (foot) shall be withheld if lack of thickness is found more than three (3) times per mile, or project if less than 1 mile in length. Each line shall be checked a minimum of six (6) times per mile, or project if less than 1 mile in length, using the random number tables and method of sampling as set forth in section 5.17.06 of Part V of the KDOT Construction Manual.

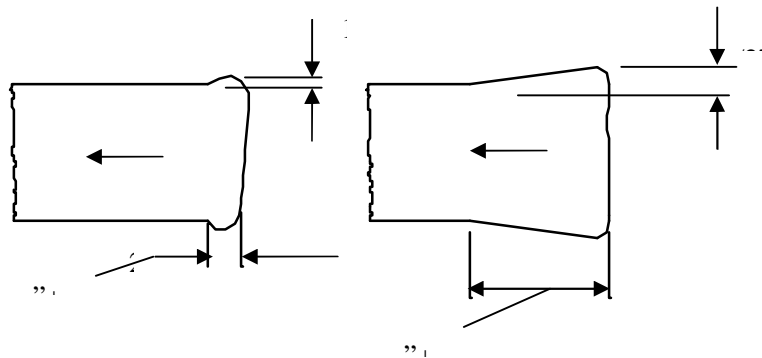
**Lack of specified width:** Payment shall be made with penalty being equal to 25% of the unit price bid per foot for each 1/4" of width lacking not to exceed 100% of the unit price bid per foot for the length of

the line less than specified width. Penalty shall be imposed upon the first occurrence and every occurrence thereafter.

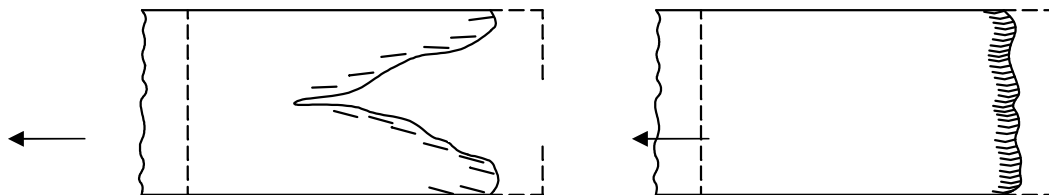
**Lack of specified length/cycle:** Payment shall be made with penalty being equal to 25% of the unit price bid per foot for each 1" of length lacking or exceeding the specified length for broken lane line and/or broken center line not to exceed 100% of the unit price bid per foot for the length of the line less than specified length. Penalty shall be imposed upon the first occurrence and every occurrence thereafter.

**Lack/Excess of Surface Spheres or Improper Application:** The full unit price bid per foot shall be withheld for each lineal foot of material with inappropriate application rate of the surface glass spheres. The same penalty shall apply if the spheres are not evenly disbursed across and along a line or if the spheres imbed improperly. This penalty shall be imposed for each instance that the Contractor fails to take corrective action after one warning by the Engineer.

**Bell ends:** The full unit price bid per foot shall be withheld for wide "bell" ends greater in length than 2 inches. This penalty shall be for the full 6 feet of a lane line or broken centerline or for no more than 6 feet of a long line.

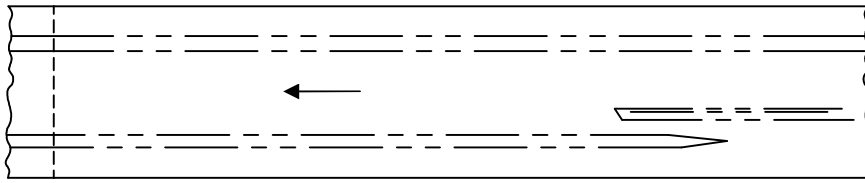


**Lack of adhesion:** The full unit price bid per foot shall be withheld for one foot for each occurrence if found more than three (3) times per 1 mile, or project if less than 1 mile in length.

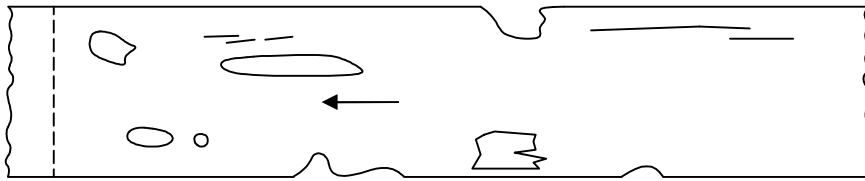


**Line Deviation:** A line that in the judgment of the Engineer deviates from the specified layout by an unreasonable amount shall be replaced. The Contractor shall be responsible for removal of the deviated marking material/repair of the pavement as designated by, and to the satisfaction of, the Engineer at no additional compensation.

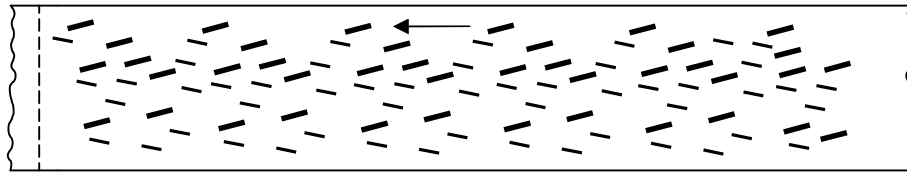
**Pitted Line:** The full unit price bid per foot shall be withheld for each pit greater than 10 feet in length.



**Gaps in Line or Crumbly Edges:** The full unit price bid per foot shall be withheld for the entire length of the portion of any line receiving less than the required amount of thermoplastic material. This penalty shall be imposed when the Contractor fails to correct line quality after the second warning within 1 mile, or project if less than 1 mile in length.



**Rough Line Surface:** The full unit price bid per foot shall be withheld for the entire length of the portion of any line with a rough or “burlap” surface. Penalty shall be imposed upon the first occurrence and every occurrence thereafter.

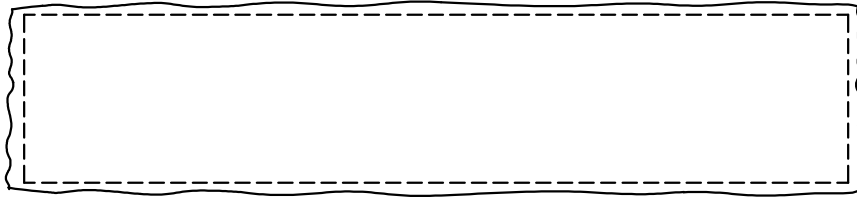


**Excessive Dripping between Lines:** The full unit price bid per foot shall be penalized for the length of any dribbled open space between broken lines that is not removed to the satisfaction of the Engineer before leaving the project site that work day. Penalty shall be imposed upon the first occurrence and every occurrence thereafter.



**Swollen Line of Excessive Width:** The full unit price bid per foot shall be penalized for swollen lines in excess of the specified width.

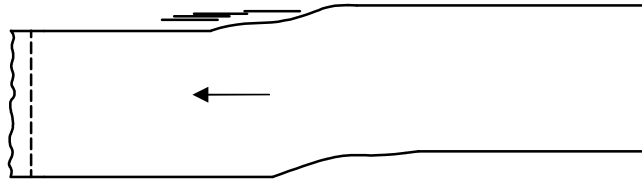




**Smeared Line Edges:** Fifty (50) percent of the unit price bid per foot shall be penalized for each occurrence of a length greater than 15 feet.



**Wavy Line:** The full unit price bid per foot shall be withheld for the entire length of waviness in a line caused by poor operation by the driver/operator of the application equipment. Penalty shall be imposed from the first occurrence.



**Work Outside the Scope/Limits of Project:** Payment for all pavement marking work performed shall be withheld in full until the Contractor (a) removes all pavement marking material placed outside the scope/limits of the project, and (b) repairs the pavement surface as directed by and to the satisfaction of the Engineer and the local entity, if different from the Engineer.

**Timeliness:** All thermoplastic material shall be completely installed within two (2) calendar weeks of the road surface material being laid. Failure to install markings on schedule shall result in liquidated damages of \$1500 per day, separate from the project liquidated damages as stated elsewhere in the Contract Documents, until pavement markings are installed on schedule, or completion of the markings completes the project. These liquidated damages shall be imposed each time the Contractor fails to install pavement markings within the two-week window as described above.

**b. Preformed Thermoplastic Installation Performance Measures**

Applied material must be from an approved manufacturer, of proper dimensions and composition. Material must be applied per manufacturer's instructions. No substitutions of materials will be allowed without prior approval of the Engineer.

Contractor is responsible for accurate layout and measurement. Preformed thermoplastic to be used only where specified or with approval of the Engineer.

Applied material must adhere fully and completely to road surface, with straight edges and squared ends; lay smooth on surface with no warps, folds, creases, waves, bubbles or rips. Color and beading must be uniform and consistent.



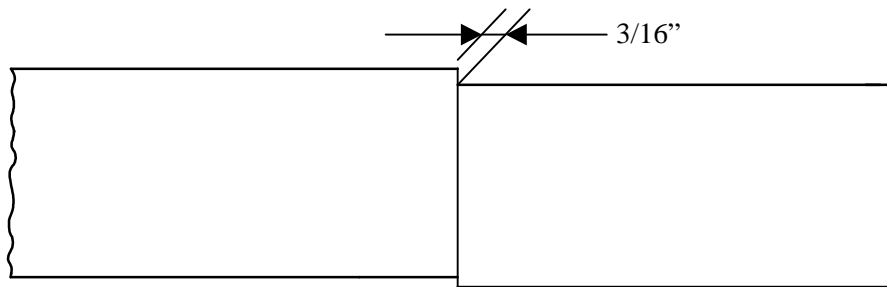
No overlap of materials. Ends or sides matched to existing markings must not exceed 1/8" in separation. Applied material to be in alignment with existing markings and of consistent size.

Preformed thermoplastic pavement marking materials shall not be applied when pavement temperatures are below 32 degrees F, or when the surface of the pavement shall show evidence of moisture.

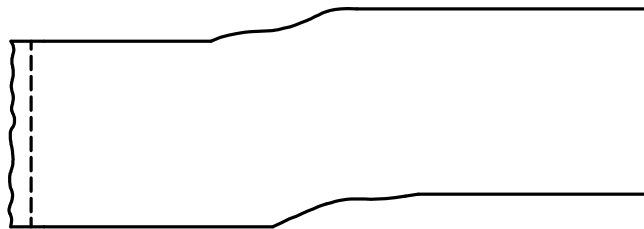
**Lack/Excess of Surface Spheres or Improper Application:** The full unit price bid per foot shall be withheld for each lineal foot of material or per each for symbol markings with inappropriate application rate of the surface glass spheres. The same penalty shall apply if the spheres are not evenly disbursed across and along a line or if the spheres imbed improperly. This penalty shall be imposed for each instance that the Contractor fails to take corrective action after one warning by the Engineer.

**Lack of adhesion:** The full unit price bid per foot or per each for symbol markings shall be withheld for one foot for each occurrence if found more than three (3) times per 1 mile, or project if less than 1 mile in length.

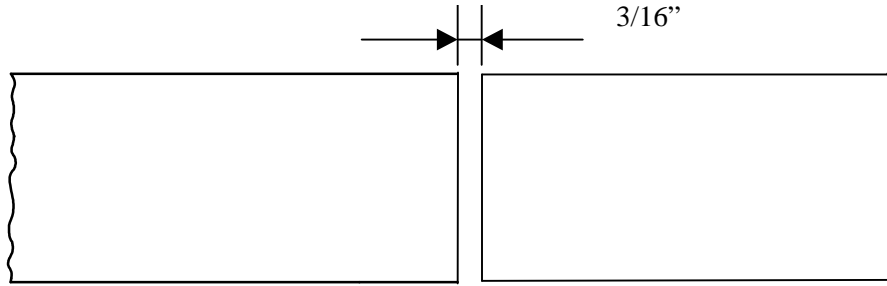
**Line Deviation:** A line that deviates from the specified layout by an unreasonable amount shall be replaced. The Contractor shall be responsible for removal of the deviated marking material/repair of the pavement as designated by, and to the satisfaction of, the Engineer at no additional compensation.



**Wavy Line:** The full unit price bid per foot shall be withheld for the entire length of waviness in a line caused by poor workmanship and/or application procedures. Penalty shall be imposed from the first occurrence.



**Gaps Between Successive Lines:** Successively placed lines that contain gaps as specified by an unreasonable amount shall be replaced. The Contractor shall be responsible for removal of the deviated marking material/repair of the pavement as designated by, and to the satisfaction of, the Engineer at no additional compensation.



**Burned or Discolored Markings:** Fifty (50) percent of the full unit price bid per foot shall be withheld for each lineal foot of material or per each for symbol markings which shows signs of burning or discoloration due to prolonged application of the torch. This penalty shall be imposed for each instance that the Contractor fails to take corrective action after one warning by the Engineer.

**Work Outside the Scope/Limits of Project:** Payment for all pavement marking work performed shall be withheld in full until the Contractor (a) removes all pavement marking material placed outside the scope/limits of the project, and (b) repairs the pavement surface as directed by and to the satisfaction of the Engineer and the local entity, if different from the Engineer.

**Timeliness:** All preformed thermoplastic material shall be completely installed within two (2) calendar weeks of the road surface material being laid. Failure to install markings on schedule shall result in liquidated damages of \$1500 per day, separate from the project liquidated damages as stated elsewhere in the Contract Documents, until pavement markings are installed on schedule, or completion of the markings completes the project. These liquidated damages shall be imposed each time the Contractor fails to install pavement markings within the two-week window as described above.

**c. Cold Plastic, Durable Pre-Formed, Patterned Cold Plastic, or Durable Pre-Formed, Contrast Patterned Cold Plastic Pavement Marking Installation Performance Measures**

Applied material must be from an approved manufacturer, of proper dimensions and composition. Material must be applied per manufacturer's instructions. No substitutions of materials will be allowed without prior approval of the Engineer. Manufacturer-approved adhesive must be used and applied per instructions. No substitutions of materials will be allowed without prior approval of the Engineer.

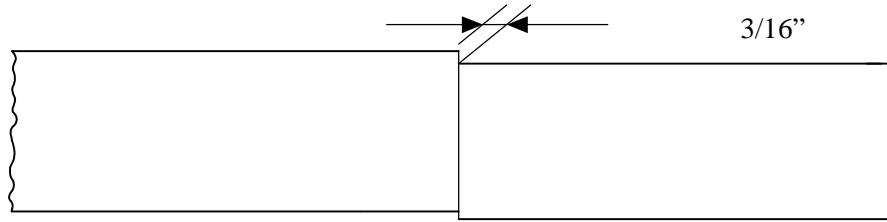
Contractor is responsible for accurate layout and measurement. Cold plastic to be used only where specified or with approval of the Engineer.

Applied material must adhere fully and completely to road surface, with straight edges and squared ends; lay smooth on surface with no warps, folds, creases, waves, bubbles or rips. Color and beading must be uniform and consistent.

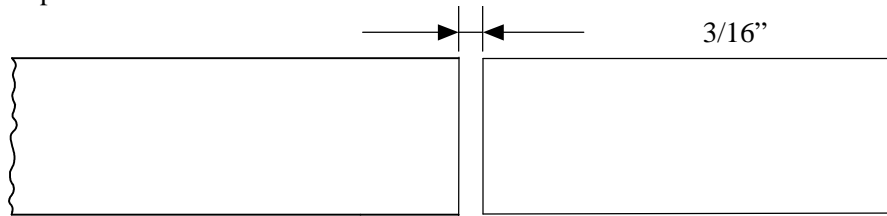
No overlap of materials. Ends or sides matched to existing markings must not exceed 1/8" in separation. Applied material to be in alignment with existing markings and of consistent size.

**Lack of adhesion:** The full unit price bid per foot shall be withheld for one foot for each occurrence if found more than three (3) times per 1 mile, or project if less than 1 mile in length.

**Line Deviation:** A line that in the judgment of the Engineer deviates from the specified layout by an unreasonable amount shall be replaced. The Contractor shall be responsible for removal of the deviated marking material/repair of the pavement as designated by, and to the satisfaction of, the Engineer at no additional compensation.

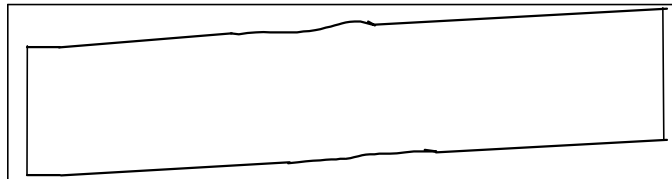


**Gaps Between Successive Lines:** Successively placed lines that contain gaps as specified by an unreasonable amount shall be replaced. The Contractor shall be responsible for removal of the deviated marking material/repair of the pavement as designated by, and to the satisfaction of, the Engineer at no additional compensation.



**Inlaid Groove Quality:** The full unit price bid per foot shall be withheld for the entire length of line that does not meet the requirements for depth of the inlaid material or for a groove that displays a coarse tooth pattern bottom that is not conducive to complete adhesion of the marking material. Penalty shall be imposed from the first occurrence.

**Wavy or Misaligned Line:** The full unit price bid per foot shall be withheld for the entire length of waviness caused by poor operation by the driver/operator of the grooving/installation equipment or for any misalignment in the material installed within the inlaid groove. Penalty shall be imposed from the first occurrence.



**Work Outside the Scope/Limits of Project:** Payment for all pavement marking work performed shall be withheld in full until the Contractor (a) removes all pavement marking material placed outside the scope/limits of the project, and (b) repairs the pavement surface as directed by and to the satisfaction of the Engineer and the local entity, if different from the Engineer.

**Timeliness:** All cold plastic, durable pre-formed patterned cold plastic, or durable pre-formed contrast patterned cold plastic material shall be completely installed within two (2) calendar weeks of the road surface material being laid. Failure to install markings on schedule shall result in liquidated damages of \$1500 per day, separate from the project liquidated damages as stated elsewhere in the Contract Documents, until pavement markings are installed on schedule, or completion of the markings completes the project. These liquidated damages shall be imposed each time the Contractor fails to install pavement markings within the two-week window as described above.

**d. Pavement Marking Paint and Urethane Acrylate Installation Performance Measures**

The line shall be uniform thickness across the entire cross section of the line with well-defined edges. Heavy inner thickness and thin edges or vice-versa will not be accepted. Glass spheres shall be spread uniformly over the entire length of line. Beginning and ends of lines shall be clean cut and perpendicular to the centerline of the street.

Pavement marking paint materials shall not be applied when pavement temperatures are below 50 degrees F, or when the surface of the pavement shall show evidence of moisture. Temperatures should be at least 50 degrees F and rising.

**Lack of specified thickness:** The full unit price bid per foot shall be withheld if lack of thickness is found more than three (3) times per 1 mile, or project if less than 1 mile in length. Each line shall be checked a minimum of six (6) times per 1 mile, or project if less than 1 mile in length, using the random number tables and method of sampling as set forth in section 5.17.06 of Part V of the KDOT Construction Manual.

**Lack of specified width:** Payment shall be made with penalty being equal to 25% of the unit price bid per foot for each 1/4" of width lacking not to exceed 100% of the unit price bid per foot for the length of the line less than specified width. Penalty shall be imposed upon the first occurrence and every occurrence thereafter.

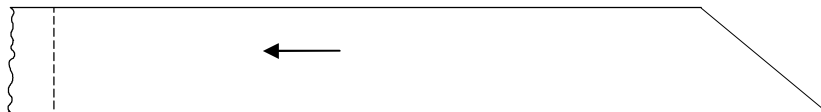
**Lack of specified length/cycle:** Payment shall be made with penalty being equal to 25% of the unit price bid per foot for each 1" of length lacking or exceeding the specified length for broken lane line and/or broken center line not to exceed 100% of the unit price bid per meter (foot) for the length of the line less than specified length. Penalty shall be imposed upon the first occurrence and every occurrence thereafter.

**Lack/Excess of Surface Spheres or Improper Application:** The full unit price bid per foot shall be withheld for each lineal foot of material with inappropriate application rate of the surface glass spheres. The same penalty shall apply if the spheres are not evenly disbursed across and along a line or if the spheres imbed improperly. This penalty shall be imposed for each instance that the Contractor fails to take corrective action after one warning by the Engineer.

**Pointed Ends:** The full unit price bid per foot shall be withheld for pointed ends. This penalty shall be for the full 6 feet of a lane line or broken centerline or for no more than 6 feet of a long line.



**Skewed Ends:** The full unit price bid per foot shall be withheld for skewed ends. This penalty shall be for the full 6 feet of a lane line or broken centerline or for no more than 6 feet of a long line.



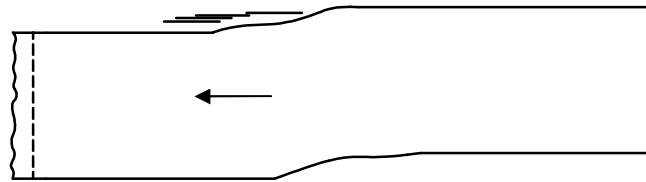
**Line Deviation:** A line that in the judgment of the Engineer deviates from the specified layout by an unreasonable amount shall be replaced. The Contractor shall be responsible for removal of the deviated marking material/repair of the pavement as designated by, and to the satisfaction of, the Engineer at no additional compensation.

**Excessive Dripping between Lines:** The full unit price bid per foot shall be penalized for the length of any dribbled open space between broken lines that is not removed to the satisfaction of the

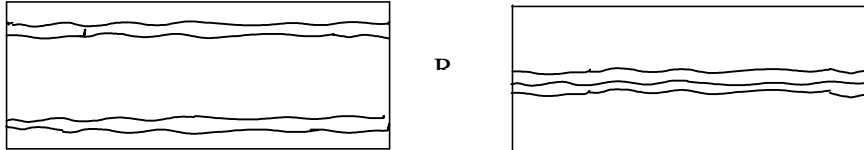
Engineer before leaving the project site that work day. Penalty shall be imposed upon the first occurrence and every occurrence thereafter.



**Wavy Line:** The full unit price bid per foot shall be withheld for the entire length of waviness in a line caused by poor operation by the driver/operator of the application equipment. Penalty shall be imposed from the first occurrence.



**Non-Uniform Thickness:** The line shall be uniform thickness across the entire cross section of the line with well-defined edges. Heavy inner thickness and thin edges or vice-versa will not be accepted. The full unit price bid per foot shall be withheld for lines that are not of uniform thickness. Penalty shall be imposed from the first occurrence.



**Work Outside the Scope/Limits of Project:** Payment for all pavement marking work performed shall be withheld in full until the Contractor (a) removes all pavement marking material placed outside the scope/limits of the project, and (b) repairs the pavement surface as directed by and to the satisfaction of the Engineer and the local entity, if different from the Engineer.

**Timeliness:** All paint or urethane acrylate material shall be completely installed within two (2) calendar weeks of the road surface material being laid. Failure to install markings on schedule shall result in liquidated damages of \$1500 per day, separate from the project liquidated damages as stated elsewhere in the Contract Documents, until pavement markings are installed on schedule, or completion of the markings completes the project. These liquidated damages shall be imposed each time the Contractor fails to install pavement markings within the two-week window as described above.

**e. Epoxy Installation Performance Measures**

The line shall be uniform thickness across the entire cross section of the line with well-defined edges. Heavy inner thickness and thin edges or vice-versa will not be accepted. Glass spheres shall be spread uniformly over the entire length of line. Beginning and ends of lines shall be clean cut and perpendicular to the centerline of the street.

Pavement marking paint materials shall not be applied when pavement temperatures are below 50 degrees F, or when the surface of the pavement shall show evidence of moisture. Temperatures should be at least 50 degrees F and rising.

**Lack of specified thickness:** The full unit price bid per foot shall be withheld if lack of thickness is found more than three (3) times per 1 mile, or project if less than 1 mile in length. Each line shall be checked a minimum of six (6) times per 1 mile, or project if less than 1 mile in length, using the random number tables and method of sampling as set forth in section 5.17.06 of Part V of the KDOT Construction Manual.

**Lack of specified width:** Payment shall be made with penalty being equal to 25% of the unit price bid per foot for each ¼" of width lacking not to exceed 100% of the unit price bid per foot for the length of the line less than specified width. Penalty shall be imposed upon the first occurrence and every occurrence thereafter.

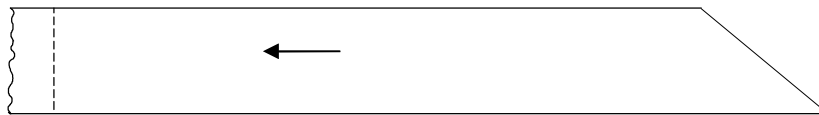
**Lack of specified length/cycle:** Payment shall be made with penalty being equal to 25% of the unit price bid per foot for each 1" of length lacking or exceeding the specified length for broken lane line and/or broken center line not to exceed 100% of the unit price bid per foot for the length of the line less than specified length. Penalty shall be imposed upon the first occurrence and every occurrence thereafter.

**Lack/Excess of Surface Spheres or Improper Application:** The full unit price bid per foot shall be withheld for each lineal foot of material with inappropriate application rate of the surface glass spheres. The same penalty shall apply if the spheres are not evenly disbursed across and along a line or if the spheres imbed improperly. This penalty shall be imposed for each instance that the Contractor fails to take corrective action after one warning by the Engineer.

**Pointed Ends:** The full unit price bid per foot shall be withheld for pointed ends. This penalty shall be for the full 6 feet of a lane line or broken centerline or for no more than 6 feet of a long line.



**Skewed Ends:** The full unit price bid per foot shall be withheld for skewed ends. This penalty shall be for the full 6 feet of a lane line or broken centerline or for no more than 6 feet of a long line.

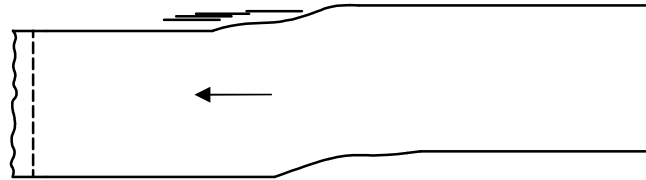


**Line Deviation:** A line that in the judgment of the Engineer deviates from the specified layout by an unreasonable amount shall be replaced. The Contractor shall be responsible for removal of the deviated marking material/repair of the pavement as designated by, and to the satisfaction of, the Engineer at no additional compensation.

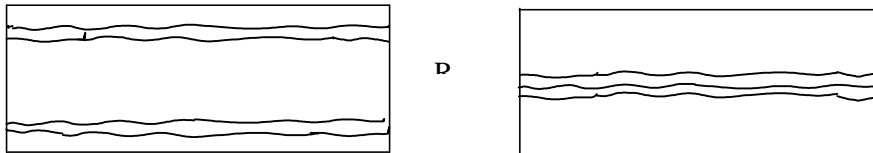
**Excessive Dripping between Lines:** The full unit price bid per foot shall be penalized for the length of any dribbled open space between broken lines that is not removed to the satisfaction of the Engineer before leaving the project site that work day. Penalty shall be imposed upon the first occurrence and every occurrence thereafter.



**Wavy Line:** The full unit price bid per foot shall be withheld for the entire length of waviness in a line caused by poor operation by the driver/operator of the application equipment. Penalty shall be imposed from the first occurrence.



**Non-Uniform Thickness:** The line shall be uniform thickness across the entire cross section of the line with well-defined edges. Heavy inner thickness and thin edges or vice-versa will not be accepted. The full unit price bid per foot shall be withheld for lines that are not of uniform thickness. Penalty shall be imposed from the first occurrence.



**Work Outside the Scope/Limits of Project:** Payment for all pavement marking work performed shall be withheld in full until the Contractor (a) removes all pavement marking material placed outside the scope/limits of the project, and (b) repairs the pavement surface as directed by and to the satisfaction of the Engineer and the local entity, if different from the Engineer.

**Timeliness:** All epoxy material shall be completely installed within two (2) calendar weeks of the road surface material being laid. Failure to install markings on schedule shall result in liquidated damages of \$1500 per day, separate from the project liquidated damages as stated elsewhere in the Contract Documents, until pavement markings are installed on schedule, or completion of the markings completes the project. These liquidated damages shall be imposed each time the Contractor fails to install pavement markings within the two-week window as described above.

## 44 - TREE WELL/PLANTING BEDS

### 44.1 DESCRIPTION

Tree wells and planting beds shall be constructed as shown on the plans. All concrete, asphalt, gravel, and dirt as shown on the plans shall be removed and select planting soil replaced.

#### 44.2 MATERIALS

All concrete shall consist of KCMMB 4K concrete.

The select planting soil shall be an acceptable top-soil mixture composed of 45-77 percent silt, 0-25 percent clay, and 25-33 percent sand. The select planting soil shall include three (3) to five (5) percent organic matter, have a pH of 6.0 to 7.0 and free of subsoil, stones, weeds, plant roots, sticks, gravel, debris, or harmful chemicals and petroleum by-product.

#### 44.3 CONSTRUCTION REQUIREMENTS

All areas as shown on the plans shall be excavated to a depth of 3 feet minimum, which shall include removal of all asphalt, concrete, gravel, and compacted sub-soil. The select soil shall be placed and lightly compacted to the elevation of the tree well. Excavation shall be subsidiary to the select planting soil bid item.

The select planting soil shall be in place prior to construction of the tree wells. No. 4's reinforcing grade 40 or 60 steel at 6 inch centers shall be placed as shown on the plans prior to placing concrete.

Concrete under the concrete paver bricks including reinforcement shall be subsidiary to the concrete paver bricks. The tree wells shall be formed as shown on the plans and the surface finished with a wooden or metallic float.

All concrete shall be cured in accordance with "Concrete Construction".

### 45 - TEMPORARY EROSION AND POLLUTION CONTROL

#### 45.1 DESCRIPTION

At the locations shown on the plans or as directed by the Engineer, temporary erosion and pollution control Best Management Practices (BMPs) shall be installed, maintained and removed in accordance with Section 901 of the Standard Specifications except as otherwise modified herein.

<b>Erosion and Pollution Control Bid Item</b>	<b>Units</b>
Water Pollution Control Manager	Each
SWPPP Inspection	Each
Compost Cover	Cubic Yard
Erosion Control Blankets (Class & Type)	Square Yard
Turf Reinforcement Mat (Class & Type)	Square Yard
Hydraulic Erosion Control (Type)	Ton
Temporary Slope Drain	Linear Foot
Biodegradable Log (Size)	Linear Foot
Construction Entrance	Square Yard
Temporary Ditch Check (Type)	Each
Temporary Diversion Berm	Linear Foot
Temporary Filter Berm	Linear Foot
Filter Sock (Size)	Linear Foot



Temporary Inlet Sediment Barrier (Type)	Each
Temporary Sediment Basin	Lump Sum
Temporary Sediment Trap	Each
Silt Fence	Linear Foot
Synthetic Sediment Barrier (Type)	Linear Foot
Temporary Stream Crossing	Each

## 45.2 GENERAL REQUIREMENTS

Take all measures necessary including, but not limited to, the installation, maintenance and removal of temporary erosion and pollution control BMPs as required during the construction of the project to prevent erosion and pollution on the project and project related borrow areas in accordance with the requirements of the Kansas Department of Health and Environment (KDHE) National Pollution Discharge Elimination System (NPDES) Stormwater Runoff from Construction Activities General Permit (herein after referred to as Construction General Permit), City Ordinances, and the Stormwater Pollution Prevention Plan (SWPPP) developed for the project.

### a. Permits

Owners or operators of construction activities which may disturb one (1.0) or more acres of soil or are part of a larger common plan of development or sale which may disturb a cumulative total of one (1.0) or more acres of soil must obtain a Construction General Permit and other local permits as required. Where such permits are required, the Owner will provide the Contractor with a Stormwater Pollution Prevention Plan (SWPPP) which has been prepared by the Engineer or other qualified professional. The Contractor shall comply with all requirements of such permits and the SWPPP, and shall enforce compliance with such requirements by all Subcontractors.

If a Construction General Permit is not required for a project, the Engineer may waive certain documentation and record-keeping provisions of this specification. The Contractor is required to comply with all other provisions in this specification and is required to install such measures for erosion and pollution control as may be called for in the plan or ordered by the Engineer.

### b. Installation, Maintenance, And Removal of BMPs

(1) **Installation:** Install erosion and pollution control BMPs as shown on the plans. Do not perform any land disturbance until erosion and pollution control BMPs are in place and approved by the Engineer. As approved by the Engineer, installation of BMPs may occur simultaneously with the clearing and grubbing operations. Install BMPs to establish perimeter control of the project in areas where it is anticipated that storm water runoff will leave the project.

(2) **Maintenance:** All installed erosion and pollution control BMPs shall be maintained in a manner that preserves their effectiveness until all Construction General Permit requirements are met. If any BMP in place does not provide adequate protection, at any time during the project, alternate BMPs to provide effective control shall be provided. The obligation to conduct formal inspections and complete an associated report every 14 days and within 24 hours of a rainfall event of ½ inch or more does not limit or otherwise modify the Contractor's obligation to monitor and maintain temporary erosion and pollution control BMPs daily. Any deficiencies noted shall be corrected by the Contractor prior to the next anticipated rain event or within 7 calendar days of the inspection, whichever occurs first, despite weather conditions that make it difficult (but not impossible) to perform corrections. The Contractor shall receive no additional time for making corrections unless approved by the Engineer.

(3) Removal: Completely remove BMPs from the site when they are no longer needed, unless approved by the Engineer to remain in place for permanent stabilization or biodegradation. After removing BMPs, remove and dispose of accumulated sediment and permanently stabilize disturbed areas.

**c. Maximum Areas Of Disturbance At One Time**

Limit the erodible earth material exposed by clearing and grubbing, excavation, borrow and embankment operations according to the capability and progress, and in keeping with the approved schedule. Existing vegetation shall be preserved or retained as long as practical and the time period for soil areas to be without permanent surface or vegetative cover shall be minimized.

Unless requested in writing from the Contractor, and approved in writing by the Engineer, or specified otherwise on the plans, do not exceed 750,000 square feet (17.2 acres) of surface area of erodible earth material at one time.

Disturbed areas which have been graded, stabilized and restricted from access will not count toward the 750,000 square feet limit.

**d. Stabilization Of Disturbed Areas**

Immediately initiate placement of appropriate erosion control BMPs in any exposed steep slope areas where construction activities have permanently or temporarily ceased, and will not resume for a period exceeding 7 calendar days. For vegetative cover areas, in addition to seeding, watering, mulching, and any other required activities related to the planting and establishment of vegetation, utilize other appropriate erosion control BMPs such as erosion control blankets and turf reinforcement mats.

Immediately initiate stabilization on areas that have been disturbed after construction activities have permanently ceased on that portion of the project site. Immediately initiate temporary stabilization BMPs on areas that have been disturbed after construction activities have temporarily ceased on that portion of the project site if construction activities will not resume for a period exceeding 14 calendar days. Temporary stabilization may include establishment of vegetation, geotextiles, mulches or other techniques to reduce or eliminate erosion until either final stabilization can be achieved or until further construction activities take place to re-disturb the area. This stabilization must be completed within 21 calendar days.

**e. Construction Near Or In Water Bodies**

Restrict construction operations near or in water bodies to those areas essential for the construction of temporary or permanent structures. When no longer required, promptly remove all falsework, piling, temporary crossings and other obstructions caused by the construction.

Minimize the duration of time over which area is disturbed. Once begun, construction shall proceed expeditiously to completion. Use temporary erosion and pollution control BMPs to prevent contamination of adjacent water bodies including the use of turbidity curtains, as approved by the Engineer. Immediately initiate stabilization on areas that have been disturbed after construction activities have ceased on that portion of the project site.

Where practical, do not store equipment or materials (including soil stockpiles) within 50 feet of water bodies. Avoid storing equipment or materials (including soil stockpiles) in flowlines of ditches or other drainage courses. Where such storage is necessary, obtain the Engineer's written approval and include in the SWPPP appropriate BMPs for the storage area.

Temporary channels used to divert flow shall be constructed as shown in detail and shall be stabilized immediately.

Contractor shall not ford live streams with equipment, but shall use temporary stream crossing as detailed in the plans.

**f. Borrow Areas**

When borrow or plant sites are outside the project limits, Contractor shall obtain all required permits and clearances required for compliance.

**g. Dewatering**

During pumping or dewatering activities, a manufactured device, or other BMP that provides equal or better performance, for filtering sediments from water shall be provided as approved by the Engineer. Repair and/or replace as necessary to maintain function and integrity.

**h. Sediment Removal**

Accumulated sediment shall be removed when it exceeds the volumes specified for any particular BMP or when ordered by the Engineer. Sediments removed shall be mixed with other onsite materials and incorporated into project fills, spread loosely across the site, or hauled offsite as necessary. Sediments shall be located and stabilized to prevent erosion of sediment. Sediments hauled offsite shall be dewatered first or hauled in a water tight truck. When hauled offsite, Contractor shall obtain all required permits and clearances required for compliance.

**i. Chemical And Waste Controls**

- (1) Solid Waste: Trash and debris shall be contained and hauled offsite for proper disposal. Floating debris, found in any waterbody on or adjacent to the construction site, shall be removed immediately regardless of source.
- (2) Sanitary Waste: Portable facilities shall be properly anchored and not be placed within 20 feet of any storm water inlet.
- (3) Chemicals: Shall be stored onsite in their original container. Materials stored outside shall be in closed and sealed water-proof containers and located outside of drainageways or areas subject to flooding.
- (4) Leak Prevention: All equipment used onsite shall be free of leaks. No fueling, servicing, maintenance, or repair of equipment shall be done within 50 feet of a water body. Onsite fuel tanks shall be in good condition, free of leaks or drips, painted brightly for visibility, and monitored daily. All fuel tanks, including mobile trailers, shall be protected by a secondary containment system or earthen berm sized to contain 110% of the full tank volume.
- (5) Concrete Washout: Concrete wash or rinse water from concrete mixing equipment, tools and/or ready-mix trucks, etc, shall be contained and not be discharged into or be allowed to run directly into any existing water body or storm inlet. One or more locations for concrete wash out shall be designated on site, such that discharges during concrete washout shall be contained in a small area where waste concrete can solidify. If the washout facility is not within view from the pour location, signage will be required to direct the truck drivers.
- (6) Spill Reporting and Management: In case of a spill notify the following in accordance with KDHE under part 10 of the Construction General Permit:

U.S. EPA National Response Center:  
(24 hours a day) (800) 424-8802  
Kansas Division of Emergency Management: (KDEM)  
(24 hours a day) (785) 296-8013  
or (800) 275-0297  
Website: [www.ksready.gov](http://www.ksready.gov)  
KDHE: (24 hours a day) (785) 296-1679

Spills that pose an immediate threat to public safety or contamination of a water body shall be reported immediately to the Overland Park Fire Department at 911 in addition to the afore mentioned emergency spill contacts.

Notify the Engineer in writing within 24 hours of any chemical, sewage or other material spill which is required to be reported to the KDHE under part 10 of the Construction General Permit. The notification shall include at a minimum the material spilled, location of the spill, and a description of

containment or remediation actions taken. This notice to the Engineer does not relieve the Contractor of responsibility to report to the KDHE or to any other agency.

If it is safe to do so, Contractor shall stop the source of any spills or leaks and shall contain spills immediately with an appropriate BMP, earthen berm, sawdust, sand, kitty litter, rags or other absorbents. Contractor shall have the tools, equipment, and supplies necessary for spill response onsite at all times and ready for immediate use. All spills shall be cleaned up and disposed of in accordance with applicable federal, state, and local regulations.

**j. Storm Water Pollution Prevention Plan (SWPPP)**

Projects disturbing 1 or more acres shall have a SWPPP in accordance with the Construction General Permit. Projects disturbing less than 1 acre, neither Construction General Permit coverage nor a SWPPP will be required. Even though a SWPPP is not required, the Contractor is required to comply with the City Ordinances and utilize appropriate BMPs to minimize stormwater pollution.

Prior to the pre-construction meeting, the Contractor shall provide a copy KDHE's authorized NOI.

A copy of SWPPP shall be retained and available onsite. The SWPPP shall be maintained to reflect modifications or amendments to the plans until all Construction General Permit requirements are met. During the progress of the job, the effectiveness and performance of the BMPs used shall be monitored and additional modifications and amendments proposed as needed.

**k. SWPPP Inspections**

SWPPP Inspections shall be performed by the Contractor's Environmental Inspector. The Environmental Inspector shall have completed KDOT's Environmental Inspector Training within the last thirty-six months and provide the City with proof of certification prior to the pre-construction meeting

The Contractor's Environmental Inspector shall perform an inspection of the temporary erosion and pollution control BMPs every 14 days during normal work hours and within 24 hours of a rainfall event of ½ inch or more. Inspections shall continue at this frequency once construction activities commence and until all Construction General Permit requirements are met. The Contractor's Environmental Inspector shall sign the report.

Corrective actions are required to be taken prior to the next anticipated rain event or within 7 calendar days of the inspection, whichever occurs first.

**45.3 TEMPORARY EROSION CONTROL**

**a. Compost Cover**

(1) Description: Organic material applied with or without seed to protect the soil surface from water and wind erosion.

(2) Materials: Shall meet the requirements of Section 909 of the Standard Specifications.

(3) Construction Requirements: Soil shall be prepared to eliminate compaction, gullies, depressions, and large clods. Compost shall be uniformly applied to a depth of 1.5 to 2 inches when alone or uniformly applied 1 to 1.5 inches when used in conjunction with seeding operations.

(4) Maintenance: Compost shall be replaced or repaired as needed. Bare spots shall be filled in, by hand if necessary. Vehicle and personnel traffic shall be minimized in areas covered.

**b. Erosion Control Blankets (ECB) and Turf Reinforcement Mats (TRM)**

(1) Description: Manufactured product placed on bare soil including slopes, channels, ditches, or areas of concentrated flow for short-term, long-term, or permanent protection.

(2) Materials: Shall meet the requirements of Section 2113 of the Standard Specifications.

(3) Construction Requirements: Install according to the manufacturer's recommendations for trenching, splice and longitudinal overlaps, staple size and staple pattern. In no instance shall the overlaps be less than the minimum shown on the standard details. Installation areas shall be free

of erosion rills, rocks, clods or other debris that may cause “tenting” or otherwise inhibit uniform soil contact. To avoid jointing in the center of the channel, install single width of erosion control material in direction of flow. Do not cover erosion control materials with soil or mulch unless recommended by the manufacturer and approved by the Engineer.

(4) Maintenance: Torn or degraded product shall be repaired or replaced, unless such degradation is within the functional longevity specified by the manufacturer. Edges or seams which are loose or frayed shall be secured.

**C. Hydraulic Erosion Control**

(1) Description: A manufactured product composed of fibrous material mixed with water and hydraulically broadcast as a slurry designed to reduce soil erosion and/or assist in the establishment and growth of vegetation.

(2) Materials: Shall meet the performance standard of the type specified on the plans. The hydraulic erosion control type and performance standard are categorized as shown in Table A below. Manufacturer’s product certification for performance and packaging requirements shall be submitted to the Engineer for approval.

Table A - Hydraulic Erosion Control				
Type	Estimated Longevity (months)	Typical Application Rate (lb/acre)	Typical Maximum Slope Gradient	Maximum Uninterrupted Slope Length
1	1	1500 - 2500	≤ 5:1	20
2	2	2000-3000	≤ 4:1	25
3	3	2000-3500	≤ 3:1	50
4	6	2500 - 4000	≤ 2:1	75
5	12	3000- 4500	≤ 2:1	100

Deliver, store and handle in strict compliance with manufacturer’s instructions and recommendations. Protect product from damage due to weather conditions and construction operations.

Water used in this work shall be furnished by the Contractor and will be suitable for irrigation and free from ingredients harmful to plant life. All watering equipment required for the work shall be furnished by the Contractor. Under no circumstances shall the Contractor use water except that metered from adjacent fire hydrants or public water lines.

(3) Construction Requirements:

Shall conform to the manufacturer’s application rates and installation requirements, or as approved by the Engineer. The soil shall be prepared to eliminate compaction, gullies, depressions, and large clods. Apply from opposing directions to achieve best soil coverage. It is not intended to be applied in channels, swales or other areas where concentrated flows are anticipated.

The Contractor shall schedule the application of the hydraulic erosion control slurry in conjunction with suitable weather on unsaturated soils and allowed to dry 24 hours prior to a rain event in order to ensure the adequacy of the cure.

When specified in the plans or as directed by the Engineer, the Contractor shall apply temporary or permanent seeding to all areas to where hydraulic erosion control will be applied before application occurs. Seeding shall be in accordance with the requirements set forth in the “Seeding” section of this special provision.

The Contractor shall notify the Engineer prior to commencing hydraulic erosion control application operations. If stages of construction have been established by the Engineer, the Contractor shall notify the Engineer upon completing a stage of construction and obtain approval prior to commencing with subsequent stages of construction.

Upon completion of the application operations, the Contractor shall immediately remove all debris and excess materials from the site.

**The performance of the hydraulic erosion control product must proceed unabated until the designated area is completed. Areas shall be protected from disturbance including but not limited to foot and vehicle traffic. Any erosion of the area prior to drying shall be repaired by the Contractor at no additional cost to the City. Severe damage to any area caused by the Contractor's activities shall be repaired by the Contractor at no additional cost to the City.**

(4) Maintenance: Any damaged areas shall be repaired utilizing the exact blend and application procedure as specified above or as directed by the Engineer.

**d. Temporary Slope Drain**

(1) Description: Flexible tubing or conduit used to convey concentrated water from the top of a slope down to the toe and thereby preventing erosion over the slope face.

(2) Materials: Shall be metal, plastic, or flexible rubber pipe having a minimum 6 inch diameter. Pipe walls shall be impermeable and not slotted. Standard flared end sections shall be provided at both the inlet and outlet. Energy dissipation shall be provided at the outlet to provide stabilization and prevent scour. The Engineer will accept the material based on the condition of the pipe and visual inspection of the installed drain.

(3) Construction Requirements: Install as shown on the plans. Water shall be directed towards the inlets by the use of temporary berms, silt fence, gravel bags, or other barrier systems shown on the plans or approved by the Engineer.

(4) Maintenance: Accumulation of any visible sediment at the inlet and outlet shall be removed promptly. Outlet conditions shall be repaired if scour is observed. Leaking or damaged sections of pipe shall be repaired immediately. Barriers directing water to the inlet shall be monitored for continuity and effectiveness.

#### **45.4 TEMPORARY POLLUTION CONTROL**

**a. Biodegradable Log**

(1) Description: Commercially manufactured biodegradable sediment barrier of material bound with a containment netting.

(2) Materials: Filler consists of straw, excelsior wood fiber, coconut fiber, jute or other biodegradable material. Containment netting includes open mesh fabric made of jute or light weight plastic. Stakes are per manufacturer's requirements.

(3) Construction Requirements: Install as shown on the plans. Individual units shall be installed in accordance with manufacturer's recommendations. Do not use biodegradable logs manufactured from straw for ditch checks or inlet sediment barriers.

(4) Maintenance: Remove and dispose of sediment deposits when the deposit approaches 1/2 the height of the biodegradable log. Avoid driving over logs and replace segments damaged by vehicles. Replace as necessary to maintain function and integrity of installation.

**b. Construction Entrance**

(1) Description: Stabilized access point intended to remove mud from vehicle tires to prevent offsite tracking.

(2) Materials: Aggregate shall be clean 2" to 3" coarse aggregate. Geotextile fabric shall be non-woven.

(3) Construction Requirements: Install as shown on the plans or as approved by the Engineer. Remove all vegetation and other unsuitable material from the foundation area, grade and crown for

positive drainage. Divert all surface runoff and drainage from the entrance to a sediment control BMP. If conditions warrant, install geotextile fabric under aggregate. Rumble strips, track pads, wash racks, or similar track out prevention BMPs may be needed in conjunction with construction entrance.

(4) Maintenance: Reshape entrance as needed to maintain function and integrity of installation. Top dress with clean aggregate as needed.

**c. Temporary Ditch Check**

(1) Description: Barriers used to impede concentrated flow to allow settlement of soil particles.

(2) Materials: Rock shall consist of clean aggregate free of deleterious material. Refer to "Ditch Check" Standard Detail for sizing. Synthetic Sediment Barriers and Biodegradable Logs shall meet the material requirements given by other items of this special provision

(3) Construction Requirements: Install as shown on the plans and refer to "Ditch Check" Standard Detail for spacing. Rock shall be keyed into the bottom and sides of slope a minimum of 6 inches. Synthetic Sediment Barriers and Biodegradable Logs shall meet the material requirements given by other items of this special provision

(4) Maintenance: Remove and dispose of sediment deposits when the deposit approaches 1/2 the height of the ditch checks. Replace and reshape as necessary to maintain function and integrity of installation.

**d. Temporary Diversion Berm**

(1) Description: Earthen berm generally installed along the contour to divert storm runoff or to trap small areas of overland flow. A furrow is typically excavated adjacent to the berm on the upstream side, so as to further establish the drainageway.

(2) Materials: Shall consist of soil material that is capable of being compacted.

(3) Construction Requirements: Install as shown on the plans. Berm shall be compacted until no further consolidation is observed, using a dozer track, grader wheel or other equipment. Berm shall be temporarily stabilized immediately after installation.

(4) Maintenance: Berm shall be reshaped, compacted, and stabilized as necessary to maintain their function. Breaches in the berm shall be repaired immediately.

**e. Temporary Filter Berm**

(1) Description: Berm or dike of compost or wood mulch to contain and filter storm runoff from small areas of overland flow.

(2) Materials: Compost shall meet the requirements of Section 909 of the Standard Specifications. Wood mulch shall consist of tree and shrub debris ground by mechanical means. Mulch sizing may vary with a maximum width of 2 inches and a maximum length of 10 inches.

(3) Construction Requirements: Place in un-compacted windrows as shown on the plans. The berm shall be of uniform height and width. (Refer to "Filter Berm" Standard Detail). Do not use filter berms in concentrated flow paths.

(4) Maintenance: Berm shall be reshaped and material added as necessary to maintain function and dimensions. Breaches in the berm shall be repaired promptly.

**f. Filter Sock**

(1) Description: Commercially manufactured mesh bags containing permeable material to slow and filter stormwater runoff.

(2) Materials: Filler shall consist of clean coarse aggregate 1/2" to 1" diameter; compost meeting the requirements of Section 909 of the Standard Specifications; or other permeable filler material. Mesh Bag shall consist of pervious non-biodegradable material having a minimum unit weight of 4 ounces per square yard. The Mullen burst strength shall exceed 300 pounds per square inch per ASTM D3786 and shall have ultraviolet stability exceeding 70% per ASTM D4355.

(3) Construction Requirements: Shall be located as shown on the plans and installed in accordance with manufacturer's recommendations.

(4) Maintenance: Remove any visible accumulation of sediment. Replace as necessary to maintain function and integrity of installation.

**g. Temporary Inlet Sediment Barrier**

(1) Description: A variety of BMPs or procedures used to allow water to enter a stormwater inlet while filtering or temporarily impeding the flow sufficiently to reduce the quantity of sediment carried.

(2) Materials: Filter sock, synthetic sediment barriers, silt fence, and rock ditch checks shall meet the material requirements given by other items of this special provision. Prefabricated BMPs or alternative systems may be used with the Engineer's approval.

(3) Construction Requirements: Install as shown on the plans. Filter sock, synthetic sediment barriers, silt fence, and rock ditch checks shall meet the construction requirements given by the respective items of this special provision. Placement shall not increase the risk of flooding or other hazards. Inlets under construction may block or impede flow and shall provide an excavated area around inlet to allow settling of soil particles. Completed and existing inlets shall allow runoff to enter the inlet and be protected with stabilization and filter sock or similar.

(4) Maintenance: Remove deposited sediment from excavated storage areas when available storage has been reduced by 20%. Remove deposited sediment from filter socks or similar when any accumulation of sediment is visible. Repair or replace as necessary to maintain function and integrity of installation.

**h. Temporary Sediment Basin**

(1) Description: Reservoir and embankment with engineered spillways and surface dewatering that is constructed to intercept sediment-laden runoff from large areas and provide retention to settle out soil particles.

(2) Materials: Refer to "Temporary Sediment Basin" Standard Detail for material requirements.

(3) Construction Requirements:

Embankment, reservoir, spillway and appurtenances shall be constructed as shown on the plans and "Temporary Sediment Basin" Standard Detail. Surface dewatering shall be achieved by use of skimmer or other approved equivalent. Baffles are required. Basin shall be stabilized immediately following installation.

Construction warning fence shall be installed around the perimeter of the pond and warning signs erected when directed by the Engineer.

Construction of the sediment basin shall be carried out in a manner such that it does not result in sediment problems downstream.

(4) Maintenance: Check sediment basins after periods of significant runoff. Remove sediment and restore the basin to its original dimensions when sediment accumulates to 20% of the storage capacity. Immediately repair any erosion damage to the embankment and outlets. Repair and/or replace baffles as necessary to maintain function and integrity of installation. Keep outlet, skimmer, and pool area free of all trash and other debris.

**i. Temporary Sediment Trap**

(1) Description: Reservoir and embankment with a stone outlet that is constructed to intercept sediment-laden runoff and provide retention to settle out soil particles.

(2) Materials: As shown on the plans and "Temporary Sediment Trap" Standard Detail.

(3) Construction Requirements: Install as shown on the plans and "Temporary Sediment Trap" Standard Detail. Trap shall be stabilized immediately following installation.

(4) Maintenance: Check sediment traps after periods of significant runoff. Remove sediment and restore the trap to its original dimensions when sediment accumulates to 20% of the storage capacity. Immediately repair any erosion damage to the embankment and outlet. Keep outlet and pool area free of all trash and other debris.



**j. Silt Fence**

(1) Description: Barrier of geotextile fabric generally installed along the contour to divert and/or contain storm runoff to allow settlement of soil particles.

(2) Materials:

Geotextile Fabric shall consist of material that complies with AASHTO M 288 for unsupported silt fence, with 4 ft. maximum post spacing.

Provide wood, steel, or synthetic posts of sufficient strength to resist damage during installation and to support the applied loads. Length is to be a minimum of 4 feet. Hardwood posts having dimensions of at least 1 3/16 x 1 3/16 inch, No. 2 Southern Pine at least 2 5/8 x 2 5/8 inch or steel posts of U, T, L, or C shape, weighing 1.33 lbs per foot minimum are satisfactory.

When conditions warrant, supplement the silt fence with woven-wire fencing with a minimum wire gage between 9 and 14 and a maximum mesh spacing of 6 inches in all directions. Wire-supported fence requires steel posts.

(3) Construction Requirements: Install as shown on the plans and "Silt Fence" Standard Detail. Installation shall be made by a specialized machine capable of inserting the fence securely into the ground with a slicing method and firmly compacting the slice closed. Trenching will only be allowed for small or difficult areas where slicing cannot be reasonably used. Silt fence shall be firmly embedded and anchored to the ground such that runoff cannot undermine the fence. Joints in silt fence shall overlap to prevent leakage. Securely attach the fabric to the upstream side of post with staples or plastic zip ties.

(4) Maintenance: Remove and dispose of sediment deposits when the deposit approaches 1/3 the height of the silt fence. Repair as necessary to maintain function and structure.

**k. Synthetic Sediment Barrier**

(1) Description: Commercially manufactured BMP such as Geo-Ridge Permeable Berm™, Triangular Silt Dike™ or equivalent used for slope barriers or ditch checks. The synthetic sediment barrier shall be accepted based on the City's Approved Materials List or as approved by the Engineer.

(2) Materials: Shall conform to the manufacturer's specifications.

(3) Construction Requirements: Shall be located as shown on the plans. Individual units shall be installed in accordance with manufacturer's recommendations.

(4) Maintenance: Remove and dispose of sediment deposits when the deposit approaches 1/2 the height of the barrier. Replace as necessary to maintain function and integrity of installation.

**l. Temporary Stream Crossing**

(1) Description: Culvert crossing, stream ford, or temporary bridge constructed in a water body to allow construction access and crossing.

(2) Materials: As shown on the plans and Temporary Stream Crossing Detail.

(3) Construction Requirements:

Construct as shown on the plans. When the Contractor's operations require a temporary stream crossing, and one is not shown on the plans, the Contractor shall notify the Engineer and comply with all applicable rules and regulations, obtain all required permits and provide copies of all permits to the Engineer.

Before beginning work in the streambed, record existing stream channel elevations.

Place 1 pipe buried 6 inches into the stream bottom, in the lowest point of the channel to allow the passage of aquatic organisms, with additional pipes placed along the remainder of the stream channel bottom such that ordinary high water (OHW) flows designated on the plans shall flow through the pipes without overtopping the crossing. If the OHW is not designated on the plans, the Engineer will determine the OHW.

Submit to the Engineer for review and approval, the design flow calculations to determine the number and diameter of pipes required. A minimum 12 inch diameter pipe is required, place pipes parallel to flow, and cover pipes with a minimum of 12 inches of clean aggregate fill.

(4) Maintenance:

Repair stream bank erosion by stabilizing with erosion control BMPs such as erosion control blankets. For in-stream degradation, armor the culvert outlet(s) with riprap to dissipate energy. If sediment or debris is accumulating upstream of the crossing, remove as needed to maintain the functionality of the crossing.

If a temporary crossing is requiring excessive maintenance, replacement with a larger culvert or alternate design may be necessary. Remove the temporary crossing as soon as no longer needed. Restore the disturbed bed and bank area of the stream channel to its pre-existing elevation and stabilize immediately. Take care to minimize the amount of sediment lost into the stream upon removal.

**46 - SEEDING**

**46.1 DESCRIPTION**

This work shall consist of the furnishing and planting of seed at those locations indicated on the plans or as designated by the Engineer.

Permanent seeding shall be used to establish perennial vegetation during final stabilization.

Temporary seeding shall be used to provide interim stabilization with annual vegetation as a temporary cover to minimize erosion.

All materials, bed preparation, and planting shall conform to the applicable requirements of Sections 901, 902, 903 and 904 of the Standard Specifications, except as otherwise modified herein. In general, all disturbed areas should have a minimum of 6 inches of select topsoil uniformly placed. All disturbed areas shall be seeded as soon as practicable.

**46.2 CONSTRUCTION REQUIREMENTS FOR PERMANENT SEEDING**

**a. Seeding Season**

Determine seeding rate and season using the following table. Any seeding done outside of the seeding season as specified in the Standard Specifications will be maintained by the Contractor until satisfactory growth is established or reseeded shall be done at the Contractor's expense if the growth is unsatisfactory.

Seed Type	Minimum Pure Live Seed (%)	Rate of Pure Live Seed (lbs/acre)	Seeding Dates
Cool Season Grasses			
Fescue	83	348	Feb 15 – April 20 and Aug 15 – Sept 30
Kentucky Bluegrass	64	120	
Warm Season Grasses			
Buffalo	72	45	Nov 15 – June 1

**b. Preparation of Seedbed**

All areas to be seeded shall be tilled to a minimum of 4 to 6 inches before application of seed. The final seedbed shall be well mixed with no large clumps of any kind and shall have no foreign

material in it. The seedbed should be uniform and well packed. **Approval of the seed bed shall be obtained from the Engineer before seeding is started.**

**c. Seeding**

Seed shall be applied within 24 hours of seedbed preparation by use of an acceptable seed drill or other equipment approved by the Engineer at a depth of 1/4 inch in a uniform manner at the prescribed rate. Broadcasting and hand raking to a depth of 1/4 inch will only be used on areas where it is impossible to operate a seed drill.

**d. Mulching**

Mulch shall be applied within 24 hours following the seeding operation. Vegetative type mulch shall be spread uniformly in a continuous blanket at the rate of 2 tons per acre resulting in 90% coverage. Application shall be by mechanical spreader or other approved means. The mulch shall be anchored in the soil to a depth of three inches by a mulch puncher or straight serrated coulter disk mulch anchor machine designed to force the mulch into the soil surface. The machine shall be weighted and operated in such manner to secure the mulch firmly in the ground to form a soil-binding mulch and prevent loss or bunching by wind. The coulters shall be at least ten inches in diameter. Two passes may be required to anchor the mulch to the satisfaction of the Engineer. No mulch shall be placed unless it can be anchored on the same day.

**e. Hydraulic Erosion Control**

Shall meet the requirements found in the Temporary Erosion and Pollution Control Special Provision.

**f. Fertilizer**

Starter fertilizer shall be an approved commercial brand composed of a mixture of soluble and insoluble Nitrogen and shall conform to the State Fertilizer Laws. It shall be uniform in composition, dry and free flowing, and shall be delivered to the site guaranteed analysis.

Certification shall be submitted to the city on the fertilizer. Any fertilizer which becomes caked or otherwise damaged, making it unsatisfactory for use, will not be accepted. Fertilizer shall be placed prior to seeding and incorporated into top soil at a rate of application of 1 lb. of actual nitrogen per 1000 square feet of planting area unless otherwise determined by a soil test. No fertilizer shall be used when seeding the banks of sediment basins or sediment traps.

**g. Seed Maintenance and Acceptance**

All seeded areas shall be maintained by the Contractor prior to acceptance by the Engineer. Prior to acceptance, seeded areas shall be kept free of weeds in accordance with Weed Control paragraph in "General Requirements". The Engineer will issue a written notification of acceptance once a stand of perennial vegetation free of weeds is present that has a 70% density that covers all of the disturbed area, as measured by the Engineer.

**46.3 CONSTRUCTION REQUIREMENTS FOR TEMPORARY SEEDING**

This item only covers seeding installed by conventional drilling. Temporary seeding shall only be used for periods not to exceed 12 months unless approved by the city. During final stabilization, temporary seeding shall only be used to establish vegetation outside of the permanent seeding or sodding dates as specified in the Standard Specifications.

The following seed mixtures and planting rates shall be used:

Seed Type	Minimum Pure Live Seed (%)	Rate of Pure Live Seed (lbs/acre)	Seeding Dates
Annual Ryegrass	83	90	Anytime
Millet	77	65	May 1 – Aug 15 Heat Tolerance
Winter Wheat	83	120	Sept 15 – Nov 30 Cold Tolerance

**a. Preparation and Planting**

Preparation, planting and all other construction requirements for temporary seeding shall be as specified for permanent seeding, except as modified herein. Temporary seeding shall be drilled. Prior to application, the soil shall be tilled to a depth of at least 2 inches and gullies, depressions, and large clods eliminated. Roller compaction of the seedbed is not required. Within 24 hours of seeding, mulch or erosion control blankets shall be applied. When mulch is used, it shall be applied in accordance with the same requirements given for permanent seeding. Fertilizer is not required. Contractor shall schedule work so as to provide temporary seeding as early as practical in the construction process. Contractor shall maintain a readiness to perform temporary seeding frequently during the progress of the project. No more than 7 calendar days shall elapse between the Engineer’s request for temporary seeding and its application. Multiple mobilizations to seed areas as construction progresses shall be expected.

**b. Maintenance**

Mulch shall be replaced or repaired as needed during germination and early growth. Bare spots shall be patched, by hand seeding if necessary. Vehicle and personnel traffic shall be minimized in areas seeded.

**47 - SEEDS**

**47.1 DESCRIPTION**

This specification covers the material requirements for seeds. This work shall consist of seed application as shown on the plans and in accordance with Section 2103 of the Standard Specifications except as otherwise modified herein.

**47.2 MATERIALS**

Due to invasiveness, Crownvetch (*Coronilla varia*) shall not be used.

**48 - SODDING**

**48.1 DESCRIPTION**

This work shall consist of furnishing and placing sod at those locations indicated on the plans or as designated by the Engineer in accordance with Section 906 of the Standard Specifications except as modified herein.

**48.2 MATERIALS**

**a. Sod Types**

The type of sod to be used will be Turf Type Fescue sod, except where Zoysia sod or Kentucky Bluegrass sod is identified under the property owners name and address on the plans, or designated by the

Engineer. In the case of mixtures of Bluegrass and Zoysia sod, Zoysia shall be used unless otherwise directed by the Engineer.

**b. Sod Material**

All materials shall conform to the requirements of these Specifications and to Section 2104 of the Standard Specifications. The Contractor shall retain a person knowledgeable of the different types of sod to ascertain prior to bidding, the location and types of existing sods. Sod shall be of best quality Bluegrass, Zoysia, or Turf Type Fescue, not more than two years old, shall conform to the quality standards of Nursery Grown Sod as defined by the American Sod Producers Association, and shall meet the following standards:

- (1) Thickness of Cut: Sod shall be machine cut at a uniform soil thickness of 5/8 inch, plus or minus 1/4 inch, at the time of cutting. Measurement for thickness shall exclude top growth and thatch.
- (2) Pad Size: Individual pieces of sod shall be cut to the suppliers's standard width and length as approved by the Engineer. Maximum allowable deviation from standard widths and lengths shall be plus or minus 1/2 inch on width and plus or minus 5 percent on length. Broken pads and torn or uneven ends will not be acceptable.
- (3) Strength of Sod Sections: Standard size sections of sod shall be strong enough to support their own weight and should retain their size and shape when suspended vertically from a firm grasp on the upper 10 percent of the section.
- (4) Moisture Content: Sod shall not be harvested or transplanted when moisture content (excessively dry or wet) will adversely affect its survival.
- (5) Mowing Height: Before stripping, sod shall be mowed uniformly at a height of 2 to 3 inches.
- (6) Thatch: Sod shall be relatively free of thatch, up to 1/2 inch allowable (uncompressed).
- (7) Diseases, Nematodes, and Insects: Sod shall be reasonably free of diseases, nematodes, and soil-borne insects. State nursery and/or plant materials' laws require that all sod entering inter-state commerce be inspected and approved for sale. The same applies to sod being shipped intra-state. The inspections and approval must be made by the state agricultural department, office of the state entomologist.
- (8) Weeds: Sod shall be free of objectionable grassy and broad leaf weeds. Sod shall be considered free of such weeds if less than 5 such plants are found per 200 square feet of area. Sod will not be acceptable if it contains any of the following weeds: quackgrass, Johnson grass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, wild garlic, ground ivy, perennial sorrel, brome grass, bentgrass, and Bermuda grass.

**c. Fertilizer**

Fertilizer shall conform to the State fertilizer laws, and shall conform to Section 2108 of the Standard Specifications.

Furnishing and placing fertilizer shall be in accordance with Section 902 of the Standard Specifications. Fertilizer shall be uniform in composition, dry and free flowing, and shall be delivered to the site in the original unopened containers, each bearing the manufacturer's guaranteed analysis. Certification shall be submitted to the city on the fertilizer. Any fertilizer which becomes caked or otherwise damaged, making it unsuitable for use, will not be accepted. Fertilizer shall be placed prior to sodding at not less than 1 lb. of pure nitrogen per 1000 square feet of sodding area unless otherwise determined by a soil test. Fertilizer shall be subsidiary to sodding bid items.

**48.3 CONSTRUCTION REQUIREMENTS**

**a. Sod Season**

Bluegrass and Fescue sod may be planted during the periods of March 1 to May 15 and September 1 to November 15. Bluegrass and Fescue sod may be planted during the period, November 15 to March 1,

when the soil and sod is workable and with the approval of the Engineer. If sod is planted between November 15 and March 1, the Contractor will maintain the sod until 20 days after the beginning of the spring sodding season. The Engineer reserves the right to delay the sodding of all types of sod or to vary the permissible sodding seasons, due to weather, soil conditions, or for other causes.

Zoysia sod may be planted during the period April 1 to October 15.

**b. Bed Preparation and Moisture Requirements**

Where the width of the disturbed area to be sodded exceeds 18 inches, the area shall be widened to a uniform size by removing enough existing turf from behind the disturbed area, creating an area whose width is a multiple of 18 inches (width of sod roll). A clean edge should be established at the outer limits of the area to be sodded, so that good contact can be made between the new sod and the established turf.

Where the width of the disturbed area is less than 18 inches, enough existing turf shall be removed to create an area of uniform width, no less than six (6) inches.

All backfill shall consist of soil suitable for vegetation. The area shall be prepared such that sodding can be placed on bare soil. This will consist of cultivating, smoothing, removing of clods, surface stones 1 inch in diameter or larger, and weeds. All backfilling shall be subsidiary to other bid items.

Area to be sodded shall consist a minimum of 6 inches of top soil, free from clods, rocks, trash, and other debris. Any fertilizer applied shall be incorporated into the top soil. If the area has been severely compacted by heavy trucks or other equipment, it shall be cultivated to a depth of 6 to 8 inches by tilling or disking. Backfill areas shall be compacted to a sufficient density to prevent excessive settling after placement of sod. If footprints left by an adult walking across the area are more than 1/2 inch deep, the compaction is not sufficient.

Grade of the area shall be approximately 1 inch below desired final grade, to allow for the thickness of the sod.

**c. Water**

Water used in this work shall be furnished by the Contractor and will be suitable for irrigation and free from ingredients harmful to plant life. All watering equipment required for the work shall be furnished by the Contractor. Under no circumstances shall the Contractor use water except that metered from adjacent fire hydrants or public water lines.

**d. Placing Sod**

Sod strips shall be laid parallel with the ends staggered in a running bond pattern. Each successively laid strip shall be pressed firmly up against the one next to it or up against the edge of the existing turf, to ensure good contact with no overlapping. Sod shall be staked in places where the slope exceeds 3:1. Sod shall be staked with a minimum of two to four stakes per square yard or roll, as determined by the Engineer. Stakes shall be of lath or similar materials and shall be driven six inches into the ground, leaving approximately 1/2 inch of the top above the sod line.

After placing sod, the area shall be tamped with a hand tamp or rolled with a lawn roller half filled with water. Rolling shall be done in a direction perpendicular to the direction in which the sod lengths were laid.

**e. Sod Watering and Maintenance**

After each days sod is placed, it shall be watered sufficiently to wet the sod pads and at least 2 inches of the sod bed. Thereafter in the absence of adequate rainfall, watering shall be performed daily and as often as necessary to keep the sod pads moist at all times. Watering by the Contractor shall continue until the roots of the sod are anchored in placed, and the sod is growing and accepted.

All sodded areas shall be mowed immediately prior to the Engineer's inspection for acceptance. Mowing is required to facilitate visual assessment and acceptability of the work. Mowing shall not be attempted until the sod is firmly rooted and secure in place. Not more than 1/3 of the grass leaf shall be removed. Any debris that would interfere with mowing shall be collected and removed.

**f. Sod Acceptance**

All sodded areas shall be kept free of weeds until the sod has been accepted.

All sodded areas shall be kept thoroughly watered by the Contractor for a period of 20 days after laying and as often as required thereafter, until completion of all other items of work in the contract. If sodding is the last item of work to be performed, the Contractor shall continue watering until all sod is growing and accepted.

The Contractor shall be fully responsible for the condition of the sod work until written notification that his obligation to maintain the sod is terminated, and the sod has been accepted. At that time the property owners shall be notified by the Engineer that further maintenance of the sod is their responsibility.

## **49 - TOPSOIL**

### **49.1 DESCRIPTION**

Topsoil shall be furnished and placed at the locations shown on the plans, or as directed by the Engineer. Topsoil shall consist of suitable surface soil as stipulated in Section 2101 of the Standard Specifications and as approved by the Engineer. Furnishing topsoil shall be in accordance with Section 905 of the Standard Specifications and placing topsoil shall be in accordance with Section 206 and Special Provision 07-02002 of the Standard Specifications except as otherwise modified herein.

### **49.2 CONSTRUCTION REQUIREMENTS**

The Contractor shall stockpile existing top soil, unless specifically authorized and approved by the Engineer, prior to deep excavations and reuse it in the same general locations. No payment will be made for topsoil furnishing and placement necessary due to excessive hauling off of existing top soil on the project site.

Contractor's source of furnished topsoil shall be approved by the Engineer. All areas to be seeded or sodded shall consist of a minimum of 6 inches of topsoil, free from clods, rocks, trash, and other debris. If the area has been severely compacted by heavy trucks or other equipment, it shall be cultivated to a depth of 6 inches - 8 inches by tilling or disking. At locations where excavation to final grade results in material unsuitable for vegetation, as determined by the Engineer, the Contractor shall undercut and remove the material and place topsoil.

## **50 - CONTRACTOR CONSTRUCTION STAKING**

### **50.1 DESCRIPTION**

This work shall be performed in accordance with Section 802 of the Standard Specifications as amended herein. The Contractor shall set construction stakes establishing all lines, slopes, continuous profile-grades, centerlines, and benchmarks necessary to control and perform the work.

### **50.2 CONSTRUCTION REQUIREMENTS**

#### **a. Vertical Control**

Prior to construction Johnson County Bench Marks that will be damaged or removed by construction shall be replaced by a benchmark outside of construction area. New benchmarks shall be an aluminum cap (caps will be furnished by the County) set in a rigid concrete structure. A hole shall be drilled into concrete and the cap grouted into place. The preferred locations are traffic signal bases, culvert headwalls and bridge handrails. A standard monument record sheet shall be completed for each permanent benchmark. Elevations shall be determined with a double rod level run using digital level and bar code rods and shall tie into Johnson County vertical control network at each end of the level run. Level runs shall close within 0.1 ft. per 4 miles. Level run data shall be furnished in digital and paper format.

Mapping grade state plane coordinates shall also be provided. This effort shall be coordinated with the Johnson County Public Works Department County Surveyor.

**b. Horizontal Control**

Prior to construction Section Corner and quarter section corners shall be referenced to points outside construction and a Land Corner Endangerment Report submitted to the Kansas State Historical Society and the County Engineer within 30 days of the survey as required by state law. During construction the surveyor will coordinate with contractor on the placement of the monument box. After construction the surveyor shall use his previous reference ties and preliminarily mark the aluminum cap. This location shall be checked with coordinates from the design survey to insure that the ties match the previous coordinates. If within tolerance the aluminum cap shall be punched at the proper location. New Land Corner Reference Reports with updated references shall be submitted to the Kansas State Historical Society and the County Engineer within 30 days of the survey as required by state law.

**c. Property Corners**

The Contractor shall locate all existing property corners within the project limits prior to commencing construction. All existing property corners shall be marked and protected. Property corners anticipated to be disturbed during construction shall be located by ties and shall be reset by the Contractor at the termination of construction activities. All property surveying shall be performed by a qualified land surveyor registered in the State of Kansas.

**d. KCP&L Conduits**

A stamped sealed survey shall be provided by the Contractor for all conduit installed as part of the contract.

**e. Swale Staking**

The Contractor shall set cut stakes for all rough swale grading and shall maintain or reset such stakes for checking of the grade as required by the Engineer. Final grade for the swales and berms shall be established by "blue top" surveying or other approved method, and grade devices shall be maintained for inspection by the Engineer prior to sodding.

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