

# TECHNICAL SPECIFICATIONS FOR PUBLIC IMPROVEMENT PROJECTS

CITY OF GARDNER, KANSAS  
JANUARY 2023

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## **SECTION 1000 - SITE PREPARATION**

**1001 SCOPE.** This section covers the necessary clearing, grubbing, demolition, and other appurtenant work in accordance with the approved plans.

### **1002 DEFINITIONS.**

- a. Clearing. Clearing shall consist of the removal of all vegetable matter, such as trees, brush, down timber, rotten wood, sod, rubbish, and other objectionable combustible materials. It shall include the removal of wood buildings, fences, lumber, waste dumps, abandoned utilities, and trash, and salvaging the specified materials.
- b. Grubbing. Grubbing shall consist of the removal of all stumps, roots, buried trees and brush, and other objectionable combustible materials appearing on or below the surface of the ground which has not been included under the definition of "*Clearing*" above.
- c. Demolition. Demolition shall include destruction and removal of all non-vegetative matter located above, on or below the ground surface. This shall include, but not limited to, all material derived from the demolition of Portland cement concrete items such as base courses, curbs, curb and gutters, sidewalks, flows, steps, driveways, drainage structures, fences, other miscellaneous items such as foundations or walls, iron or steel items and asphaltic items such as pavement and base courses.
- d. Trees. Vegetable growth forty (40) inches or greater in circumference, measured two (2) feet above the ground shall be classified as a tree.
- e. Brush. Vegetable growth less than forty (40) inches in circumference, measured two (2) feet above the ground shall be classified as brush.

**1003 UTILITY COORDINATION.** The Contractor shall be responsible for protecting existing and private improvements in the vicinity of clearing, grubbing and demolition operations. The Contractor shall not be responsible for the cost of utility locating services, but he shall be responsible for the cost of all damage to such facilities arising from his carelessness or negligence.

**1004 LIMITS OF CONSTRUCTION.** The limits of clearing, grubbing, and demolition shall be as defined on the approved plans.

### **1005 PROGRESS OF CONSTRUCTION.**

- a. Erosion and Sedimentation Control. Prior to clearing, grubbing, and demolition, erosion, and sedimentation controls shall be in place in accordance with Section 7300.
- b. Clearing. Clearing shall proceed well in advance of the construction operation so as not to delay the progress of the work. The debris from clearing operations shall be lawfully hauled to a waste site, or shall be burned when authorized by the Fire Marshal. Under no circumstances will the authorization to burn on the site relieve the contractor in any way from damages which may result from his operations. In no case shall any materials be left on the project site, shoved into abutting properties, or buried in embankments or trenches on the site.

- b. **Grubbing.** Erosion control measures shall be in place prior to the start of grubbing operations. Grubbing shall parallel the clearing as nearly as the sequence of operations will permit. Except for the special circumstances enumerated below, all stumps, roots, and other objectionable matter within the construction area shall be removed to a minimum depth of twelve (12) inches below the subgrade or the original ground, whichever is lower. All stumps, roots, and other objectionable matter outside the limits of the construction area but within the right-of-way shall be cut off flush with the ground.

All stumps, roots, and other objectionable matter within the specified limits of embankments having a depth of two (2) feet or less shall be removed and disposed of. Piling and butts of utility poles within the limits shall be removed to a minimum depth of two (2) feet below the subgrade or the original ground, whichever is lower.

All stumps, roots, and other objectionable matter found within borrow material shall be removed.

All stumps, roots, and other objectionable matter found within the bottoms or sidewalls of excavation and trenching areas shall be completely removed from the respective bottom areas, and removed to a minimum depth of twelve (12) inches below the respective sidewalls.

- c. **Demolition.** Demolition work shall occur well in advance of the construction operation. Masonry and concrete walls, miscellaneous foundations, or other objects extending below ground shall be removed to a depth of at least twelve (12) inches below the original ground or the subgrade, whichever is lower.

When explosives are used in demolition, the contractor shall comply with the provisions of Specification Section 6100 *Blasting*.

Portland cement concrete pavement, base courses, curbs, curb and gutters, gutters, sidewalks and similar objects shall be removed at an existing joint or at a full depth sawed joint.

- 1006 PROTECTION OF TREES AND SHRUBS.** Tree preservation areas, protection zones and stream setback areas shall be protected in accordance with the approved plans using the standard orange barricade fencing material approved by the City Engineer. The fencing shall be four (4) feet in height and supported by metal channel posts spaced at a maximum of eight (8) feet on center. The fencing shall be located at the drip line of all trees or wooded areas and shall remain erect and secure throughout all construction phases.

During construction operations, the Contractor shall leave in place and protect from damage all trees, shrubbery and planting beds unless shown on the approved plans to be removed. Where existing trees are to remain, it shall be the responsibility of the Contractor to perform trimming operations on low branches. The trimming shall be performed in a professional manner. The Contractor shall not operate equipment within the drip line of protected trees.

- 1007 CONSTRUCTION STAKING.** The Contractor shall be responsible for all staking required on the project unless otherwise stipulated in the approved plans. The Contractor shall be responsible for and shall provide all staking, furnish all stakes, labor, transportation, and other materials as may be required for the proper staking of the work and establish temporary or permanent reference marks. All work performed on the project shall be done to the lines, grades, and elevations shown

on the plans.

Any work done without being properly located and established by base lines, off-set stakes, benchmarks, or other basic references may be ordered to be removed and replaced at the Contractor's expense.

The Contractor shall be responsible for all preservation of all permanent monuments, property corners, benchmarks, reference points, and stakes. If the loss of stakes or reference marks causes a delay in the work, the Contractor shall have no claim for damages or extensions of time.

## **SECTION 1100 – GRADING**

**1101** **SCOPE.** This section covers the performance of all the work and appurtenances required for grading the project in accordance with the approved plans.

### **1102** **MATERIALS AND DEFINITIONS.**

- A. **Grading.** Grading shall be defined as all excavation and placement of embankment and backfill.
- B. **Excavation.** Excavation is defined as the removal of materials from the construction area to the lines and grades as shown on the approved plans.

Unless otherwise provided for in the Special Conditions and included in the approved plans, all excavation shall be unclassified excavation and the contractor shall satisfactorily remove and dispose of all materials encountered regardless of their nature.

When provided for in the Special Conditions and included in the approved plans, the excavation may be classified according to the following categories.

- 1. **Common Excavation.** Suitable materials shall include all earth free of rock, sod, weeds, roots and other debris, and containing the soil characteristics and moisture content to obtain the required compaction.
  - 2. **Rock Excavation.** Rock excavation will be so classified when sandstone, limestone, blue shale or other similar material is encountered and, in the opinion of the engineer, requires drilling or blasting to remove the material.
- C. **Embankment.** Embankment is defined as the placement and compaction of material to the lines and grades as shown on the approved plans.

Construction of fills and embankments in frozen conditions shall not be permitted unless otherwise approved by the City Engineer. No fill or embankment material shall be installed on frozen surfaces, nor shall frozen materials, snow or ice be placed in any fill or embankment.

Material suitable for use as embankment shall be entirely imperishable and shall be approved by the City Engineer.

Earth embankment shall be free of waste material and shall contain less than ten (10) percent by volume of rock and gravel and contain no particles having a dimension greater than three (3) inches.

Rock embankment shall be free of waste material and shall contain ten (10) percent or greater by volume of rock or gravel with particles ranging in size from a minimum dimension of three (3) inches to maximum dimension of twenty-four (24) inches.

Embankment material shall not include frozen material, organic material, topsoil, rubbish, broken concrete, brick, asphaltic concrete and other debris and soil.

D. Structures. Structures, as used herein, refers to bridges, basins, street drainage structures, headwalls, retaining walls, and similar construction.

**1103 CONSTRUCTION - GENERAL**. During excavation and embankment grading operations, the work shall be performed in a manner and sequence that will provide positive drainage at all times. Unstable areas that develop during grading operations shall be undercut, backfilled with suitable material, and compacted in accordance with the approved plans. No additional payment will be made to the Contractor for undercutting.

**1104 EXCAVATION - GRADING**. Excavation within the construction limits shall be performed to the lines and grades on the approved plans.

All suitable material removed by excavation shall be used for embankment construction or elsewhere when directed by the City Engineer. The Contractor shall coordinate excavation operations to ensure suitable materials are readily available. No additional compensation will be made for any re-handling of materials.

Excavation materials in excess of the amount needed to complete the grading shall be considered as waste material, and shall be removed from the site by the Contractor.

Any additional fill material required which is not available from excavation within the construction limits shall be supplied by the Contractor at no expense to the City unless provided for in the approved plans. All such material brought to the site and incorporated in the work shall be approved by the City Engineer.

Unsuitable or unstable material, as determined by the City Engineer, shall be undercut to the depth required to reach stable material, backfilled with suitable material and compacted in accordance with the approved plans. No additional compensation for undercutting will be made unless provided for in the Special Conditions.

All roadway excavation in rock shall be undercut no less than twelve (12) inches for the full width of the roadway and backfilled with suitable soil or granular material. Undercut shall be unclassified excavation.

**1105 EMBANKMENT - GRADING**. The embankments shall be formed with suitable materials procured from excavations made on the project site or from approved borrow pits

Where embankments, regardless of height, are placed against hillsides or existing embankments, either of which have a slope steeper than one (1) vertical to six (6) horizontal, the existing slope shall be benched or stepped in approximately eighteen (18) inch rises as the new fill is brought up in eight (8) inch lifts. Benching shall be of sufficient width to accommodate placing and compacting equipment. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous cuts. Materials thus cut out shall be recomacted to the required density along with the new embankment material. Material cut out, bladed into place, and compacted shall not be measured and paid for directly but will be considered as incidental work.

Maximum slopes for final grades shall be 4:1. Any steeper slope shall require approval of the

City Engineer. Any slope greater than 3:1 shall require City Engineer approval as well as a geotechnical analysis.

The existing surface upon which embankment material is to be placed shall have all unstable and unsuitable material, such as topsoil, peat, mulch, coal seams, disintegrated shale, rubbish, logs or stumps, and unconfined saturated soils, removed in accordance with Section 1000 prior to the embankment work.

Where embankments two (2) feet or less in depth are to be placed on areas covered by existing pavement, the existing pavement shall be removed and the cleared ground surface shall be compacted at optimum moisture to the specified density. Where embankments greater than two (2) feet in depth are to be placed on areas covered by existing pavement, the existing pavement shall be broken into pieces not larger than twenty-four (24) inches maximum dimension, left in place and the embankment started thereon.

Earth embankment shall be placed in successive horizontal layers distributed uniformly over the full width of the embankment area. Each layer of material shall not exceed eight (8) inches in thickness (loose measurement) and shall be compacted to the density specified in Section 1106 before the next layer is placed thereon. As the compaction of each layer progresses, continuous blading will be required to level the surface and to ensure uniform compaction. Embankment construction shall not be performed when the material to be compacted contains frost or is frozen.

Successive horizontal layers of rock embankment not exceeding two (2) feet in depth, shall be made by placing larger stones uniformly over the embankment area. Small stone fragments, sand, earth, or gravel shall be placed between the larger stones to fill all voids. Each layer shall be thoroughly compacted before the next layer is placed.

Large rocks shall be withheld from the top one foot of the embankment and only crushed stone or earth used in this layer. The crushed stone shall be well graded to form a dense mass when compacted.

**1106 EMBANKMENT – BACKFILL AND COMPACTION.** Embankment material shall be compacted in accordance with the City of Gardner *Technical Specifications and Design Criteria for Public Improvement*.

Backfilling of the curb shall be permitted when the concrete has been placed for a period of five (5) days or when the compressive strength of the concrete has reached seventy-five (75) percent of its mix design strength, unless otherwise directed by the City Engineer. All fill material placed within the right-of-way shall be compacted to ninety-five (95) percent of maximum density at the optimum moisture content as determined by ASTM D698. The material used to backfill the curb shall be free of rock and debris and shall leave no voids when compacted.

The top portion of the backfill in unpaved areas shall be finished with at least twelve (12) inches of topsoil. Topsoil shall be approved by the City Engineer prior to placement, and unless otherwise directed, shall be material previously excavated and stockpiled during excavating and grading operations.

Grades on areas to receive topsoil shall be established and maintained as a part of the grading operations. Immediately prior to placing topsoil, the surface shall be loosened by discing or



scarifying to a depth of two (2) inches to permit bonding of the topsoil to the underlying surface.

**1107 STRUCTURE BACKFILL.** The Contractor shall be responsible for any damages to the structure caused by his backfilling operations. Uneven loading of the structure during backfilling will not be permitted. Backfill around and outside of structures shall be deposited in layers not to exceed eight (8) inches in uncompacted thickness and brought to 95% of maximum density at optimum moisture content as determined by ASTM D698. The Contractor shall be required to uniformly adjust the moisture of the material as necessary to comply with the optimum moisture range specified. Compaction of structure backfill by rolling will be permitted provided the desired compaction is obtained and damage to the structure is prevented. Compaction of structure backfill by inundation with water will not be permitted.

Material for structure backfill shall be composed of earth only and shall contain no organic materials, broken concrete, stones, trash, or debris of any kind.

No tamped, rolled, or otherwise mechanically compacted backfill shall be deposited or compacted in water.

All backfill material shall consist of loose, earth having a moisture content such that maximum density of the compacted soil will be obtained. Moisture content shall be distributed uniformly and water for correction of moisture content shall be added sufficiently in advance that proper moisture distribution and compaction will be obtained.

Backfill around and outside of structures that will ultimately lie under proposed pavements shall be compacted to the requirements of Section 1205 "*Compaction Requirements*".

**1108 SHEETING AND SHORING.** The Contractor shall be responsible for the safety of the excavation which shall comply with all OSHA regulations pertaining to trench safety, except where banks are cut back on a stable slope, excavation for structures shall be properly and substantially sheeted, braced, and shored, as necessary, to prevent any caving or sliding. Sheeting, bracing, and shoring shall be designed and constructed to withstand all loads caused by earth movement or pressure.

**1109 FINAL GRADING.** All areas which area to be finish graded shall be brought to the indicated elevations, slopes, and contours. The use of suitable equipment for final area grading and dressing of slopes will be required. The Contractor shall be required to re-grade any areas that are not in accordance with the approved plans.

**1110 CLEANUP.** Cleanup shall follow the work progressively and final cleanup shall follow immediately behind the finish grading. The contractor shall remove all equipment, tools, and discarded materials, and other construction items. The entire right-of- way or easement shall be left in a finished, mowable, and neat condition. Cleanup shall be considered a subsidiary obligation of the grading work.

In the event the contractor does not promptly comply with the terms of such instructions, the city may have the defective work corrected or the rejected work removed and replaced and all direct and indirect costs of such removal and replacement, including compensation for additional professional services, shall be paid by the contractor. The contractor will also bear the expenses of repairing work of others destroyed or damaged by his correction, removal or

replacement of defective work.

- 1111 SETTLEMENT.** The contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within two (2) years after final completion of the contract under which the work was performed.

The Contractor shall repair or replace settlement deficiencies within thirty (30) days of receiving notice from the City Engineer. The Contractor shall be responsible for all costs associated with the repair work.

- 1112 TEMPORARY SURFACING.** Temporary aggregate surface shall be provided for ingress and egress during construction at the direction of the City Engineer. Temporary aggregate surfacing shall meet the requirements of the applicable sections of these Technical Specifications unless otherwise approved by the City Engineer.

Temporary surfacing for sidewalk, bikeways, trails, and other walkways shall be asphaltic concrete or Portland cement concrete, with a minimum width of four (4) feet and minimum thickness of four (4) inches.

Temporary surfacing shall be subsidiary to other grading items unless stated otherwise in the approved plans.

## **SECTION 1200 - SUBGRADE PREPARATION**

**1201 SCOPE.** This section governs all labor, equipment, tools and materials, and the performance of all work associated with subgrade preparation. The subgrade shall provide a foundation for streets, alleys, parking areas, sidewalks, drive approaches and concrete and gutter. This section does not include the construction of any base courses.

### **1202 DEFINITIONS.**

- A. Subgrade. Subgrade is defined as a well-graded and compacted surface conforming to the lines, grades, cross-section and density specified on the approved plans, upon which pavement or curb and gutter will be placed.
- B. Subgrade Preparation. Subgrade preparation is the operation of fine grading and compacting the subgrade in accordance with the specified lines, grades, cross-sections and density specified on the approved plans.

### **1203 CONSTRUCTION REQUIREMENTS.**

- A. General. All underground work, including clearing, grubbing and demolition, shall be completed in accordance with the applicable sections of these Technical Specifications prior to commencement of any subgrade preparation.

Prior to beginning any work on the street subgrade, the Contractor shall secure the services of a qualified testing agency to acquire samples of the material to be used for subgrade construction. These samples shall be analyzed to determine Proctor values, liquid limits and plasticity index. Copies of the analysis shall be provided to the City Engineer for review prior to commencing any subgrade preparation.

Pavement subgrades shall be modified with class "C" fly ash or replaced with AB-3 in accordance with these Technical Specifications.

- B. Foundation Treatment. Unless otherwise specified or shown on the approved plans, the soil below subgrade in cut sections shall be scarified, broken up, adjusted to a moisture content within the designated moisture range and compacted as specified on the approved plans.

When the depth of compaction in cut sections is shown to be more than nine (9) inches, material shall be removed to within nine (9) inches of the subgrade surface. The layer of material left in place shall be scarified, broken up, adjusted to satisfactory moisture content, and compacted as specified on the approved plans. This process shall be repeated until the cut section is compacted to the grade and density indicated on the approved plans.

All roadway excavation in rock (e.g., shale, sandstone, limestone) shall be undercut to a depth no less than nine (9) inches below the subgrade surface for the full width of the roadway and backfilled with suitable soil or AB-3. Undercut shall be unclassified excavation.

**1204 MOISTURE CONTENT REQUIREMENTS.** The moisture content of the soil at the time of compaction shall be uniform and within the acceptable moisture range designated on the approved plans or as directed by the City Engineer.

When the moisture content of the soil is not satisfactory to the City Engineer, water shall be added or the material aerated, whichever is needed, to adjust the soil to the proper moisture content. In no case shall water be added without the consent of the City Engineer.

If Type B compaction is specified, the moisture content shall be sufficient to produce a uniform mixture. Acceptable Type B compaction is achieved when the tamping feet of a sheepsfoot roller “walk out” of the soil and rides on top of the lift being compacted.

Moisture content shall conform with KDOT Table 205-2: Soil Moisture Content Requirements and as recommended by a Geotechnical Engineer.

**1205 COMPACTION REQUIREMENTS.** Roadway embankment fill materials shall be placed in horizontal layers not exceeding eight (8) inches, unless otherwise approved by the City Engineer. Each layer shall be compacted as specified before the next later is placed. Effective spreading equipment shall be used on each layer to obtain uniform thickness prior to compaction.

A. Pavements. The subgrade for pavements shall be compacted to a density of at least ninety-five (95) percent of the maximum standard Proctor test for a depth of at least nine (9) inches below the finished subgrade elevation.

Subgrade for curbs and pavements shall be compacted using sheepsfoot rollers. The roller may be self-propelled or machine drawn. The sheepsfoot roller shall be fully loaded with liquid or solid ballast to produce adequate compactive energy to the tamping foot. The roller shall have a minimum drum diameter of thirty (30) inches and minimum tamping foot length of six (6) inches.

Compaction of low plasticity or non-plastic, fine-grained material shall be considered adequate when the tamping feet “walk out”, provided the entire weight of the roller is supported on the tamping feet.

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

B. Sidewalks. In areas not requiring fill, the subgrade for sidewalk pavements shall be compacted to a density equivalent to the density of the immediately surrounding soil. In areas where fill is required, the subgrade shall be compacted to ninety-five (95) percent of the maximum dry density as determined by ASTM D698.

C. Drive Approaches and Concrete Curb & Gutter. The subgrade for drive approaches and concrete curb and gutter shall be compacted to the same requirements as stated above in part *a. Pavements.*

**1206 PROTECTION AND MAINTENANCE OF SUBGRADE.** Any settlement, erosion or other damage to the subgrade that occurs prior to the acceptance of the work shall be repaired to the specific lines, grades, cross-sections, and density indicated on the approved plans, and shall be approved by the City Engineer.

All existing pavements, curbs, curb and gutters and sidewalks shall be protected during subgrade preparation with an earth cushion, timber planking or other methodologies approved by the City Engineer. Any damage to existing improvements shall be repaired or replaced to the satisfaction of the City Engineer at the Contractor's own expense.

**1207 COMPACTION TESTING AND PROOF ROLLING.** At the option of the City Engineer, compaction may be required prior to the placement of pavement. The subgrade must successfully pass compaction testing by a nuclear density/moisture measuring device and proof rolling with a loaded multi axle dump truck with the ability to proof roll in a tandem axle setup carrying a minimum load of sixteen (16) tons. If as a result of the testing/proof rolling, the City Engineer determines that further compaction is required, the Contractor shall recompact the area to the specified density.

**1208 SUBGRADE TREATMENT.**

**General:** Fly ash treated subgrade shall be a uniform mixture of fly ash and pulverized material compacted to the specified moisture content, fly ash content, density and depth. The fly ash shall be spread in an approved manner at the rate specified. Care shall be taken to prevent the fly ash from flowing off the area to be treated. The fly ash shall be distributed at a uniform rate in such a manner as to minimize the scattering of fly ash by wind. Fly ash shall not be applied when wind conditions, in the opinion of the City Engineer, are such that blowing fly ash becomes objectionable to adjacent property owners or significantly reduces the amount of fly ash incorporated into the subgrade.

A. The Contractor shall secure the services of a qualified testing agency, approved by the City Engineer, to perform on site testing. The testing agency shall monitor placement, mixing, moisture content and in-place density. Copies of the test results shall be provided to the City Engineer for review prior to pavement placement. All costs incurred through the use of the testing agency shall be borne by the Contractor.

B. A sample of the fly ash intended for use on the project shall be submitted to the testing laboratory for the purpose of developing a fly ash proctor. The fly ash supplier will submit certified laboratory analysis indicating that fly ash used on the project conforms to A.S.T.M. C618, Class C, except the supplementary optional physical requirements in table 4 will not apply and the minimum calcium oxide (CaO) content of the fly ash shall be 25%. Fly ash shall be sampled and tested in accordance with A.S.T.M. C311.

Fly ash shall be stored and handled in closed waterproof containers, and fly ash that has been partially caked or set shall not be used. A certification indicating compliance to these specifications shall be provided with the scale ticket for each load delivered. The certification shall be signed by the fly ash producer or his assigned representative.

**Portland Cement:** Portland Cement treated base shall comply with the Fly Ash section above, except the type of Portland Cement and quantity of Portland Cement shall be as recommended by a

Professional Engineer Registered in the State of Kansas. The minimum quantity of Portland Cement shall be five (5) percent unless otherwise approved by the City Engineer.

## 1209 CONSTRUCTION REQUIREMENTS.

- A. Preparation of Roadbed: The subgrade shall be trimmed as near as possible to finish subgrade elevations as shown on the approved plans. The subgrade may be trimmed to an elevation slightly below the proposed finished subgrade to allow for swell, depending on the soil characteristics.
- B. Equipment: The machinery, tools, and equipment necessary for proper execution of the work shall be mobilized and approved by the City Engineer prior to beginning of subgrade preparation. Pulverization of existing subgrade and blending the additives shall be accomplished using drum-rotary type tiller equipped with an adjustable water proportioning system. Initial compaction shall be achieved using a sheepsfoot compactor having a minimum operating weight of twelve (12) tons with a minimum centrifugal force of twenty-four (24) tons. Rubber-tired or smooth-wheeled rollers shall be used for final compaction of the stabilized section. All machinery, tools and equipment used shall be maintained in satisfactory and workmanlike manner.
- C. Application: The fly ash shall be spread in an approved manner at the rate specified. Care shall be taken to prevent the fly ash from flowing off the area to be treated. The fly ash shall be distributed at a uniform rate in such a manner as to minimize the scattering of fly ash by wind. Fly ash shall not be applied when wind conditions, in the opinion of the Engineer, are such that blowing fly ash becomes objectionable to adjacent property owners or significantly reduces the amount of fly ash incorporated into the work.
- D. Moisture Control: The required moisture content shall be established by the Contractor's testing agency based on laboratory tests on the materials and specific fly ash content to be used for the treatment. Water shall be introduced directly into the rotary mixing drum during the tilling procedure. Final moisture content of the mix immediately prior to compaction shall be uniform and not exceed plus or minus three (3) percentage points of the specified optimum moisture content. If the moisture content exceeds the specified limits, additional fly ash may be added to lower the moisture content at the expense of the Contractor. Lowering the moisture content by aeration following addition of fly ash shall not be allowed. If the moisture content is below the specified limits, additional water shall be added and uniformly blended with the mixture.
- E. Mixing: The pulverized subgrade material and fly ash shall be thoroughly mixed until a homogenous, friable mixture of pulverized subgrade material and fly ash meeting the specified size requirements is obtained. The subgrade material shall be pulverized through use of the specified equipment, to the depth designated on the approved plans. All clods shall be reduced in size by mixing until all particles pass through the 1" Sieve and fifty (50) percent of the particles pass through the one-half (1/2) inch sieve.
- F. Compaction: The subgrade shall be compacted immediately after mixing and confirmation that the moisture content is within the specified range. The specified compaction shall be obtained within one hour after the incorporation of the fly ash. The subgrade shall be sprinkled as necessary to maintain the specified moisture content. Compaction of the mixture shall continue until the entire depth of mixture is uniformly

compacted to the specified density.

All non-uniform (e.g., too wet, too dry or insufficiently treated) areas shall be corrected immediately by scarifying the areas affected, adding or removing material as required and reshaping and recompacting.

The stabilized section shall be compacted to a minimum of ninety-five (95) percent of the combined materials' maximum dry density.

In addition to the requirements specified for density, the subgrade shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed, the density and moisture content shall be verified by the testing agency. If the material fails to meet the density requirements, the City Engineer may require it be reworked as necessary to meet those requirements and/or require the Contractor to modify his construction methods. Additional fly ash shall be added to the areas that are reworked at no additional cost to the City, and the amount required shall be determined by the testing agency. Should the section, due to any reason or cause, lose the required stability, density and finish before the pavement is placed or the work is accepted, it shall be reprocessed, recompacted and refinished at the sole expense of the Contractor. Reprocessing shall follow the same patterns as the initial stabilization including the addition of fly ash.

- G. Finishing and Curing: Following the compaction of the stabilized, the subgrade shall be trimmed to the required lines and grade using equipment with automatic controls. The surface shall then be compacted with a smooth wheel or pneumatic tired roller.

The City Engineer may waive the use of automatic controlled equipment on projects containing narrow or irregular dimensions where operation of the automated equipment is impractical. Finishing of these areas may be as set forth above or the surface will be lightly scarified during finishing operations and bladed to a uniform grade and cross section to eliminate any imprints left by equipment.

Fly ash treated subgrade surfaces shall be protected against rapid drying by either of the following curing methods:

1. Maintain in a thorough and continuously moist condition by sprinkling.
2. Apply an asphaltic prime coat.

- H. Weather Limitations: Fly ash mixing operations shall not be performed when the ambient air temperature or soil temperature is less than 40°F. The Contractor shall be responsible for protection and quality of the fly ash modified subgrade mixture under any weather conditions.

- I. Proofrolling: Proof rolling with a loaded tandem dump truck carrying a minimum load of sixteen (16) tons shall be required before acceptance of finish subgrade. Subgrade failures shall be repaired by incorporating additional flyash into the subgrade, unless otherwise approved by the City Engineer.

**1210 AB-3 MODIFIED AGGREGATE BASE.** AB-3 Modified Aggregate Base may be used with City Engineer approval. The AB-3 Modified Aggregate Base shall be supplied in accordance with

Section 1104 of the *Kansas Department of Transportation Standard Specifications for Road and Bridge Construction*, except as otherwise modified herein:

Paragraph 1104.2 (a): Composition shall be modified so that the AB-3 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 the AB-3 Modified shall have the gradation shown on line AB-3; however, the plasticity index shall be between 0 and 5 with the liquid limit a maximum of 25.

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

**1211 PAVEMENT WIDENING AND CONFINED AREAS.** Commercial Grade Aggregate Base shall be utilized for all pavement widening projects less than or equal to fifteen (15) feet in width, pavement projects which are less than 5,000 square feet or as directed by the City Engineer. The thickness of the aggregate base shall be as recommended by the Design Engineer; however, the minimum thickness shall be six (6) inches.

During construction, the maximum drop off at the edge of pavement shall be four (4) inches. Any drop off exceeding four (4) inches shall be wedged at a slope of 3:1 using Commercial Grade Aggregate Base or asphalt as directed by the City Engineer. The subgrade and asphalt under the proposed curb and gutter, where applicable, shall be constructed and approved prior to removing the existing curb and gutter for pavement widening projects. All traffic control measures and drop off treatments shall conform to Table 1212-1.



**Table 1212-1 - Pavement Drop Off Treatment**

| <b>Condition</b>   | <b>Treatment</b>  |
|--|---|
| Drop off is 2 inches or less and the adjacent area is not an open driving lane | None  |
| Drop off is 2 inches or less and the adjacent area is an open driving lane     | 36"x36" W8-11 Uneven Lane signs shall be installed at the point of beginning with a maximum spacing of 1,000 feet   |
| Drop off is between 2 and 4 inches   | Shoulder Drop Off Signs (W8-9A and W7-3A) shall be installed at the beginning of the condition and at each intersecting roadway. Signs shall be removed or covered when not applicable. Install channelizers along the edge of pavement with spacing equal to the posted speed limit. |
| Drop off is greater than 4 inches  | Construct a Modified AB-3 wedge and install channelizers along the edge of pavement with spacing equal to or less than the posted speed limit.  |

## **SECTION 1300 – ASPHALT -KCMMB**

**1301 SCOPE.** This section discusses asphaltic concrete pavement requirements for roadways, residential roadways, multipurpose pathways, parking areas, and other areas intended for use in City of Gardner, unless otherwise approved by the City Engineer.

**1302 GENERAL.** Division 600 of the latest edition of the Kansas Department of Transportation *Standard Specifications for State Road and Bridge Construction* shall govern asphaltic concrete pavement requirements except as otherwise modified herein. The Contractor shall be responsible for all costs incurred for the asphaltic concrete mix design, material, delivery, placement, and testing, unless otherwise specified by the City Engineer.

If the project site has not been stabilized with seed and mulch prior to paving operations, erosion control devices including silt fence, wattles, or mulch berms shall be installed at the back of the curb and gutter or at the right-of-way in areas where the devices are needed to effectively control erosion and sedimentation. Erosion control devices in these locations must be installed before paving operations will be permitted. The devices shall be installed immediately after the curb has been backfilled. An exception will be granted when one or more lifts of base asphalt need to be placed before the curb and gutter can be placed. The placement of subsequent lifts of asphalt will not be permitted until the curb is backfilled and erosion control devices are in place.

Paving will not be permitted until the compressive strength of the concrete used for curb and gutter construction has reached seventy-five (75) percent of its design strength unless otherwise approved by the City Engineer.

Pavement shall be constructed to the lines, grades, dimensions, and details contained herein or as shown on the plans.

**1303 MATERIALS.** Asphalt shall conform to the standards and specifications established by the Kansas City Metro Materials Board (KCMMB). If KCMMB asphalt is not available, the City Engineer must approve the mix design.

**1304 MIX DESIGNS.** The Contractor shall submit a KCMMB approved mix design to the City Engineer for review and approval before any asphalt is scheduled for placement.

**1305 DELIVERY.**  
**Release Agent**

The use of diesel fuel as a release agent in the bed of haul trucks is strictly prohibited. The release agent shall be a compound specifically designed to allow the asphaltic concrete mix to be dumped from the haul trucks, but shall in no way change or modify the properties of the asphalt cement binder. The Contractor shall submit to the City Engineer a specification of the release agent to be used for this purpose. It shall be the responsibility of the Contractor to inform all drivers hauling the asphalt mix of this requirement.

### **Transportation of Mix**

All haul trucks providing asphalt mix to the project site shall utilize load covers of sufficient size and weight to completely cover the truck bed protecting the upper surface of the asphalt from cooling. Failure to have the load completely covered shall be sufficient cause for rejection of the entire load. The load shall remain covered until the truck is next in line to be unloaded, but in no case shall the load remain uncovered for more than ten minutes before unloading begins. If for any reason there is a delay in unloading, the remaining part of the load shall be recovered until unloading resumes. It shall be the responsibility of the Contractor to inform all drivers hauling the asphalt mix of these procedures prior to starting the work. All bituminous mixtures shall be mixed and then delivered to the project within the mixing and compaction temperature ranges reported on the accepted mix design. Asphalt mixtures having a temperature less than 235°F when dumped into the mechanical spreader will be rejected. The Contractor shall provide a sufficient number of haul vehicles of the proper size, speed, and condition to ensure an orderly and continuous placement operation. The Contractor shall schedule and route his hauling operation to minimize hauling over newly paved areas.

## **1306 EQUIPMENT.**

### **Mechanical Paving Machines**

Bituminous-material spreaders shall be the self-propelled type equipped with hoppers, tamping, or vibrating devices, distributing screws (augers), adjustable screeds operated either manually or automatically, and 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. The spreader shall be required place 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 one hundred (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. When the Contractor chooses to pave lanes through the project wider than twelve (12) feet, the paver shall be equipped with auger extensions.

### **Steel-Wheel Rollers**

Steel-wheel (drum) rollers shall be self-propelled, two-axle tandem, vibratory type, weighing not less than 20,000 pounds static weight and not less than 150 pounds per inch of wheel. Wheels shall be equipped with adjustable scrapers, water tanks, and sprinkling apparatus for keeping the wheels wet, thereby preventing the bituminous mixture from sticking to the wheels. Rollers shall be capable of reversing direction without backlash. The Contractor shall be responsible to maintain the equipment in a satisfactory condition. Roller wheels with flat and pitted areas or projections that leave marks in the pavement shall not be permitted. A minimum of two (2) steel-wheel rollers (one breakdown and one finish) shall be required with each paving operation.

### **Heavy Pneumatic-Tired Rollers**

Heavy pneumatic rubber-tired rollers shall be self-propelled and shall consist of two (2) axles on which are mounted an odd number of pneumatic rubber-tired wheels. The roller shall have at

least nine (9) pneumatic rubber-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 inflated to ninety (90) psi. The surface of the tires shall remain smooth. Construction of the roller shall be such that each wheel can be loaded to a minimum of 1043 kg (2,300 pounds). A pneumatic rubber-tired roller shall be required with each paving operation.

## **1307 PREPARATION.**

### **Subgrade**

Subgrade preparation for pavement shall be as specified in Section 1200. The Contractor must receive the approval of the City Engineer before covering the subgrade with any pavement.

### **Road Surface Preparation**

When the bituminous mixture is placed on an existing bituminous surface, Section 614.3 (b) (3) of KDOT's *Standard Specifications for State Road and Bridge Construction* shall apply, except that 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. Blowers and brooms shall be power type and suitable for cleaning the surface to be paved.

Equipment compliance with this specification shall be visual observation by the City Engineer at the commencement of washing operations. No direct payment shall be made for this item as it shall be considered subsidiary to other bid items.

### **Tack Coat**

Emulsified Asphalt CSS-1h shall be used for the tack coat. All existing asphaltic concrete surfaces shall receive a tack coat not more than six (6) hours prior to placement of the asphaltic concrete. Surfaces previously tack coated and not covered with new asphaltic concrete for more than six (6) hours shall be re-tacked. 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 ten (10) percent with water versus the normal fifty (50) percent dilution with water. Tack coat shall not be paid for directly but shall be considered subsidiary to other bid items.

The spray nozzles and spray bar on the distributor truck shall be so adjusted and frequently checked that uniform distribution is ensured. The distribution shall cease immediately upon any clogging or interference of any nozzle and corrective measures taken before distribution is resumed. Hand sprays shall be used in tacking small patches or inaccessible areas that have been missed by the distributor.

The asphalt tack shall be entirely fogged over the base course and therefore requires no sand blot. If, however, it has not been uniformly distributed, sufficient sand shall be spread over the surface to blot up the excess asphalt and prevent it from adhering to construction equipment and vehicles. Prior to laying an intermediate or surface course, all loose or excess sand shall be swept from the base.

The Contractor shall maintain the tack coat treatment and the surface of the sub-base intact until it has been covered by the surface course. Areas that have been damaged by traffic shall be repaired and shall receive applications of tack coat material in compliance with these specifications. The maintenance and repair of the tack coat shall be done at the Contractor's expense. The Contractor shall be responsible for the cost of any clean-up that becomes necessary due to his operations.

## **1308 PLACEMENT.**

### **Placing Requirements**

The Contractor shall receive the approval of the City Engineer before placing any asphaltic concrete pavement.

Asphaltic concrete shall be placed in compacted lifts to the depths as indicated on the contract drawings. The maximum lift thickness of compacted asphalt shall not exceed four (4) inches for base courses and two (2) inches for surface courses. A minimum of two (2) leveling courses shall be placed for asphalt pavements with a total thickness of ten (10) inches or greater. A minimum of one (1) leveling course shall be placed for asphalt pavements with a total thickness of less than ten (10) inches. 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.

All mixed material shall be delivered to the paver in time to permit completion of spreading, finishing, and compaction of the mixture during the daylight hours. Night time work on projects will not be permitted unless approved by the City Engineer.

### **Preventing Material Segregation**

The wings of the spreader hopper shall not be emptied between truck loads. The screed auger shall be operated approximately three-fourths (3/4) full and the hopper conveyor shall not be allowed to run out of material during the paving operation. The augers should be running automatically and the vibrating screed should be turned on. The hopper conveyor shall always have approximately six (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 segregation. The Contractor shall be responsible for the repair or replacement of segregated areas occurring in the asphaltic pavement. The repair or replacement shall be as directed by the City Engineer.

### **Pavement Joints**

Header joints between old and new pavements, between successive day's work, and joints that have become cold because of delay, shall be vertically sawed and tacked. The pavement joints shall be carefully constructed to insure continuous bond between old and new sections of the pavement 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 one (1) inch to two (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 by the City Engineer. 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 Section 1307. 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.

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

### **Transverse Joints**

The roller shall pass over the unprotected end of freshly placed mixture only when placement 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 for the full thickness of the course. When paving continues, 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.

### **Offsetting Joints**

The surface course shall be placed such that longitudinal joints of the surface course will not coincide with joints in the underlying course by approximately nine (9) inches. Care shall be taken to offset longitudinal joints in a manner that the final surface course joint is in the correct location. Transverse joints in the surface course shall be offset by at least two (2) feet from transverse joints in the underlying course.

### **Special Requirements for Placing Adjacent Pavement Lanes**

The Contractor shall be responsible to determine the width of paving lanes ensuring acceptable joint locations prior to beginning the paving operation. A pre-pave coordination meeting will be held to discuss the proposed joint locations and their relationship to any pavement markings that will be placed. Longitudinal pavement joints shall be located so they are no closer than four (4) inches from the nearest edge of lane markings and no further than eight (8) inches from the nearest edge of the markings unless otherwise approved by the City Engineer. **The Contractor shall be responsible for locating pavement joints outside of areas where vehicle tires will travel.** The Contractor shall be required to suspend paving operations and make any necessary repair including pavement removal if he has failed to locate the pavement joint in the correct location.

In placing each succeeding pavement lane after the initial lane has been spread and compacted as specified, the screed end gate of the mechanical spreader shall overlap the previously placed lane slightly and shall be approximately 1.25 times thicker than the existing compacted lane to allow for satisfactory compaction roll down producing a smooth compacted joint with the specified density. Mixture placed on the edge of the previously placed lane by the paver screed shall be pushed back 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 strip should be approximately equal to the thickness being allowed for roll down during compaction. These procedures shall be used to facilitate a smooth joint with density. Excess mixture shall be removed and wasted. In no case shall the Contractor waste excess material by broadcasting it over the uncompacted mat.

### **Compaction of Mixture**

The Contractor is responsible for the development of a compaction procedure that meets the density requirements specified. Failure to meet the required density shall be cause for rejection. Replacement of the material shall be at the Contractor's expense. 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 (2) steel-wheel rollers and one (1) pneumatic rubber-tired roller as specified above with a qualified operator for each roller. Combination rollers may be approved by the city engineer.

The speed of the 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-wheel rollers and plates of vibrating plate compactors shall be moistened to prevent adhesion of the mixture to the wheels or plates, but excess water shall not be permitted. Tires of heavy pneumatic rollers 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 minimum number of rollers shall be adequate to obtain the specified density. Places inaccessible to rollers shall be thoroughly compacted with hot hand-tampers or vibrating plate compactors.

Rollers shall not travel faster than three (3) mph. Steel-wheeled rollers shall not be used in the vibratory mode except for initial breakdown rolling. Rolling shall continue until the required density has been achieved.

The following information provides general guidelines for acceptable rolling procedures but may vary from the specific procedure developed by the Contractor:

Breakdown rolling- Breakdown rolling shall be as close behind the paver as possible. The breakdown roller shall be a steel-wheeled vibratory roller. The vibratory mode shall be used on the first forward pass and may be used in subsequent passes either forward or back. The vibratory mode should be set at maximum frequency and minimum amplitude. 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 shall be broken down last. Delays in rolling freshly spread mixture shall not be permitted.

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. The breakdown roller in the vibratory mode shall lap over the joint approximately six (6) inches onto the previously placed and compacted lane. The pneumatic rubber-tired roller shall make at least one (1) complete pass (forward and backward) operated on the hot lane with the four-wheeled axle forward and the front outside tire as close as possible to the previously placed lane. After the pneumatic rubber-tired roller rolls the joint, it shall make at least one (1) pass over the rest of the mat and then drop back to its intermediate rolling. The steel-wheeled roller in static mode shall immediately smooth out the pneumatic rubber-tired roller marks.

Intermediate rolling- The pneumatic rubber-tired roller shall be used as an intermediate roller; however, it shall also roll closely behind the breakdown roller. The pneumatic rubber-tired roller shall always be kept moving in order to keep its tires warm. The rubber-tired roller shall roll the same pattern as the breakdown roller. The rubber-tire roller should stay the thickness of the lift away from the free edge of the pavement.

Finish rolling- The second steel-wheel roller shall be used as a final finish roller. Finish rolling shall start when the mat has cooled down 20° to 40° below the intermediate rolling

(approximately 225°F plus or minus). The steel-wheel roller in static mode shall immediately smooth out the rubber-tire roller marks using the same pattern making the same coverage as the breakdown roller. Finish rolling should be completed by the time the asphalt cools to 150°F.

- 1309 TESTING.** A rolling pattern shall be established for testing asphalt on service and arterial streets. Refer to Section 8005 for all other asphalt testing.
- 1310 WEATHER LIMITATIONS.** Hot-mix asphalt paving shall be placed when the ambient temperature is 40°F and rising for base pavements and 50°F and rising for surface pavements. Hot-mix asphalt paving shall not be placed when there is frost in the subgrade or at any other time when weather conditions are unsuitable for the type of material being placed without the expressed consent of the engineer. When the ambient temperature falls below 55°F, precautions shall be taken to compact the mix before it cools too much to obtain the required density. In no case shall successive lifts of asphalt be placed until the previous lift has cooled to 150°F or less.
- 1311 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. Testing for plan grade conformance and surface smoothness shall be performed by the Contractor in the presence of a representative of the City Engineer. The Contractor shall be required to perform profilograph measuring of the pavement smoothness, at his expense, if so directed by the City Engineer. Low or defective areas shall be immediately corrected by cutting out the faulty areas, replacing them with fresh hot mixture and compacting the areas to conform to the remainder of the pavement. The Contractor may be allowed to perform diamond grinding as an alternative repair method when approved by the City Engineer.
- 1312 PROTECTION.** The Contractor shall protect all sections of newly compacted base and surface courses from traffic until they have properly cooled, or as directed by the City Engineer. The Contractor shall be responsible for the repair or replacement of any asphalt surface that has been damaged.



## **SECTION 1400 - PORTLAND CEMENT CONCRETE PAVEMENT**

**1401** **SCOPE.** This section governs the furnishing of all labor, equipment, tools, and materials and the performance of all work necessary to construct Portland Cement Concrete Pavement.

**1402** **MATERIALS.** Except as modified herein, all materials used for construction of Portland Cement Concrete Pavement shall conform to the requirements stipulated in applicable sections of this Technical Specification for Public Improvement Projects of the City of Gardner.

a. **Concrete.** The concrete for the use in Portland cement concrete pavement shall be classified as KCMMB-4K and mix designs shall be approved by the Kansas City Metro Materials Board prior to use.

b. **Reinforcing Steel.**

Bars: Bars shall be Grade 60 conforming to ASTM A615 and A996.

Welded Steel Wire Fabric: Fabric shall conform to ASTM A185.

Supporting Elements: Representative samples of supporting elements shall be approved by the City Engineer prior to their use in the project.

c. **Epoxy Coating.** All reinforcing shall be epoxy coated unless specifically waived by the approved plans. Epoxy coating for bars and dowel bars shall conform to ASTM A775 or ASTM A934. Epoxy coating for welded steel wire fabric shall conform to ASTM A884, Type 1, with Class A coating thickness.

d. **Expansion Joint Fillers.** Expansion joints shall be formed with pre-formed non-extruding, resilient expansion joint filler which shall include the following: cork, self-expanding cork, sponge rubber, cork rubber and bituminous fiber. These materials shall meet the requirements of ASTM D994, D1751 or D1752.

e. **Joint Sealing Compound.** Joint sealing compounds shall conform to ASTM D3405

f. **Curing Membrane.** Portland cement concrete curing material must be approved by the City Engineer prior to application. The cure shall be Type 2, white-pigmented liquid membrane type and shall conform to AASHTO M 148.

**1403** **CONSTRUCTION DETAILS.** Portland cement concrete pavement shall be constructed to the configuration, and to the lines and grades shown on the approved plans and Standard Details.

A. **Grading and Subgrade Preparation.** All excavation or embankment required shall be as defined in these Technical Specifications.

B. **Forms.** All forms shall be in good condition, clean, and free from defects. Each form shall not vary more than 1/4 inch in horizontal and vertical alignment for each ten (10) feet 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.
3. 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.
4. 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.
5. Paving Machine. A slip-form paving machine may be used in lieu of forms. The machine must be equipped with mechanical internal vibrators, and be capable of placing the Portland cement concrete pavement to the correct cross-section, thickness, line and grade within the allowable tolerances.

**1404 JOINTS.** Joints shall be formed at right angles to the alignment of the pavement and to the depths and configuration specified by the Standard Details or as modified by the approved plans, unless otherwise approved by the City Engineer.

A. Expansion Joints. Expansion joints shall be placed at all locations where shown on the approved plans and Standard Details or as directed by the City Engineer.

1. General. Expansion joints shall extend the entire width of the pavement and from the sub-grade to one inch below the surface of the pavement. Expansion joints shall be formed by one (1) piece of one (1) inch thick preformed joint filler.

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

2. 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.
3. Dowels. If expansion joints are to be equipped with dowels they shall be of the size and type specified, and shall be firmly supported in place by means of a dowel basket which shall be installed in such a position that the center line of the joint assembly is perpendicular to the center line of the slab and the dowels lie parallel to the slab surface and parallel the center line of the slab. One half of each dowel shall be painted in accordance with the directions shown on the Plans, and then thoroughly coated with hard grease, or an approved bond breaker, to prevent the concrete from bonding to that portion of the dowel. As an option, a dowel sleeve of the dimensions shown on the plans or standard drawings may be used in lieu of grease.

B. Contraction Joints. Longitudinal and transverse contraction joints shall be of the type, dimensions, and spacing shown on the approved plans or Standard Details. Contraction joints shall be cut by means of wet sawing with an approved concrete saw.

All joints shall be sawed during the initial curing period. The Contractor shall appropriately schedule sawing operations to prevent both joint raveling and uncontrolled cracking of the pavement. Material created by sawing shall be removed from the pavement before it has had time to dry or set.

The Contractor shall remove and replace any concrete that has uncontrolled cracking at his expense.

- C. Longitudinal and Construction Joints. Longitudinal and transverse construction joints shall be placed as shown on the approved plans or as required by the Contractor's construction procedure. Joint configuration shall conform to the dimensions shown on the approved plans or Standard Details.
1. Longitudinal Construction Joints. Longitudinal construction joints of the type shown on the approved plans and Standard Details shall be placed between adjacent paving lanes or where the curb and gutter is not poured monolithically with the pavement slab.
  2. Transverse Construction Joints. Transverse construction joints of the type shown on the approved plans and Standard Details shall be located where concrete placement operations are suspended for more than thirty (30) minutes or until the concrete has begun set. No construction joint shall be placed within ten (10) feet of an expansion, contraction, or other construction joint.
  3. Tiebars. Tiebars shall be of deformed steel of the dimensions specified by the approved plans and Standard Details. Tiebars shall be supported in the proper position and at the specified spacing and be firmly secured so as not to be disturbed by the construction procedure. They shall be free from dirt, oil, paint, grease, loose mill scale, and thick rust which could impair bond of the steel with the concrete. Tiebars shall be epoxy coated.

**1405 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 these Technical Specifications and as specified herein.

- A. Concrete Placement. Prior to placement of the concrete pavement, all debris and foreign material shall be removed from the inner surfaces of the forms, and all forms and subgrade properly moistened. All required reinforcement and other special metal parts shall be properly and firmly set into position to restrict movement during placement operations. No concrete shall be placed without the approval of the City Engineer.

The concrete shall be placed between the forms in such a manner that segregation will not occur. Lateral displacement of the concrete will not be permitted. The concrete shall be poured to the required depth and width in successive batches and in a continuous operation without the use of intermediate forms or bulkheads.

The concrete shall be thoroughly vibrated along the forms, expansion joints and longitudinal joints. The vibrator shall not be allowed to contact the subgrade or dislodge the joints. Attachments on finishing machines to vibrate the concrete adjacent to forms and

longitudinal joints will be permitted, provided satisfactory results are attained. The vibrating shall be sufficient to produce a smooth pavement edge but shall not cause segregation. Honeycomb in the pavement may be cause for rejection of the pavement.

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 adjusted to the required grade, alignment, and cross slope. All utility appurtenances shall be boxed out and isolated using expansion joint material. The minimum size of a boxed-out section shall be two (2) feet by two (2) feet.

Concrete shall not be allowed to extrude below the forms.

- B. Concrete Finishing. The pavement shall be struck off and consolidated with a mechanical finishing machine or by hand-finishing methods.

When a mechanical finishing machine is used, a depth of at least two (2) inches of concrete shall be carried in front of the strike-off screed for the full width of the slab. The finishing machine shall be provided with a screed which will consolidate the concrete by pressure. The concrete shall, through the use of this machine, be brought to a true and even surface, free from rock pockets, with minimal passes of the machine. The edge of the screed along the curb line may be notched out to allow for sufficient concrete to form the integral curb. Hand- finishing tools shall be kept available in the event the finishing machine becomes inoperable.

When hand finishing is used, the pavement shall be struck off and consolidated by a vibrating screed to the lines and grades shown on the plans. When the forward motion of the vibrating screed is stopped, the vibrator shall be shut off and shall not be allowed to idle on the concrete. Internal mechanical vibration shall be used along all formed surfaces.

1. Longitudinal Floating. After the concrete has been struck off and consolidated, it shall be further smoothed smoothed by means of a mechanical longitudinal float or by a longitudinal hand float. If a longitudinal hand float is used, it shall be operated from foot bridges spanning the pavement and shall be worked with a wiping motion parallel to the centerline, and passing from one side of the pavement to the other. Movement ahead along the centerline of the pavement shall be in successive advances of not more than 1/2 of the length of the float. The float shall not be less than twelve (12) feet in length and six (6) inches in width, and shall be properly stiffened and provided with handles at each end. Excess water and laitance shall be removed from the surface of the pavement. This operation may be eliminated if specified tolerances can be attained by other approved methods.

Additional water shall not be used to aid in the floating operation, unless otherwise approved by the City Engineer.

2. Straight edging. While the concrete is still plastic, the slab surface shall be tested for smoothness with a 10-foot straight edge swung from handles three (3) feet longer than one-half the width of the slab. The straight edge shall be placed on the surface

parallel to the centerline of the pavement and at not more than five (5) foot intervals transversely. After each test, the straight edge shall be moved forward one-half its length and the operation repeated. Irregularities shall be corrected by adding or removing concrete. All disturbed places shall be smoothed with a float not less than three (3) feet long and not less than six (6) inches wide. The smoothness of the repaired surface shall be verified with a ten-foot straight edge. The final pavement surface shall be free of depressions in which water will stand.

3. Edging. Before final finishing is completed and before the concrete has taken its initial set, the edges of the slab and curb shall be carefully finished with an edger of the radius shown on the approved plans or Standard Details.
4. Final Surface Finish. The final surface finish shall be either grooved or broomed as directed by the City Engineer. A burlap drag shall be utilized ahead of the grooving operation. The drag shall be at least three (3) feet in length and wide enough to cover the entire lane of pavement, and shall be kept clean and saturated while in use. It shall be laid on the surface of the pavement and dragged in the direction in which the pavement is being poured. The grooving operation shall be done in a neat and uniform manner. A hard bristle broom shall be used for broom finishing. The broom shall be kept clean and shall provide a uniformly textured surface. The direction of the grooving or brooming operation, either transverse or longitudinal, shall be determined by the City Engineer. The curb shall have a broomed finish.

The final surface of the concrete pavement and curb shall have a uniform gritty texture free from excessive harshness and true to the grades and cross section shown on the plans. The City Engineer may require changes in the final finished procedure as required to produce the desired final surface texture,

- C. Curing. Curing shall conform to the requirements set forth in Section 2000 with the exception that water proof paper, or polyethylene sheeting, shall not be acceptable as curing methods for concrete pavement. The use of straw or burlap for curing shall be as approved by the City Engineer.

The concrete shall be cured prior to taking set. If a liquid curing membrane is used, it shall be applied according to the manufacturer's directions, except the rate of application will be at least one (1) gallon per one hundred and fifty (150) square feet. A nozzle producing a uniform mist pattern shall be used on all spray equipment when applying the liquid curing membrane.

All exposed surfaces shall be cured if a slip form paving machine is used or if the forms are removed from hand poured concrete pavement within a period of seventy-two (72) hours.

- D. Protection. The Contractor shall, at his own expense, protect the concrete work against damage or defacement until the project has been accepted by the City Engineer. Concrete pavement which 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.

All vehicular traffic shall be prohibited from using the new concrete pavement until the proper strength has been achieved. The concrete pavement shall not be opened for light traffic for

a period of not less than seventy-two (72) hours after placement, and the after concrete has attained a minimum compressive strength of 3,000 psi and 75% of the mix design strength. The pavement shall not be fully opened to traffic for a period of not less than one hundred and twenty (120) hours, and after the concrete has attained a minimum compressive strength of 3,500 psi and 80% of the mix design strength. If high early strength concrete is used, the pavement may be opened to all types of traffic when the concrete has attained a compressive strength of 3,500 psi and 80% of the mix design strength.

E. Temperature Limitation. Concrete work shall proceed in accordance with the requirements established in Section 2000-*Concrete*.

**1406 BACKFILL.** A minimum of twenty-four (24) hours shall lapse before forms are removed and five (5) days shall lapse before pavement is backfilled, unless otherwise approved by the City Engineer.

Backfill shall be placed and compacted in accordance with these Technical Specifications.

The Contractor shall be responsible for repairing any damage to the existing pavement to the satisfaction of the City Engineer.

**1407 JOINT SEALING AND CLEANUP.** All joints shall be sealed with an approved joint sealer applied in accordance with the manufacturer's directions and the City of Gardner Technical Specifications and Design Criteria for Public Improvement Projects. The joints shall be sealed within seven (7) days of the placement of the concrete and prior to the opening of the pavement to traffic.

The joints shall be thoroughly cleaned by sand-blasting the dry joint in two (2) passes, one for each face prior to the placing of the joint material. Any residual sand, as well as dust and dirt deposited by wind and traffic, shall be blown out of the joint and away from the adjacent pavement using a high-pressure air blast prior to placing the joint material.

**1408 CONCRETE CURB.** Concrete curb will be constructed in accordance with these Technical Specifications and as shown on the approved plans, unless otherwise approved by the City Engineer. The options available for concrete curb are as listed below and detailed in Standard Details.

A. Integral curb Integral curb shall be constructed immediately following the finishing operation unless otherwise shown on the approved plans. The curb construction shall not lag the pavement construction and form a "cold joint."

Steel curb forms shall be required to form the backs of all curbs, unless otherwise approved by the City Engineer.

The concrete shall be sufficiently spaded to secure adequate bond with the paving slab and eliminate all voids in the curb.

Curbs shall be constructed to the specified cross section as shown on the Standard Details.

The finished surface of the curb and gutter shall be checked by the use of a 10-foot

straightedge and corrected if necessary. Where proposed grades are less than one (1) percent, and while the concrete is still plastic, the slope of the gutter should be checked with a 4-foot level.

- B. Separate Curb and Gutter with Tiebars. Separate curb and gutter may be poured prior to pouring the remaining pavement. Tiebars 5/8 inches (5/8”) in diameter and 24 inches (24”) long shall be cast in the curb and gutter at 30-inch centers as shown on the Standard Details. Tiebars shall be epoxy coated.
- C. Separate Curb and Gutter with Keyway. Separate curb and gutter may be placed prior to placing the remaining pavement using a keyway. A keyway of the configuration and dimensions shown on the Standard Details shall be cast in the curb and gutter section.

**1409** CLEANUP. The Contractor shall be responsible for the removal of excess dirt, rock, broken concrete, concrete splatters, and overspray from the construction area.

**1410** SURFACE TOLERANCES. Concrete pavement shall have a surface tolerance in all directions of 1/8 inch in twelve (12) feet when checked with a 12-foot straightedge. The Contractor shall be required to perform profilograph measuring of the pavement smoothness, at his expense, if so directed by the City Engineer.

**1411** THICKNESS TOLERANCES. The thickness of the pavement section shall conform to the pavement thickness specified. The thickness of the pavement shall be measured by coring. Where pavement thickness is deficient, compensation may be made at an adjusted unit price approved by the City Engineer, or the pavement shall be removed and replaced at the expense of the Contractor.

Unless specified otherwise, thickness coring shall be performed by an approved materials testing service at the expense of the Contractor. The cores shall be a minimum of two (2) inches in diameter and shall be taken at random locations within each lane of pavement as approved by the City Engineer. A minimum of one (1) core per every 1,000 feet of lane width shall be taken. The stagger spacing between initial cores in adjacent lanes shall be a minimum of 100 feet.

The transverse limits of pavement removal shall be from the outside edge of the curb and gutter (curb and gutter with tie bars or keyway may remain if in good condition) to a longitudinal joint. The longitudinal pavement removal limits shall extend beyond each side of the deficient core sample to a point where no portion of the exposed pavement is more than 0.2 inch deficient. In no case shall less than five (5) linear feet of pavement be removed, and if less than ten (10) feet of acceptable pavement remains between the section that has been removed and a transverse contraction, expansion, or construction joint, the Contractor shall remove the pavement to the joint.

## **SECTION 2000 - CONCRETE**

**2001 SCOPE.** This section covers all cast-in-place concrete, including reinforcing steel, forms, finishing, curing, and other appurtenant work. The requirements of this section shall also apply to pre-cast structures intended for use in City of Gardner, unless otherwise approved by the City Engineer.

**2002 GENERAL.** Concrete shall conform to the standards and specifications established by the Kansas City Metro Materials Board (KCMMB). If KCMMB concrete is not available, Kansas Department of Transportation (KDOT) concrete designated Grade 3.0 AE and/or Grade 4.0 AE shall be used. Prior to opening any concrete construction to light traffic, the concrete shall achieve a minimum of 75% of the mix design strength. Concrete construction shall achieve 80% of the mix design strength prior to opening to full traffic.

**2003 MATERIALS.** All material used in the manufacture of concrete shall conform to the following:

**KCMMB Concrete Mixes:** All materials proposed for use in KCMMB approved concrete mixes shall be approved by KCMMB prior to use.

**KDOT Grade 3.0 AE and Grade 4.0 AE Concrete:** Materials used for KDOT Grade 3.0 and Grade 4.0 concrete shall conform to the requirements of Sections 400, 1100, 1400, 2000, and 2400 of the *Standard Specifications for State Road and Bridge Construction* (latest edition), except as modified herein.

Cement: KDOT Specification 2001.2b. Type I, II, and III Portland cements conforming to AASHTO M 85 with exceptions.

Water: KDOT Specification 2401.

Fine Aggregate: KDOT Specification 1102.2c. Type FA-A, except that artificial or manufactured sand will not be acceptable.

Coarse Aggregate: KDOT Specification 1102.2a. Certification by an independent testing laboratory that the aggregates used were obtained from an approved source and identifying the name and location of the quarry and bed number shall be filed, at the Contractor's expense, with the City Engineer.

Curing Membrane: Type 2-White Pigmented compound, AASHTO Designation M148.

Air-Entrained Agent: AASHTO M 154

Admixtures: ASTM C494, ASTM C1017 for plasticizing admixtures

Reinforcing Steel: ASTM A615: Bars, Grade 60, Beam stirrups & column ties, Grade 40

Welded Wire Fabric: ASTM A185, and AASHTO Designation M 55



## 2004 MIX DESIGNS.

**KCMMB Mixes:** The Contractor shall submit a KCMMB approved mix design to the City Engineer for review and approval before any concrete is scheduled for placement. Mix designs shall be submitted for each combination of materials and differing proportions of mixes and water/cement ratios. Admixtures for water reduction, set acceleration or set retardation may be shown as optional provided the mix design shows the allowable application rates or dosages for each optional admixture. Mix designs should include strength, proportions of all materials, gradations of all aggregates, unit weight at the design air content, slump and allowable slump range.

The design water/cement ratio shall not exceed 0.44. The minimum water/cement ratio shall be 0.25.

Air entrainment shall meet the requirements set forth in the current ASTM C260 specifications. The field measured percentage of air content by volume shall be 6.5% plus or minus 1.5%. All concrete mixes shall be designed for 6.5% air entrainment.

**KDOT Grade 3.0 AE and Grade 4.0 AE Mixes:** The Contractor shall submit a mix design to the City Engineer for approval before any concrete is scheduled for placement. The mix design shall include data on proposed use, design strength, concrete mix proportions, maximum water/cement ratio, slump range, percentage of air entrainment, chemical admixtures and the fine and coarse aggregate gradation. Mix designs shall be submitted for each combination of materials and differing proportions of mixes and water/cement ratios. Adjustments made to an approved mix design shall require approval by the City Engineer. Failure to obtain mix design approval by the City Engineer prior to concrete placement may be cause for removal of the concrete at the Contractor's expense.

**2005 CONCRETE MIX DESIGNATIONS.** Table 2005-1 illustrates the concrete mix design requirements for each type of construction project. The concrete mix design requirement for project types not listed in the table shall be approved by the City Engineer. KCMMB approved high-early strength concrete mixes may be used when approved by the City Engineer. The Contractor shall be required to submit the high early strength concrete mix design to the City Engineer for approval prior to concrete placement.

**Table 2005-1 - Mix Design Requirement per Project Type**

| Type of Project                                    | KCMMB 4K | KDOT Grade 4.0 AE | KDOT Grade 3.0 AE |
|--|----------|-------------------|-------------------|
| Sidewalks  | ✓        |                   |                   |
| Curb and Gutter                                    | ✓        |                   |                   |
| Gutter Section of Drive Approaches                 | ✓        |                   |                   |
| Driveway Approaches                                | ✓        |                   |                   |
| Concrete Encasement                                | ✓        |                   |                   |
| Integral Sidewalks and Retaining Walls             | ✓        |                   |                   |
| Storm Sewer Structures                             |          | ✓                 |                   |
| Curb and Area Inlet Tops                           | ✓        |                   |                   |
| Sanitary Sewer Manholes                            |          | ✓                 |                   |
| Sanitary Sewer Flowable Fill                       | ✓        |                   |                   |
| Inverts, Aprons and Collars                        |          |                   | ✓                 |
| Concrete Pavement                                  | ✓        |                   |                   |
| Traffic Signal Pole Bases & Controller Foundations | ✓        | ✓                 |                   |
| Street Light Pole Bases & Controller Foundations   | ✓        | ✓                 |                   |

**2006 LIMITING REQUIREMENTS.** All concrete shall be within the allowable slump range shown on the approved mix design. In no case shall the water/cement ratio of concrete delivered to the site exceed the water/cement ratio shown on the approved mix design. Concrete with a water/cement ratio exceeding the design water/cement ratio will be rejected.

The Contractor must receive approval from the City Engineer before utilizing optional admixtures in the KCMMB approved mix design. The admixtures must be within the dosage limits specified. A revised slump range will be required if the addition of the admixture causes the slump to fall outside of the range shown on the original approved mix design. Admixtures not shown in the approved mix designs for KDOT Grade 3.0 and Grade 4.0 will not be allowed without approval of the City Engineer. The approval of the City Engineer will be required before admixtures are added to the concrete after the truck has left the batch plant.

The mix design requirement for KDOT Grade 3.0 AE and Grade 4.0 AE concrete mixes shall conform to Table 401-A1 in the KDOT *Standard Specifications for State Road and Bridge Construction*.

Table 2006-1 indicates the acceptable minimum strengths for the various types of concrete.

*Table 2006-1 - Mix Design Compressive Strength Requirements*

| <b>Mix Design</b> | <b>7 Day Strength<br/>(psi)</b> | <b>28 Day Strength<br/>(psi)</b> |
|-------------------|---------------------------------|----------------------------------|
| KDOT 3.0 AE       | 2,250                           | 3,000                            |
| KDOT 4.0 AE       | 3,000                           | 4,000                            |
| KCMMB 4K          | 3,000                           | 4,000                            |

Concrete that does not meet the 28-day minimum compressive strength shall be removed and replaced at the Contractor's expense.

**2007 MIXING AND DELIVERY.** Concrete shall be furnished by an acceptable ready-mixed concrete supplier and shall conform to ASTM C94.

The consistency of concrete shall be suitable for placement conditions, and the slump shall be uniform.

All concrete delivery tickets shall include the plant name, design water/cement ratio, batch weights per cubic yard, total batched weight of all materials for quantity delivered, time batched, design slump, water withheld (2 gallons per cubic yard maximum), allowable slump range, moisture correction for aggregates and dosages of all approved admixtures. Precast concrete manufacturers shall keep concrete delivery tickets on file for one year. Certifications for the precast concrete shall be provided when the product is delivered to the job site. Concrete tickets for colored concrete shall include the specified federal standard color code.

Ready-mix trucks shall reset the drum revolution counter to zero before batching. Concrete shall be mixed in quantities required for immediate use. Concrete shall be discharged without delay and shall be of the consistency and workability required for the job. The rate of discharge of the plastic concrete from the mixer drum shall be controlled by the rotational speed of the drum with the discharge gate fully open. Concrete shall not be used once it has developed an initial set.

Adding water to the concrete shall not be permitted, except when concrete is delivered in truck mixers. A maximum of two (2) gallons of water per cubic yard may be withheld from the load at the batch site, and if needed, added at the construction site to control the slump as necessary to meet the specified requirements. The need for additional water shall be determined as soon as possible after the load has arrived at the construction site. The adjustment shall be made to the entire load to ensure the water/cement ratio has not been exceeded. After additional water is added, the drum or blades shall be turned an additional twenty (20) to thirty (30) revolutions at mixing speed. The amount of water added at the construction site shall not exceed the amount withheld at the batching plant. Adding water shall be under the City Engineer's supervision and shall be permitted no more than one (1) time per load and only after the initial revolutions at mixing speed have been completed. Calibrated water measuring devices shall be used for dispensing water. In no case shall the water/cement ratio exceed the design water/cement ratio. Concrete that is not within the specified slump limits at the time of placement shall not be used. The concrete shall be delivered to the site and discharged within the maximum time allowed in these Technical Specifications, unless otherwise approved by the City Engineer. The time will

begin with the initial mixing of cement and water at the batch plant. Non-agitating equipment shall not be used for transportation of concrete.

**2008 PLACEMENT.** The limits of each concrete placement shall be approved by the City Engineer prior to concrete delivery. All concrete within such limits shall be placed in one continuous operation.

All forms, reinforcements and embedment's shall be secured in proper position, and shall be free of all dirt, mud, water, and debris prior to delivery of the concrete. Bonding surfaces shall be cleaned of all foreign material and shall be free from laitance. Concrete shall not be placed on frozen subgrade or in excavations which have not been dewatered.

Concrete shall be placed within forty-five (45) minutes of mixing operations, with the exception that the City Engineer may extend the period to ninety (90) minutes dependent upon weather conditions.

Concrete shall be placed in a manner that prevents segregation of the materials and reinforcing steel shall be properly placed and secured to prevent displacement. During and immediately after placement, concrete shall be thoroughly vibrated to produce a solid mass. Vibrators shall not be used to move the concrete laterally.

Chutes equipped with baffle boards or in short lengths that reverse the direction of flow shall be used for steep slopes. Chutes shall not be made of aluminum.

Concrete shall not be dropped from a height greater than five (5) feet, unless confined by chutes or pipes. Each part of the form shall be filled by depositing the concrete as near to the final position as possible. After initial set of the concrete, the forms shall not be jarred, and no strain shall be placed on the projecting reinforcement.

**2009 COLD WEATHER CONCRETING.** Unless authorized in writing by the City Engineer, concrete mixing and placement operations shall be discontinued when the descending ambient air temperature reaches 35°F, and shall not be resumed until the ascending ambient air temperature reaches 35°F. Under no circumstances shall concrete placement continue when the air temperature is less than 25°F.

When concrete work is authorized during cold weather, the aggregates may be heated by methods approved by the City Engineer prior to being placed in the mixer. Frozen ingredients or ice shall not be placed in the mixer. The temperature of the concrete shall be not less than 60°F and not more than 80°F at the time of placement. No concrete shall be placed on frozen subgrade. Sudden cooling of concrete shall not be permitted. Concrete damaged by cold weather conditions shall be removed and replaced at the Contractor's expense.

When the ambient air temperature is expected to drop below 35°F, a sufficient supply of insulated blanketing material shall be used to cover the concrete maintaining a minimum temperature of 40°F as measured on the surface. The concrete shall be maintained at the minimum temperature of 40°F for a period of four (4) days. An approved moisture barrier such as wet burlap or plastic sheeting shall be placed on the concrete prior to placement of the blanketing material.

**2010 HOT WEATHER CONCRETING.** The provisions of this section shall apply to all concrete work which is done when the air temperature is above 80°F at the time of placement.

The temperature of the concrete, when placed, shall not be high enough to cause excessive loss of slump, flash set or cold joints. In no case shall the temperature of the concrete, when placed, exceed 90°F. Forms, reinforcing and subgrade surfaces shall be wetted immediately before placement. In all cases, if the temperature of the concrete at time of placement is 90°F or above, the concrete will be rejected.

When the air temperature exceeds 90°F and as soon as practicable without causing damage to the surface, all exposed concrete shall be kept continuously moist by means of fog sprays, wet burlap, cotton mats or other means acceptable to the City Engineer. This cooling with water shall be in addition to the membrane curing compound. The initial sealing membrane shall be applied within five (5) minutes of completing the finishing operation.

**2011 CURING AND PROTECTION.** Concrete shall be protected against loss of moisture and rapid temperature changes for at least four (4) days after placement. A white-pigmented liquid curing compound meeting ASTM C-309, type 2, class A shall be applied after finishing operations have been completed and immediately after the free water has left the surface. The surface of the work shall be completely coated and sealed with a uniform layer of the curing compound at a rate of not less than one (1) gallon per 150 square feet. The compound shall not be thinned and shall remain agitated to prevent settlement of pigment. On surfaces where forms are removed prior to the end of the specified curing period, the entire exposed surface shall be coated at the specified rate of coverage. If rain falls on the newly coated surface before the film dries sufficiently to resist damage, or if the film is damaged in any other way, the Contractor shall apply a new coat of curing compound to the affected area. Other methods of curing shall be as approved by the City Engineer.

For stamped concrete median islands, parkways, and roundabouts where colored concrete is specified, a clear, non-yellowing, liquid cure and seal compound meeting ASTM C-1315, Type 1, Class A, shall be applied to the surface. Unless otherwise directed by the Engineer, cure and seal compounds shall be applied the next day after finishing when all surface moisture has disappeared. In all other instances when colored or decorative concrete is specified, cure and seal or seal, as recommended by the manufacture of the decorative concrete system. The surface shall be free of dirt and debris prior to application of the cure and seal. A low-pressure spray, roller or brush shall be used to apply the liquid and shall be applied uniformly without puddles. Multiple thin coats shall be applied, rather than a heavy coat.

**2012 FORMS.** Forms shall be designed to produce concrete in accordance with the shape, lines, and dimensions shown on the approved plans. They shall be mortar-tight and shall be braced to maintain the desired position, shape, and alignment during and after concrete placement.

Forms may be constructed of wood or metal and shall be designed to permit removal without damaging the concrete. Forms for all exterior exposed surfaces, which will be visible after backfilling, shall be prefabricated plywood panel forms, job-built plywood forms or forms that are lined with plywood or fiberboard. Decorative form liners in accordance with the Standard Details shall be used for retaining walls located along arterial roadways and at all other specified locations. Forms shall be coated with an approved light oil to prevent adhesion and shall be

thoroughly cleaned and re-oiled before re-use.

Form removal shall be in accordance with Section 710 the *KDOT Standard Specifications for State Road and Bridge Construction*.

**2013 FINISHING FORMED SURFACES.** Fins and other surface projections shall be removed from all formed surfaces except exterior surfaces that will be in contact with backfill. Surfaces to be dampproofed shall have fins removed and tie holes filled, but no additional finishing will be required.

Tie holes in all formed surfaces shall be cleaned, wetted, and filled with an expansive cement mortar. Tie hole patches shall be left flush, sound, smooth, even and shall match the texture and color of the adjacent concrete.

Unless provided otherwise in the plans all exposed edges shall be beveled by using dressed, triangular molding, having three-fourths inch (3/4”) sides.

**2014 REPAIRING DEFECTIVE AND DAMAGED CONCRETE.** Any concrete not in conformance with the approved plans, or damaged prior to acceptance of the project by the City Council, shall be removed and replaced by the Contractor at his expense. Patching shall only be permitted if approved by the City Engineer. Surface defects such as ridges and bulges may be removed by grinding with the approval of the City Engineer.

Honeycombed and other defective concrete that does not affect the structural integrity of the structure shall be chipped out and filled with a non-shrink, non-metallic grout with a minimum 28-day compressive strength of 5,000 psi or a similar material approved by the City Engineer. Prior to placement of the grout, the surface of the affected area shall be thoroughly cleaned of all loose and foreign material and shall be coated with an epoxy bonding agent.

Concrete repair work shall be performed in a manner that will not damage adjacent concrete nor interfere with the thorough curing of surrounding concrete. Repair work shall be adequately cured and protected from further damage.

**2015 REINFORCEMENTS.** Metal reinforcement shall be protected by the thickness of concrete indicated on the approved plans. The thickness of concrete over the reinforcement, unless otherwise specified, shall be as outlined in Table 2015-1.

*Table 2015-1 – Minimum Concrete Cover of Reinforcement*

| LOCATION OF REINFORCEMENT  | COVER        |
|--|--------------|
| Surfaces where concrete is deposited directly against the ground       | 3 inches     |
| Formed surfaces exposed to the ground, to water, or to weathering      | 2 inches     |
| Beams, girder, and columns not exposed to ground, water, or weathering | 1-1/2 inches |
| All surfaces other than those above                                    | 1 inch       |

Reinforcing steel shall be accurately placed and positioned on supports, spacers, hangers or other reinforcing steel as approved by the City Engineer and shall be secured in place with wire ties or suitable clips. The clear distance between bars in parallel locations shall not be less than the minimum dimension of the following:

- one and one-half (1½) times the diameter of the bars
- one and one-half (1½) times the nominal size of the coarse aggregate
- two (2) inches

Splices in reinforcing steel will not be permitted at points of maximum stress. Reinforcing steel splices at points other than those shown on the approved plans, shall be approved by the City Engineer. Welding or tack welding of reinforcement shall not be permitted. Spliced bars shall be placed in continuous contact throughout the length of the splice and shall be securely tied together. Metal reinforcement shall be free from rust, scale or other contaminants that will reduce the bond.

**2016 CONSTRUCTION JOINTS.** Construction joints shall be made at the locations and to the configuration shown on the approved plans, unless otherwise approved by the City Engineer.

**2017 EXPANSION AND CONTRACTION JOINTS.** Expansion and contraction joints shall be at locations indicated on the drawings or as specified.

Contraction joints shall consist of planes of weakness created by forming or cutting grooves in the surface of the concrete. Formed grooves shall be made by depressing an approved tool or devise into the plastic concrete. Sawed joints shall be constructed by sawing through the surface of the concrete with an approved concrete saw. Sawing of the joints shall begin as soon as the concrete has hardened sufficiently to prevent excessive raveling.

Expansion joints shall be formed with pre-formed expansion joint filler of the non-extruding and resilient types, including cork, self-expanding cork, sponge rubber, cork rubber and bituminous fiber. Expansion joint materials shall meet the requirements of ASTM D994, D1751 and D1752.

**2018 REINFORCED CONCRETE BOX FORMING SEQUENCE.** Wall forms may be placed the day following the placement of the bottom slab as long as the slab is protected during the form setting operation. The placement of concrete for the walls shall not occur prior to the fifth (5<sup>th</sup>) day after placing the bottom slab. Top forms may be placed with wall forms if the walls and top are to be monolithic construction; otherwise, top forms shall not be placed until the third (3<sup>rd</sup>) day after pouring the walls. The placement of concrete for the top shall not occur prior to the fifth (5<sup>th</sup>) day after placing the walls (for base to top shoring) or until the walls have reached their design strength for slab forms shored by the walls. Wall forms shall remain in place a minimum of two (2) days after the walls are poured. Supports for the top slab shall be left in place according to the schedule shown in these Technical Specifications.

The above guidelines for placing forms for reinforced concrete boxes are based on the use of standard forming procedures and with the use of concrete containing no admixtures to achieve high early strength. Variations in forming techniques and/or the use of high early strength concrete shall only be allowed if approved by the City Engineer.

**SECTION 2100-CONCRETE CURB, CURB AND GUTTER, SIDEWALK, AND DRIVEWAY ENTRANCES**

**2101** **SCOPE.** This section covers concrete curb, curb and gutter, concrete sidewalk and concrete driveway entrances, including reinforcing steel, forms, joints, finishing, curing, and other appurtenant work.

**2102** **MATERIALS.** All items of material included in this work shall conform to the requirements of the Technical Specifications.

**2103** **GENERAL.** All construction covered in this section shall conform to the requirements of the Technical Specifications. All improvements shall be constructed to the lines, grades and cross-sections shown on the approved plans and Standard Details. All curb construction shall be performed prior to placement of pavement or sidewalk, except when the curb is placed on the base asphalt, unless otherwise approved by the City Engineer.

There shall be a wheelchair passing space constructed where length of a 4' wide sidewalk exceeds two hundred (200) feet in length.

**2104** **GRADING AND SUBGRADE PREPARATION.** All excavation required in the grading and subgrade preparation shall be considered as "Unclassified Excavation" as defined in the Technical Specifications. All grading shall be done in conformance with the Technical Specifications.

**2105** **FORMS.** All forms shall be in good condition with not more than one-fourth (1/4) inch variation horizontal and vertical alignment for each ten (10) feet in length. The forms shall have adequate strength and bracing to obtain an acceptable finished product.

A slip-form machine equipped with electronic controls may be used in lieu of forms. The machine shall be equipped with mechanical internal vibrations, and shall be capable of placing the finished curb to the cross-section, line and grade shown in the plans.

**2106** **EXPANSION AND CONTRACTION OR CONSTRUCTION JOINTS.** Expansion and contraction or construction joints shall be formed at right angles to the alignment of the curb in accordance with the Standard Details, unless otherwise specified by the City Engineer.

The Contractor shall perform sawing and jointing operations in a manner that prevents uncontrolled cracking of the concrete. The Contractor shall be responsible for the removal and replacement of any concrete that has developed uncontrolled cracking.

Contraction joints shall be constructed by sawing the curb to a minimum depth of one and one-fourth (1 ¼) inches at a spacing of ten (10) feet. The width of the joint shall not exceed three-eighths (3/8) of an inch. Hand-tooling of the contraction joints may be permitted with the approval of the City Engineer. Hand-tooled contraction joints must conform to the sawed-joint dimension requirements.

**2107** **FINISHING.** Additional water shall not be used to aid in the finishing operation, unless otherwise approved by the City Engineer. Additional concrete shall not be added to concrete that has taken initial set. Finishing shall be performed as follows:



- a. **Curb and Curb and Gutter.** The curb shall be shaped to the required cross-section as soon as possible after the concrete has been placed in the forms. The surface of the curb shall be floated with a wood or metal float and broom finished. A one-quarter ( $\frac{1}{4}$ ) of an inch radius shall be tooled on the exposed edges of the curb. Brooming shall be perpendicular to the alignment of the curb. The finished curb shall be uniform in appearance, and shall be in conformance with the specified lines, grades and configurations shown on the approved plans.
- b. **Sidewalk and Driveway Entrances.** After the concrete has been thoroughly consolidated and leveled, the surface shall be floated with a wood or metal float and broom finished. The broom finish shall be perpendicular to the centerline of the sidewalk. All exposed edges shall be rounded with an edger with a one-quarter inch ( $\frac{1}{4}$ ") radius. The edges and joints of the sidewalk and driveway shall be straight and neat in appearance. The Contractor shall be responsible for picture-framing at locations determined by the City Engineer. The finished surface shall be uniform in color and free of voids.

**2108 PROTECTION.** The Contractor shall, at his expense, protect the concrete work against damage or defacement of any kind until the project has been accepted by the City Council.

Concrete items which are not acceptable to the City Engineer shall be removed and replaced, or repaired to the satisfaction of the City Engineer.

**2109 OPENING TO TRAFFIC.** Residential drive approaches shall not be opened to traffic until the concrete is at least seventy-two (72) hours old and has attained a minimum compressive strength of 3,000 psi and 75% of the mix design strength. Commercial drive approaches shall not be opened to traffic until the concrete is at least one hundred and twenty (120) hours old and has attained a minimum compressive strength of 3,500 psi and has attained 80% of the mix design strength. If high early strength concrete is used, the drive approaches may be opened to traffic when the concrete has attained a compressive strength of 3,500 psi and has attained 80% of the mix design strength.

**2110 REINFORCEMENT (Curb and Gutter).** Reinforcement for concrete curb and gutter shall be as designated in the Standard Details. When the curb and gutter is constructed on an asphaltic concrete base with a minimum thickness of three (3) inches, no reinforcement shall be required, unless otherwise determined by the City Engineer.

**2111 REINFORCEMENT (Other).** Reinforcement for all other work shall be as shown on the approved plans or Standard Details.

**SECTION 3000 - SANITARY SEWER PIPES**

**3001 SCOPE.** This section covers all labor and materials for the construction of sanitary sewer mains including all manholes, pipe encasements, service connections and appurtenances.

**3002 GENERAL.** When reference is made to a standard specification (ASTM, AWWA, etc.), the specification referred to shall be understood to mean the latest revision of said specification except as otherwise noted in the contract documents.

**3003 MATERIALS.** Contractor shall be required to use the materials shown on the City of Gardner Approved Materials List unless otherwise specified or approved by the City Engineer. The Approved Materials List is available on the City of Gardner public website at [www.gardnerkansas.gov](http://www.gardnerkansas.gov)

**A. Polyvinyl Chloride (PVC) Pipe**

Pipe Pipe shall be seamless. Pipe material shall conform to ASTM D1784 and shall have a minimum cell classification of 12454C, 12364A, or 13364B. Pipe diameters less than eighteen (18) inches shall be SDR 26 and conform to ASTM D3034. Pipe diameters eighteen (18) inches and larger shall be PS115 (Pipe Stiffness of 115 psi) and conform to ASTM F679 or F794.

Joints All gasketed joints shall be compression, bell and spigot push-on conforming to ASTM D3212 and ASTM F477. Lubricant shall be as recommended by the pipe manufacturer.

Fittings Molded fittings defined as tee connections suitable for assembly to six (6) inch diameter house or building sewers shall be fittings molded of PVC materials conforming to ASTM D1784. All fittings shall utilize elastomeric seals and shall be suitable for use with PVC pipe specified.

\*When PVC is used on force mains, a tracer wire shall be installed allowing accurate locates of the main.

**B. High Density Polyethylene (HDPE) Pipe**

Pipe Pipe shall be manufactured from a PE 3408 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material will meet the specifications of ASTM D3350 with a cell classification of PE 345464C. Pipe shall have a manufacturing standard of ASTM F714. Pipe shall be DPS DR 13.5 unless otherwise specified on the plans.

Fittings Butt Fusion: Fittings shall be PE3408 HDPE, cell classification of 345464C as determined by ASTM D3350. Butt fusion fittings shall have a manufacturing standard of ASTM D3261. Fabricated fittings are to be factory manufactured. All fused joints shall be de-beaded and debris removed from the main.

Electrofusion Couplings and Restrains: Couplings shall be PE3408 HDPE, cell classification of 345464C as determined by ASTM D3350. Electrofusion couplings shall have a manufactured standard of ASTM F1055.

All fittings and couplings shall have the same pressure rating as the pipe unless otherwise specified on the plans. HDPE butt fusion installers must be qualified with training from the pipe distributor or manufacturers' representatives.

**C. Cured In Place Pipe (CIPP)** Cured in place pipe (CIPP) shall only be allowed as an alternative to pipe replacement at locations by the City Engineer.

**Fabric** CIPP lining material shall consist of one or more layers of absorbent non-woven felt fabric capable of absorbing the resin and withstanding the installation pressures and curing temperatures. The tube should be compatible with the resin system used. Any plastic film applied to the tube on what will become the interior wall of the finished CIPP shall be an impermeable, flexible membrane which is compatible with and contain the resin system used.

**Resin** The resin system shall be a corrosion resistant polyester, or vinyl ester, or epoxy and catalyst system.

Minimum lining thickness is outlined in Table 3003-1.

**Table 3003-1 - Minimum CIPP Lining Thickness**

| <b>Original Pipe Diameter<br/>(inch)</b> | <b>Minimum CIPP Thickness<br/>(mm)</b> | <b>Design Criteria<br/>(inch)</b> |
|--|--|-----------------------------------|
| 8-12                                     | 6.0                                    | 0.236                             |
| 15                                       | 9.0                                    | 0.354                             |
| 18                                       | 12.0                                   | 0.472                             |
| 24                                       | 15.0                                   | 0.591                             |
| 30                                       | 18.0                                   | 0.709                             |

The cured liner shall conform to ASTM D790 for the minimum structural standards. Liner tube and resin shall also meet the requirements of ASTM F1216, ASTM D5813, ASTM F1743 and any project specific criteria.

All force mains shall be installed with granular embedment per the Technical Specifications. All force mains shall be laid to continuous slope when not shown on the Drawings.

Approved air relief valves shall be installed at all locations shown on the Drawings where required by the Engineer.

The Contractor shall restrain the pipeline to accommodate thrust and testing forces at pipe deflections, bends, tees, and plugs in accordance with the project Contract Documents. All damage caused by the Contractor's failure to provide adequate restraint shall be corrected by the Contractor at no additional cost of the Owner.

The Contractor shall obtain Kansas State Plane coordinates on the force main using survey-grade GPS equipment. The coordinates shall be obtained at 100-foot intervals on straight runs of pipe, at 25-foot intervals on curved runs of pipe, and at all fittings. The Contractor shall provide the coordinates to the City Engineer in an electronic format such as a comma delimited text file, a shape file, or a Microsoft Excel spreadsheet. The electronic file shall identify the fittings with their corresponding coordinate pair.

All force mains shall be installed with underground tracer wire and electronic locate markers and shall be installed in accordance with the Design Criteria.

**3004 ALIGNMENT.** Piping shall be installed to the grades indicated on the drawings using laser beam equipment and surveying instruments.

The following sag tolerances will be acceptable on sanitary sewer installations:

- For 8-inch and 12-inch diameter pipe with slopes below one and a half percent, a maximum sag of ten (10) percent of the pipe area and no more than two sags of ten (10) percent of the pipe area between structures.
- For all pipes with a diameter larger than 12-inches, sags shall be evaluated by the Engineer on a case-by-case basis. The City Engineer shall have final determination if the sag will be acceptable.
- For any sags not meeting acceptable criteria as outline above, backfall slope is not allowed at any point in the pipe installation. Remove and replace, otherwise repair, any sections of non-conforming pipe at no additional cost to the City.

All flexible pipelines shall be tested for deflection by pulling a mandrel through the entire length thereof.

- The mandrel (go/no-go) device shall be cylindrical in shape and constructed with nine (9) evenly spaced arms or prongs. Mandrels with fewer arms will be rejected as not sufficiently accurate. The rigid mandrel shall have an outside diameter (O.D.) equal to 95 percent of the inside diameter (I.D.) of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and the average inside diameter for I.D. controlled pipe, dimensions per appropriate standard. Statistical or other “tolerance packages” shall not be considered in mandrel sizing. The dimensions of the mandrel for PVC pipe shall be listed in the table below. The “D” mandrel dimension shall carry a tolerance of  $\pm 0.01$  inch. Contact length (L) shall be measured between points of contact on the mandrel arm. The length shall not be less than as shown in the accompanying table.

| Nominal Diameter<br>(Inches) | “L”<br>Mandrel Length<br>(Inches) | “D”<br>Mandrel Diameter<br>(Inches) |
|------------------------------|-----------------------------------|-------------------------------------|
| ASTM D3034 SDR26             |                                   |                                     |
| 8                            | 8                                 | 7.37                                |
| 10                           | 10                                | 9.21                                |
| 12                           | 10                                | 10.96                               |
| 15                           | 12                                | 13.42                               |
| ASTM F679 PS115              |                                   |                                     |
| 18                           | 18                                | 16.49                               |
| 21                           | 21                                | 19.44                               |
| 24                           | 24                                | 21.87                               |
| 27                           | 27                                | 24.65                               |
| 30                           | 24                                | 28.21                               |
| 36                           | 24                                | 33.78                               |
| 42                           | 24                                | 39.24                               |
| 48                           | 24                                | 44.80                               |

- Mandrel outside diameters for HDPE and Fiberglass Wastewater Pipe shall be calculated as described in the above paragraph. For Fiberglass Wastewater pipe, the outside diameter for the mandrel shall be 97% of the inside diameter of the pipe.
- The Engineer shall be responsible for approving the mandrel. The Contractor shall provide proving rings to verify.
- The mandrel shall be hand-pulled by the Contractor through all flexible sewer lines. Any sections of sewer not passing the mandrel test shall be uncovered and the Contractor, at no additional cost to the Owner, shall re-round or replace the sewer to the satisfaction of the Engineer. These repaired sections shall be retested.
- The testing shall be conducted after final trench backfill.

***Vertical Tolerance Table Based on Slope and Length***

| Slope | MH to MH<br>Length<br>(Feet) | Max.<br>Tolerance<br>@ Upstrm.<br>MH (Feet) | Slope | MH to MH<br>Length<br>(Feet) | Max.<br>Tolerance<br>@ Upstrm.<br>MH (Feet) | Slope | MH to MH<br>Length<br>(Feet) | Max.<br>Tolerance<br>@ Upstrm.<br>MH (Feet) |
|-------|------------------------------|---|-------|------------------------------|---|-------|------------------------------|---|
| 0.10% | 50                           | 0.01  | 0.35% | 50                           | 0.02  | 0.95% | 50                           | 0.05  |
| 0.10% | 100                          | 0.01  | 0.35% | 100                          | 0.04  | 0.95% | 100+                         | 0.10  |
| 0.10% | 150                          | 0.02  | 0.35% | 150                          | 0.05  | 1.00% | 50                           | 0.05  |
| 0.10% | 200                          | 0.02  | 0.35% | 200                          | 0.07  | 1.00% | 100+                         | 0.10  |
| 0.10% | 250                          | 0.03  | 0.35% | 250                          | 0.09  | 1.05% | 50                           | 0.05  |
| 0.10% | 300                          | 0.03  | 0.35% | 300+                         | 0.10  | 1.05% | 100+                         | 0.10  |
| 0.10% | 350                          | 0.04  | 0.40% | 50                           | 0.02  | 1.10% | 50                           | 0.06  |
| 0.10% | 400                          | 0.04  | 0.40% | 100                          | 0.04  | 1.10% | 100+                         | 0.10  |
| 0.10% | 450                          | 0.05  | 0.40% | 150                          | 0.06  | 1.15% | 50                           | 0.06  |
| 0.10% | 500                          | 0.05  | 0.40% | 200                          | 0.08  | 1.15% | 100+                         | 0.10  |
| 0.15% | 50                           | 0.01  | 0.40% | 250+                         | 0.10  | 1.20% | 50                           | 0.06  |
| 0.15% | 100                          | 0.02  | 0.45% | 50                           | 0.02  | 1.20% | 100+                         | 0.10  |
| 0.15% | 150                          | 0.02  | 0.45% | 100                          | 0.05  | 1.25% | 50                           | 0.06  |
| 0.15% | 200                          | 0.03  | 0.45% | 150                          | 0.07  | 1.25% | 100+                         | 0.10  |
| 0.15% | 250                          | 0.04  | 0.45% | 200                          | 0.09  | 1.30% | 50                           | 0.07  |
| 0.15% | 300                          | 0.05  | 0.45% | 250+                         | 0.10  | 1.30% | 100+                         | 0.10  |
| 0.15% | 350                          | 0.05  | 0.50% | 50                           | 0.03  | 1.35% | 50                           | 0.07  |
| 0.15% | 400                          | 0.06  | 0.50% | 100                          | 0.05  | 1.35% | 100+                         | 0.10  |
| 0.15% | 450                          | 0.07  | 0.50% | 150                          | 0.08  | 1.40% | 50                           | 0.07  |

|       |      |      |       |      |      |  |      |      |
|-------|------|------|-------|------|------|--|------|------|
| 0.15% | 500  | 0.08 | 0.50% | 200+ | 0.10 | 1.40%  | 100+ | 0.10 |
| 0.20% | 50   | 0.01 | 0.55% | 50   | 0.03 | 1.45%  | 50   | 0.07 |
| 0.20% | 100  | 0.02 | 0.55% | 100  | 0.06 | 1.45%  | 100+ | 0.10 |
| 0.20% | 150  | 0.03 | 0.55% | 150  | 0.08 | 1.50%  | 50   | 0.08 |
| 0.20% | 200  | 0.04 | 0.55% | 200+ | 0.10 | 1.50%  | 100+ | 0.10 |
| 0.20% | 250  | 0.05 | 0.60% | 50   | 0.03 | 1.55%  | 50   | 0.08 |
| 0.20% | 300  | 0.06 | 0.60% | 100  | 0.06 | 1.55%  | 100+ | 0.10 |
| 0.20% | 350  | 0.07 | 0.60% | 150  | 0.09 | 1.60%  | 50   | 0.08 |
| 0.20% | 400  | 0.08 | 0.60% | 200+ | 0.10 | 1.60%  | 100+ | 0.10 |
| 0.20% | 450  | 0.09 | 0.65% | 50   | 0.03 | 1.65%  | 50   | 0.08 |
| 0.20% | 500  | 0.10 | 0.65% | 100  | 0.07 | 1.65%  | 100+ | 0.10 |
| 0.25% | 50   | 0.01 | 0.65% | 150+ | 0.10 | 1.70%  | 50   | 0.09 |
| 0.25% | 100  | 0.03 | 0.70% | 50   | 0.04 | 1.70%  | 100+ | 0.10 |
| 0.25% | 150  | 0.04 | 0.70% | 100  | 0.07 | 1.75%  | 50   | 0.09 |
| 0.25% | 200  | 0.05 | 0.70% | 150+ | 0.10 | 1.75%  | 100+ | 0.10 |
| 0.25% | 250  | 0.06 | 0.75% | 50   | 0.04 | 1.80%  | 50   | 0.09 |
| 0.25% | 300  | 0.08 | 0.75% | 100  | 0.08 | 1.80%  | 100+ | 0.10 |
| 0.25% | 350  | 0.09 | 0.75% | 150+ | 0.10 | 1.85%  | 50   | 0.09 |
| 0.25% | 400+ | 0.10 | 0.80% | 50   | 0.04 | 1.85%  | 100+ | 0.10 |
| 0.30% | 50   | 0.02 | 0.80% | 100  | 0.08 | All lengths of pipe with slopes of 1.9% and greater shall have no more than 0.1 feet of tolerance. |      |      |
| 0.30% | 100  | 0.03 | 0.80% | 150+ | 0.10 |  |      |      |
| 0.30% | 150  | 0.05 | 0.85% | 50   | 0.04 |  |      |      |
| 0.30% | 200  | 0.06 | 0.85% | 100  | 0.09 |  |      |      |
| 0.30% | 250  | 0.08 | 0.85% | 150+ | 0.10 |  |      |      |
| 0.30% | 300  | 0.09 | 0.90% | 50   | 0.05 |  |      |      |
| 0.30% | 350+ | 0.10 | 0.90% | 100  | 0.09 |  |      |      |
|       |      |      | 0.90% | 150+ | 0.10 |  |      |      |

**3005 HANDLING.** The Pipe and fittings shall be handled in a manner which prevents damage and ensures the delivery and installation in a sound and acceptable condition. Hooks shall not be permitted to contact joint surfaces. Damaged pipe shall be removed from the site.

**3006 CLEANING.** The interior of all pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until the work has been accepted. All joint contact surfaces shall be kept clean until the joint is completed.

Whenever pipe installation has stopped, the open end of the pipe must be closed by using a pipe plug to prevent trench water, gravel, earth, or any other foreign object from entering the pipe. In no case will removal of sewer plug be permitted and water allowed to enter the sewer. Contractor may be required by the City Engineer to remove all water from the trench before continuing installation.

**3007 LAYING PIPE.** Lateral displacement of the pipe is not acceptable. Pipe shall not be installed with water in the trench or under unsuitable weather.

Pipe installation shall begin at the lowest elevation with bell ends facing the upstream, unless otherwise approved by the City Engineer.

**3008 JOINTING.** All joint preparation and jointing operations shall comply with the instructions and recommendations of the pipe manufacturer. Immediately before joints are pushed together, all joint surfaces shall be coated with the lubricant furnished with the pipe.

**3009 TEMPORARY PLUGS.** Provide and install watertight plugs as manufactured by pipe supplier. Secure plugs in place in a manner to facilitate removal when required to connect pipe.

Mechanical plugs, braced with a 4x4 timber wedged against the opposite wall of the manhole, shall be installed at the downstream end (connection with existing line) on all sanitary sewer extension projects under construction, and shall be verified by the Contractor at the completion of each working day. Also, the open end of the sewer shall be plugged at the end of the work day with a suitable mechanical plug to prevent entry of ground water or foreign material until work is resumed.

**3010 WYE BRANCHES.** Wye branches shall all be pitched at 45° and installed at locations designated on the plans. The contractor shall verify that wye branch locations have been marked in advance of the construction of sewers serving any property which will require sewer service and, if the locations have not been designated, shall stop the sewer construction until the necessary tee branch or saddle locations have been obtained. Wye branches shall be installed with the lower lip not more than two inches (2") below the outside top of the pipe. Wye branches not be covered until each location has been recorded.

Each wye branch shall be marked with a wooden strip extending from the wye vertically to within one foot (1') of the ground surface. **All service line branches shall be extended to within 8 feet of the minimum sewerable floor elevation at the time of the main construction.** Markers shall be securely anchored and maintained vertical until backfilling has been completed. Wye branches shall be closed with a suitable plug held in place by an approved joint sealing compound.

Service connections made to the sewer prior to backfilling shall not be installed as vertical risers but shall be laid on a slope not to exceed one foot vertical to one foot horizontal. A 45° bend shall be used to join the wye branch to the service connection. The service pipe shall make such a horizontal angle with the sewer line that a proper connection to the 45° bend is obtained without trimming the pipe and with no danger to jute or jointing material being forced into the sewer. Each service connection pipe shall have a solid bearing on rock backfill.

**3011 CONCRETE ENCASEMENT.** See the City of Gardner *Design Criteria for Public Improvement Projects* and applicable Standard Details.

**3012 WATER LINE CLEARANCES.** See the City of Gardner *Design Criteria for Public Improvement Projects* and applicable Standard Details.

**3013 SEWER MANHOLES.** Manhole construction shall comply with all the applicable requirements of the City of Gardner *Technical Specifications for Public Improvement Projects*.

**3014 ACCEPTANCE TEST.** Each reach of sewer shall meet the requirements of the following acceptance tests. All defects shall be repaired to the satisfaction of the Engineer by and at the expense of the contractor.

- A. Air Test.** Contractor shall perform a low pressure air test for pipe between successive manholes. The pipe between manholes shall be sealed with suitable plugs. One of the plugs shall have a positive on-off valve and suitable means for readily disconnecting it at the control panel. A second orifice in the plug shall be used for constantly reading the internal pressure of the pipe. This orifice shall be continuously connected to a pressure gauge capable of measuring up to 10 psi. The gauge shall have minimum divisions of 0.10 psi and shall have an accuracy of  $\pm 0.04$  psi.

The testing methods and air leakage rates shall conform to the requirements of ASTM F-1417-92 or the latest revision thereof, except as modified herein. Each reach of sewer pipe between manholes shall be tested after completion of the installation of the pipe, appurtenances and the backfill of the sewer trench. Internal air pressure shall be monitored so that it will not exceed 9.0 psig.

Determine the rate of air loss using the time-pressure drop method. Slowly introduce air into the section of pipe to be tested until the air pressure is raised to approximately 4.0 psig and the section of pipe is stabilized. As discussed previously, disconnect the air supply and decrease the pressure to 3.5 psi before starting the test. Determine the time required for the pressure to drop from 3.5 psi to 2.5 psi and compare this interval to the required time to decide if the rate of air loss is within the allowable minimum times required by pipe diameter as shown in Table 3015-1.

If the pressure drops 1.0 psi before the appropriate time shown in Table 3015-1, the air loss rate shall be considered excessive and the test section fails. If the test section fails, leaks shall be repaired and the line shall be retested to the requirements of this test method. Rubber clamp-on type repair couplers will not be an acceptable method of repair. Solid repair sleeves shall be used on all new construction. Prior to acceptance, all constructed sewer lines shall satisfactorily pass the low pressure air test.

The air test may be stopped if no pressure loss has occurred during the first fifty (50) percent of the calculated testing time. If any pressure loss or leakage has occurred during the first fifty (50) percent of the testing period, the test shall continue for the entire test duration as outlined below, or until failure.

Plugs should not be removed until all air pressure has been released.

Example of how to use Table 3015-1: What should be the required test time for a 1.0 psig pressure drop in 327 feet of 8-inch diameter pipe between manholes?

Solution: The exact time is easily calculated by using Table 3015-1. Since 327 feet exceeds the 298 feet length associated with the minimum test time for an 8-inch pipeline, the fourth column in Table 3015-1 is used to calculate the required test time as follows:

$$T = 1.520 \times L = 1.520 \times 327 = 497 \text{ seconds}$$

Therefore, the required test time for a 1.0 psig pressure drop is 497 seconds, or 8 minutes and 17 seconds.



**Table 3014-1 - Minimum Duration of Air Test Required for Maximum 1.0 psi Pressure Drop**

| Pipe Diam. In | Min. Time min:s | Length for Minimum Time, ft | Time for Longer Length, s | Specification Time for Length (L) Shown, min:s |        |        |        |        |        |        |        |
|---------------|-----------------|-----------------------------|---------------------------|--|--------|--------|--------|--------|--------|--------|--------|
|               |                 |                             |                           | 100 ft   | 150 ft | 200 ft | 250 ft | 300 ft | 350 ft | 400 ft | 450 ft |
| 4             | 3:46            | 597                         | 0.380 L                   | 3:46   | 3:46   | 3:46   | 3:46   | 3:46   | 3:46   | 3:46   | 3:46   |
| 6             | 5:40            | 398                         | 0.854 L                   | 5:40   | 5:40   | 5:40   | 5:40   | 5:40   | 5:40   | 5:42   | 6:24   |
| 8             | 7:34            | 298                         | 1.520 L                   | 7:34   | 7:34   | 7:34   | 7:34   | 7:36   | 8:52   | 10:08  | 11:24  |
| 10            | 9:26            | 239                         | 2.374 L                   | 9:26   | 9:26   | 9:26   | 9:53   | 11:52  | 13:51  | 15:49  | 17:48  |
| 12            | 11:20           | 199                         | 3.418 L                   | 11:20  | 11:20  | 11:24  | 14:15  | 17:05  | 19:56  | 22:47  | 25:38  |
| 15            | 14:10           | 159                         | 5.342 L                   | 14:10  | 14:10  | 17:48  | 22:15  | 26:42  | 31:09  | 35:36  | 40:04  |
| 18            | 17:00           | 133                         | 7.692 L                   | 17:00  | 19:13  | 25:38  | 32:03  | 38:27  | 44:52  | 51:16  | 57:41  |
| 21            | 19:50           | 114                         | 10.470 L                  | 19:50  | 26:10  | 34:54  | 43:37  | 52:21  | 61:00  | 69:48  | 78:31  |
| 24            | 22:40           | 99                          | 13.674 L                  | 22:47  | 34:11  | 45:34  | 56:58  | 68:22  | 79:46  | 91:10  | 102:33 |
| 27            | 25:30           | 88                          | 17.306 L                  | 28:51  | 43:16  | 57:41  | 72:07  | 86:32  | 100:57 | 115:22 | 129:48 |
| 30            | 28:20           | 80                          | 21.366 L                  | 35:37  | 53:25  | 71:13  | 89:02  | 106:50 | 124:38 | 142:26 | 160:15 |
| 33            | 31:10           | 72                          | 25.852 L                  | 43:05  | 64:38  | 86:10  | 107:43 | 129:16 | 150:43 | 172:21 | 193:53 |
| 36            | 34:00           | 66                          | 30.768 L                  | 51:17  | 76:55  | 102:34 | 128:12 | 153:50 | 179:29 | 205:07 | 230:46 |

In areas where ground water is known to exist, a one-half inch diameter capped pipe nipple approximately ten (10) inches long is to be installed through the manhole wall on top of one of the sewer lines entering the manhole. This installation is to be done at the time the sewer line is constructed. Immediately prior to the performance of the line acceptance test, the ground water level shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground to clear it, and then connecting a clear plastic tube to the pipe nipple. The tube shall then be held vertically and a measurement of height in feet of water shall be taken after the water height has stabilized in the tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure to be added to all readings.

All pressure sewage force mains shall have hydrostatic pressure and leakage tests performed prior to acceptance. All tests shall conform to AWWA C600 procedures except as modified herein. The test pressure and leakage allowed shall be determined by the Design Engineer and approved by the City Engineer. The test shall be conducted after line installation and trench backfilling is complete.

The test shall be performed separately in segments between sectionalizing valves and a test plug, or between test plugs. Test segments shall be selected so that adjustable seated valves are isolated for individual checking. Contractor shall furnish and install test plugs at no additional cost to the City, including all required anchors, braces and other devices to withstand hydrostatic pressure on the lugs. Any damage to public or private property caused by failure of the plugs shall be the responsibility of the Contractor. The fill rate of the line shall be limited to the available venting capacity.

If any of the above tests fail to meet the above prescribed requirements, the test shall be repeated as necessary after all leaks and defects have been repaired.

**B. Deflection Test.** A deflection test shall be required on all installations involving flexible or semi-rigid pipe after said pipe has been laid and backfilled. The maximum allowable deflection shall not exceed five (5) percent of the pipe's actual internal diameter as measured in the field. The deflection test shall consist of guiding a device of the appropriate size for the pipe involved to accurately measure any deflection in the pipe.

The device to be used shall be approved by the City Engineer prior to its use. Attention is directed to the fact that the pipe's nominal diameter is greater than the actual internal diameter of the pipe. Lamping will not be approved as a substitution for deflection testing.

Upon completion of the testing, all piping showing a deflection greater than five (5) percent shall be excavated, replaced, backfilled and retested to the satisfaction of the City Engineer.

- C. **Video Camera Inspection.** Sewer line installations shall be inspected by closed circuit television (CCTV) at the Contractor's expense to verify alignment, deflection, and workmanship to check for a smooth, structurally sound, straight, round main. A high quality internal color video recording shall be provided by the contractor showing the pre-construction conditions of all sewer mains scheduled for replacement and the post-construction of all sewer mains involved in the work, including new sewers, replaced sewers, and any restored connections. All post-construction CCTV inspection shall take place after all testing of the sewer line is complete.

The camera shall be moved through the pipe at a uniform rate, stopping when necessary to ensure proper documentation of the pipe conditions. In no case shall the camera travel at a rate faster than thirty (30) feet per minute. The camera shall be moved through the line by means which do not obstruct camera view or interfere with proper documentation of the sewer conditions. The camera shall pause as it approaches a service so that the connection between the pipe and the service can be evaluated. The lens can then rotate to display the interior of the service. The service inspection should identify any visible roots, cracks, or capped risers.

Inspection of the sewer line segments shall be performed using a color camera specifically designed and constructed for the method of inspection performed. Units shall have either an automatic or remote focus or iris controls, and the complete systems shall be operable in conditions of one hundred (100) percent humidity. The Contractor shall have the necessary camera skids, floats, and rafts available to allow inspection of lines in a manner acceptable to the Engineer under live flow conditions and designed for the size of pipe being televised. The complete video system (camera, lens, lighting, cables, monitors, and recorders) shall be capable of producing a picture quality acceptable to the Engineer, and if unsatisfactory, the equipment shall be removed and no payment shall be made for unsatisfactory inspections.

A pan and tilt viewing camera with the ability to view into the service laterals shall be used for 8" services lines and larger. A mini-camera may be utilized where necessary if the 8" camera setup is blocked. Each service lateral or tap shall be inspected to determine operational status and condition of the piping at the mainline connection.

The Contractor shall provide and have on site, heavy cleaning and root cutting equipment for use during CCTV inspection. The Contractor shall include the cost for heavy cleaning and root cutting in their bid proposal. Blowers shall be used to clear suspended moisture or fog in pipes prior to inspection.

Lighting shall be suitable to allow a clear picture of the entire periphery of the main sewer pipe. Lighting shall operate in a manner to provide adequate light for clear

inspection and minimize glare no matter what angle of the camera lens. The lighting shall be built into the unit so the lamps remain aligned with the lens.

When possible, work should start from the upstream manhole. When an obstruction prevents the camera from passing the entire segment, document the defect(s) that do not allow the camera to pass, move to the other manhole (typically the downstream manhole), create new inspection, and inspect as much of the pipe as possible.

When the flow in the upstream manhole of the line segment being inspected is above the maximum allowable level for television inspection the flow shall be reduced. The depth of flow shall not exceed the levels show below for the respective sizes, as measured in the manhole at the time of inspection:

| Pipe Diameter (in) | Max Flow Depth (% of Diameter) |
|--------------------|--------------------------------|
| ≤10                | 20                             |
| 12-24              | 25                             |
| ≥27                | 30                             |

The project internal video shall be performed by a qualified commercial or individual company who is familiar with closed circuit television (CCTV) inspection equipment and is Pipeline Assessment Certification Program (PACP) certified by the National Association of Sewer Service Companies (NASSCO). The inspection shall conform to PACP standards and the standards in this document. When PACP and this document conflict, this standard in this document shall be used.

The CCTV inspection shall be completed from manhole to manhole, and include the interior of the manhole and invert. Electronic media records shall be kept by the Contractor. Digital photographs of the pipe conditions and all defects shall be taken by Contract. Both electronic media and digital photographs shall clearly show the location, by distance in 1/10 of a foot from the manhole center, in relation to an adjacent manhole of each PACP observation and/or defect. PACP defect codes shall be recorded on the electronic media. Transparent information must appear on the viewing screen at all times. This information shall contain the site number, full date, continuous footage, and upstream and downstream manhole numbers. All pipe conditions and service connections with addresses shall be noted at the appropriate locations. Each line shall be recorded on a separate file with the upstream and downstream manhole numbers in the filename.

PACP coding standard shall be used for all observation except as expressly identified below:

- Abandoned Inspections
  - o If the length of pipe cannot be inspected, document the defect or defects that do not allow the camera to pass in addition the Miscellaneous Survey Abandoned (MSA) code. Use this method instead of documenting the reason for the abandoned inspection in the comment field. The only time it is appropriate to put the reason in the MSA comment is getting pulled off the job and when the inspection could have otherwise been continued.
- Significant and unexplained changes in turbulence:
  - o A case where flow turbulence changes significantly but there is not visual indicator why (i.e. presumably a large rock or broken/hole below the water

line). To document this, add a Miscellaneous General Observation (MGO) with “Rapids” in comments.

The Contractor shall provide deliverable with external hard drive that contains:

- PACP export database, including:
  - o Electronic media recordings, including all inspections associated with the project.
  - o Inspection logs, containing upstream and downstream manhole, street address, date, pipe diameter, direction of inspection, pipe material, line footage, lateral and observation locations, and digital photos of defects and their respective severity, PACP scoring for each line segment, and a graphic depicting the sewer line segment and showing the location and direction of lateral connections, defects, material changes, etc.

The City will review submittals for quality. Any deliverables not acceptable shall be corrected and resubmitted by the Contractor at no additional charge to the City. If additional inspections are required, the Contractor shall reschedule unacceptable inspections five days after being notified or a mutually agreed upon alternative schedule.

City will complete a second video of the sewer pipe prior to the expiration of the two (2) year maintenance bond. If any repairs are required during the two (2) year maintenance period, the Contractor will be required to video all repaired sections of pipe to verify corrections. Unacceptable defects include, but are not limited to, infiltration, displacement at joints, intrusion of foreign material, service taps entering at the wrong angle, sags outside acceptable limits as defined by these specifications, or cracked, broken, distressed or out of round pipe.

**3015 BORING WITH CASING PIPE.** Casing pipe shall conform to the requirements of the applicable Standard Details unless otherwise specified by the City Engineer.

**SECTION 3100--SANITARY SEWER MANHOLES**

**3101 SCOPE.** This section covers standard, drop, and special sewer manholes. Manholes shall be constructed of reinforced concrete complete with covers, fittings, and other appurtenances in accordance with the Standard Details, unless otherwise approved by the City Engineer.

Only manholes which are required to have outside pipe and fittings for dropping sewage into the lower line will be designated as drop manholes. Inside drop manholes where the incoming line discharges directly into the manhole and which do not require special fittings will be considered standard manholes.

**3102 MATERIALS.** The Contractor shall be required to use the materials shown on the City of Gardner Approved Materials List unless otherwise specified or approved by the City Engineer. The Approved Materials List is available on the City of Gardner public website at [www.gardnerkansas.gov](http://www.gardnerkansas.gov). The acceptable materials for manhole construction are outlined in Table 3102-1.

**Table 3102-1 - Sanitary Sewer Manhole Construction Materials**

| <b>Item</b>               | <b>Acceptable Material</b>   |
|---------------------------|--|
| Pre-Cast Concrete Manhole | Circular reinforced precast concrete shall conform to ASTM C478                                    |
| Concrete                  | Per Section 2000, KDOT 4.0 AE (4,000 psi minimum)  |
| Minimum Wall Thickness    | Per Section 3103   |
| Openings                  | Manhole/pipe connectors shall be cast into the manhole wall  |
| Manhole/Pipe Connectors   | Flexible gaskets shall conform to ASTM C923  |
| External Joint Sealant    | Adhesive tape shall conform to ASTM C877 Type III self-shrinking butyl rubber                      |
| Protective Manhole Liner  | Epoxy or polyurethane coating shall conform to ASTM D638, D658, D790, D792, D2240, D4060 and D7234 |

**3103 STANDARD MANHOLES.** All manholes shall be constructed in accordance with the Standard Details and requirements found herein. Manholes shall be precast unless otherwise specified or approved by the City Engineer. Precast bases shall be poured monolithically with the walls of the bottom manhole section. Concrete used for poured-in-place based for doghouse manholes shall conform to the Technical Specifications. Manholes may be constructed with either eccentric or concentric cones unless otherwise approved by the City Engineer.

Precast concrete manholes shall have a wall thickness not less than one-twelfth (1/12) of inside diameter plus one (1) inch or five (5) inches, whichever is greater. Precast concrete sections shall be inspected when delivered and all cracked or otherwise visibly defective units rejected. Excessive air pockets or cracks on either the interior or exterior surface of the precast sections shall be cause for rejection. A pipe to manhole connector using an ASTM C923 resilient device that provides a flexible watertight seal for pipes, including services, entering and exiting pre-cast concrete manholes shall be cast-in place at the time of manufacture by the pre-cast concrete manhole manufacturer.

**3104 CONSTRUCTION.** Manhole inverts shall be constructed of KDOT Grade 3.0 AE concrete conforming to the Technical Specifications.

In no case shall the invert section through a manhole be greater than that of the outgoing pipe. The shape of the invert shall conform to the lower half of the pipe it connects. Side branches shall be connected with as large of a radius of curvature as practicable. All inverts shall be troweled to a smooth clean surface.

Circular precast sections shall be provided with a mastic gasket or preformed flexible joint to seal joints between sections. The space between connecting pipes and the wall of precast sections shall be closed by a water-tight manhole pipe connector. Mortar shall not be placed in the open space on the outside of the manhole where the resilient connector penetrates the manhole wall. When the concrete invert fill is installed on the inside of the manhole, fill shall not be placed in the space on the top half of the pipe where the resilient connector penetrates the manhole wall.

All manholes under construction shall be covered in an appropriate manner to prevent entry of any storm water runoff, trench water, sand, earth, or any other foreign substances at any time during construction or while the manhole is unattended.

**3105 CASTINGS.** All manhole frames and covers installed within the 100-year floodplain shall be anchored to the manhole through the frame assembly, and all adjustment grade rings with not less than four 3/4-inch diameter anchor bolts shall have a minimum of four (4) inches of embedment into the concrete manhole.

**3106 CONNECTIONS TO EXISTING MANHOLES AND SEWERS.**

**Connections to Existing Manholes:** A pipe to manhole connector using an ASTM C923 resilient device that provides a flexible watertight seal for pipes entering and exiting manholes shall be installed by the Contractor from outside the manhole. All openings to accommodate these connectors shall be core drilled with approved equipment. No service line taps to existing manholes shall be allowed unless approved by City Engineer.

**Connections to Existing Sewer Lines:** Manholes installed over existing sewer lines require placement of a new precast manhole and replacement of the existing sewer pipe to the first joint in all directions.

**3107 MANHOLE STEPS.** All manholes shall be formed and cast without steps. Steps cannot be cut-off and patched.

**3108 GRADE RINGS.** Manholes shall be fitted with a grade ring(s) to support the manhole frame and cover to the specified final elevation, as needed. A maximum of three (3) rings will be accepted. These grade rings shall have a maximum of nine (9) inches of vertical adjustment. When field adjustments exceed nine (9) inches, precast concrete manhole sections shall be used to provide finished grade elevation. Contractor shall use angle grade rings to match finished pavement grade for manholes located in paved areas. Installation of grade rings shall be per manufacturer's recommendations.

Grade rings shall be as shown on the Approved Materials List. Concrete grade rings shall not be

allowed for sanitary sewer manholes.

**3109** **ACCEPTANCE TESTING.** Vacuum tests shall be conducted on all newly constructed manholes, existing manholes that have been repaired or restored or manholes constructed over existing sewers. Vacuum tests shall meet the requirements of ASTM C1244 except as modified herein.

Manholes shall be completely backfilled, up to and including the casting, before the vacuum testing begins. All lift holes shall be plugged with a non-shrinking mortar, as approved by the City Engineer. The Contractor shall plug all pipes connected to the manhole using pneumatic plugs. The pneumatic plugs should be placed into the pipe after the inside surface has been cleaned. Air shall be introduced into the plugs to 25 psig. Bracing can be used to ensure that the plugs are not pulled into the manhole during vacuum testing. After the manhole has been properly prepared, the vacuum tester shall be installed. The test head shall be placed on top of the casting or fit inside the casting in a manner which incorporates the casting and all adjustment and adaptor rings into the vacuum test. The vacuum pump shall be connected to the outlet port with the valve open. The outlet valve shall be closed after a vacuum draw of 10 inches of Mercury (Hg) has been obtained. The test shall pass if the vacuum maintains a minimum of 9 inches of Hg. in a time greater than one minute. If the manhole fails, the Contractor shall locate the leak and make proper repairs and then re-test. A visual inspection will be performed for each manhole by the City Engineer after the manhole has met the requirements of the vacuum test and is considered in its final state. The inspection shall determine the completeness of the manhole. Any defects identified shall be repaired to the City Engineer's satisfaction.

**SECTION 4000--STORM SEWERS**

**4001 SCOPE.** This section covers all labor, materials and equipment required for the complete installation of storm sewers and appurtenances. The work shall consist of storm sewer construction in accordance with these specifications and in conformity with the lines and grades shown on the approved plans. The term "Storm Sewer" shall refer to pipes, box culverts, vegetated or rock lined channels, junction boxes and inlets.

Reinforced Concrete Pipe (RCP) shall be used within the Right-of-Way (ROW) and for all street crossings. The RCP shall extend to the inlet structures located on both sides of the street crossing.

High Density Polyethylene (HDPE) pipe shall be allowed only outside the Right-of-Way and may be used under residential driveways. Corrugated Metal Pipe (CMP) shall not be permitted for any public storm sewer improvements.

Polypropylene (PP) pipe shall be allowed for storm sewer applications within the Right-of-Way.

**4002 MATERIALS.**

**Reinforced Concrete Pipe (RCP):** Reinforced concrete pipe (RCP) shall conform to the following minimum requirements:

- Round Pipe: ASTM C 76, Class III, Wall B, with Single Off-Set Joint conforming to ASTM C 443. Type R4-Confined Groove Joint conforming to ASTM C 443 shall be used where required by the City Engineer.
- Elliptical Pipe: ASTM C 507, Class HE-III
- Arch Culvert Pipe: ASTM C 506, Class A-III

The Contractor may be required to supply pipe exceeding these minimum requirements as stipulated in the approved plans.

Flexible gaskets conforming to ASTM C 1619 shall be required for all round pipe.

Mastic joints shall be required on all pipe that is not round. The mastic joint compound shall be a homogeneous blend of bituminous material, inert filler, and suitable solvents or plasticizing compounds thoroughly mixed at the factory to a uniform consistency suitable for sealing joints of concrete pipe. The compound shall conform to the following:

|  |           |
|--|-----------|
| Bitumen, soluble in CS <sub>2</sub> , percent by weight, minimum.....              | 45%       |
| Ash, percent by weight.....  | 15-50%    |
| Penetration, standard cone, 150g, 5 seconds,<br>25° C trowel grade, bulk type..... | 110-250mm |

**High Density Polyethylene Pipe (HDPE):** High density polyethylene (HDPE) corrugated pipe with an integrally-formed smooth interior wall shall conform to the requirements of AASHTO Designation M-294, Type S. Pipe. HDPE fittings shall be made of polyethylene compounds which meet or exceed the requirements of ASTM D 3350.

**Polypropylene Pipe (PP):** Polypropylene pipe (PP) corrugated pipe with an integrally formed smooth interior wall shall conform to the following requirements.

1. For 12-inch to 60-inch pipe, polypropylene pipe shall have a double wall with a smooth



interior and annular exterior corrugations and conform to ASTM F2881 and AASHTO M330. The pipe shall not be perforated unless otherwise specified by the City Engineer.

2. For 12-inch to 60-inch pipe, pipe shall be joined with a gasketed integral bell and spigot joint meeting the requirements of ASTM F2881.
3. Coupling bands shall cover at least two full corrugations on each section of pipe and shall prevent the infiltration of soil into the pipe.
4. Certification: All polypropylene (PP) pipe used for culvert and storm sewer applications shall be provided only by manufacturers that are certified through the National Transportation Product Evaluation Program (NTPEP) Third Party Certification program.

**4003 INSTALLATION.** This specification applies to the installation methods of both RCP and HDPE pipe.

**Handling and Protection:** All pipe shall be protected during installation against shock and free fall, and shall be installed without damage due to improper handling. Damaged pipe shall be removed from the site and replaced with new pipe at the Contractor's expense.

**Grade Control:** The alignment and elevation of the pipe shall conform to the requirements of the approved plans. The Contractor shall be responsible to remove and replace, at his cost, any pipe that does not meet the approval of the City Engineer.

**Laying:** The laying of pipe in graded trenches shall commence at the lowest point, with the bell end orientated upgrade. All pipe shall be laid with ends abutting in accordance with the line and grade indicated on the approved plans.

Pipes shall not be trimmed unless approved by the City Engineer. Pipes having defects may be utilized in areas where trimming is required, upon approval by the City Engineer.

**Bedding:** The pipe embedment shall conform to the requirements of the Technical Specifications and applicable Standard Details.

**Jointing:** Prior to making pipe joints, all surfaces shall be clean and dry. Lubricants, primers, adhesives and other substances shall be compatible with the jointing material recommended or specified.

All bell and spigot ends of RCP shall be primed prior to the application of the bitumastic material, if mastic joints are specified. A sufficient amount of bitumastic joint sealant shall be used to completely fill the annular space with some excess. The outside surface of the joint shall be wiped with additional bitumastic sealer to ensure a complete seal.

Flexible gaskets shall be placed around the spigot and rolled into place as the joint is assembled. O-ring gaskets shall be recessed in the groove on the spigot and confined by the bell after the joint is assembled. Lubrication shall be applied as recommended by the manufacturer.

**Backfilling:** Pipe backfilling shall conform to the requirements of the Technical Specifications.

**4004 CATCH BASINS, INLETS, AND JUNCTION BOXES.** Reinforced concrete storm sewer structures shall conform to the Standard Details. Concrete used in the structures shall have a minimum 28-day compressive strength of 4,000 psi and shall meet the requirements of the Technical Specifications. Concrete cover over steel reinforcement shall be not less than 1-1/2 inches for tops, walls and floors. The concrete shall be vibrated in a manner that prevents segregation. Small surface voids shall be grouted as directed by the City Engineer.

Inlet tops shall be cast-in-place construction. The elevation of curb inlet tops shall be established by the Contractor's surveyor placing fill marks on the installed storm sewer inlet box when the Contractor elects to pour the curb inlet tops prior to curb and gutter placement. Fill marks will not be required if curb inlet tops are poured after the curb and gutter has been completed. The concrete mix used for curb inlet tops shall conform to the requirements of the Technical Specifications. The inlet tops shall be broom finished and picture-framed. The inlet tops shall be doweled to the walls of the structure. Where sidewalks abut an inlet, tie bars shall be installed as shown on the applicable Standard Details. Variations may be made only with the approval of the City Engineer. Contractor shall install "No Dumping, Drains to Stream" markers per City requirements. The Contractor shall provide the markers per the Approved Materials List and supply the approved adhesive for installation. Wire brushing and cleaning of the concrete surface will be required prior to application of the adhesive.

The floors of all catch basins, inlets, and junction boxes shall have inverts. Inverts shall be constructed of concrete conforming to the requirements of the Technical Specifications, with the exception that the concrete shall have a minimum 28-day compressive strength of Class I 3000 psi.

The methods of excavation and backfilling for catch basins, inlets, and junction boxes shall conform to the requirements of the Technical Specifications and Standard Details of these specifications.

All catch basins, inlets, pipes, and junction boxes shall be free of any accumulation of silt, debris, or foreign matter of any kind at the time of final inspection.

**4005 REINFORCED CONCRETE BOX CULVERTS.** Construction and backfilling of reinforced concrete box culverts shall be done in conformance with the *KDOT Standard Specifications for State Road and Bridge Construction* unless otherwise specified or approved by the City Engineer.

Shop drawings for all precast box culverts shall be approved by the Design Engineer and provided to the City Engineer.

**4006 PAVED DITCHES AND RIPRAP.** Paving concrete for paved ditches shall conform to the applicable provisions of these Technical Specifications and shall conform to the standard drawings or approved equal.

The concrete shall be placed beginning at the lower end of the portion of the ditch to be lined and progressing toward the upper end. If required on the contract drawings, the concrete shall be reinforced with the type of reinforcement and in the manner indicated. Contraction or construction joints shall be spaced and formed as indicated on the contract drawings.

The surface shall be finished with a wooden float. A light brooming may be required for a more acceptable finish. Immediately after the finishing operations are completed, the concrete

shall be protected and cured in conformance with the requirements specified in the Technical Specifications.

Riprap shall be placed at the locations and to the dimensions shown on the contract drawings in accordance with the specified requirements.

Riprap shall be graded as necessary to form a dense blanket. The finished surface shall present an even surface conforming to the lines, grades, and sections given. Riprap shall be placed to a minimum depth of eighteen inches (18"). All riprap shall be placed on top of filter fabric.

Riprap shall be placed in such a manner that voids created by larger pieces are filled in by smaller pieces and no voids extend directly through the riprap to the surface below. The riprap shall be placed in rows transversely to the center line of the ditch and in the manner indicated on the drawings. The riprap shall be placed with ends and sides abutting and the joints between rows breaking with the joints in the preceding row.

Riprap shall consist of durable field or quarry stones. Riprap pieces shall range in weight from five (5) pounds to two hundred (200) pounds. Not less than 75 percent (75%) shall be within the range of one hundred (100) pounds to two hundred (200) pounds.

Stone for riprap shall be free from earth, soapstone, shale, shale-like or other easily disintegrated material that will tend to decrease the durability of the material after placement.

When grouted stone riprap is indicated the spaces between stones of grouted riprap shall be filled with grout consisting of one (1) part Portland Cement and three (3) parts of fine aggregate with sufficient water to form a plastic mix. The grout shall be poured and broomed into the spaces until they are completely filled.

**4007 HEADWALLS, WINGWALLS, ENDWALLS, AND END SECTIONS.** Construction and backfilling of headwalls, wingwalls, and endwalls shall be done in conformance with the *KDOT Standard Specifications for State Road and Bridge Construction*, unless otherwise specified or approved by the City Engineer.

End sections shall be installed according to all applicable Specifications, Standard Details and the approved plans. Precast concrete end sections may be used in place of cast-in-place concrete structures with the City Engineer's approval. RCP end sections shall be used for HDPE outfalls, unless otherwise approved by the City Engineer.

**4008 RESTORATION OF SURFACE CONSTRUCTION.** The restoration of concrete and asphalt pavement, gravel surfacing, walks, drives, curbs, and other surface construction removed or damaged during the progress of the work covered by this section shall conform to the applicable provisions of the Technical Specifications.

## **SECTION 5000--WATER LINES**

**5001 SCOPE.** This section covers all labor and materials for the construction of water lines including all thrust blocks, plugs, valves, pipe encasement, valve boxes, hydrants, connections to existing mains and other appurtenant work.

The City is not responsible for locating constructed waterline improvements until the Project Completion Certificate (PCC) has been approved. The Contractor is responsible for locating and protecting the waterline and appurtenances from damage until the project is accepted by the City Engineer.

All products to be used in contact with potable water shall be NSF 61 certified.

All products shall be NSF 372 certified to comply with the Reduction of Lead in Drinking Water Act, effective 2014.

**5002 PIPE FITTINGS.** The manufacturer of any material or equipment shall provide certification, in duplicate, to the City Engineer, indicating that their product meets these Standard Specifications and applicable AWWA standards. The certification shall be shipped with the product and be available to the City Engineer prior to installation.

All ductile iron fittings shall be encased in (1) layer of 8-mil polyethylene film or tape and shall conform to AWWA C105 with all ends sealed and visually inspected.

Polyethylene tubular or sheet encasement shall be free of tears, breaks, and defects. The film shall be linear low-density and shall be manufactured from virgin polyethylene material conforming to AWWA C105.

Polyethylene tape shall be 1-1/2-inch wide, plastic-backed adhesive tape. Duct tape or other tape not specified on the Approved Materials List shall not be used, unless otherwise approved by the City Engineer. Installation shall be as described in AWWA C105.

Any cuts, tears, punctures, or damage to the polyethylene encasement shall be repaired using adhesive tape or a short length of polyethylene sheet wrapped around the pipe to cover damaged area and secured in place.

Backfill material shall be free from cinders, refuse, boulders, rocks, stones or other material that could damage the film, and placed in accordance with the Standard Details.

**5003 PVC PIPE.** For water line diameters four (4") inches through twelve (12") inches, PVC shall meet the requirements of ASTM D1784, cell classification 12454-B for PVC compounds, and ANSI/AWWA C900, with the same outside diameter dimensions as ductile iron pipes. The pipe shall be Class 150 unless other designated by the City Engineer.

The location of all water mains shall be marked on the ground surface during construction. All marks shall remain until the project completion certification has been issued.

**5004 HDPE PIPE.** HDPE Pipe may be used for distribution mains that are less than twelve (12") inches in diameter. Water service pipe shall meet the requirements of ASTM D2239, AWWA C901, and NSF/ANSI Standards 14 and 61. All pipe dimensions shall adhere to the Iron Pipe Size (IPS) standards.

**5005 TRACER WIRE.** Underground tracer wire shall be installed to enable detection of all HDPE water mains and shall be installed in accordance with the Design Criteria.

Tracer wire used in open cut applications shall be 12 AWG copper clad steel with a 30 mil HDPE jacket and a minimum break load of 450 lbs. Tracer wire used in horizontal directional drilling applications shall be 12 AWG copper clad steel with a 45-mil blue HDPE jacket and a minimum break load of 1,150 lbs. Tracer wire for pipe bursting applications shall be 3/16" stainless steel with a 45 mil HDPE jacket and a minimum break load of 3,700 lbs.

The tracer wire system must be installed as a continuous single wire. Looping of the tracer wire is not allowed. All mainline tracer wires must be interconnected where tees and crosses are installed. Approved connectors shall be used at these locations and where any other splicing is allowed. Splicing is not allowed on the main line for directional drilling and pipe bursting applications.

The tracer wire shall be attached to the side of the watermain at approximately the 3 o'clock position with tape or tie-wraps.

The tracer wire shall be accessible at test stations and water meter pits for service connections. Enough tracer wire is required in each test station or meter pit to extend the wire a minimum of two feet above finished grade. Test stations will be required along the watermain at a maximum spacing of 800 feet, at intersections (tees and crosses), at dead-ends and at fire hydrants where the distance between the gate valve adjacent to the tee and the fire hydrant exceeds five feet. A single tracer wire will extend from the intersection to the test station at the fire hydrant.

All mainline dead-ends shall be grounded with an approved drive-in magnesium anode rod buried at the same depth as the tracer wire. Extended fire hydrant lines, including fire hydrants at cul-de-sacs, are also considered dead-ends. Test stations will be installed at locations where grounding is required.

The Contractor will perform a post-construction locate to verify the tracer wire is working as intended. This will be done prior to the issuance of the Project Completion Certificate.

**5006 GATE VALVES.** The type, size, and location of valves shall be as indicated on the approved plans. For working pressures from zero to 200 psi, valves shall be resilient seated, non-rising stem and conform to the requirements of AWWA C509.

The gate valves shall be fully encapsulated with resilient wedge disc, unobstructed waterway, counter-clockwise opening and designed for a working pressure of 200 psi. Valves shall be ductile iron conforming to ASTM A395 or A536. Bronze for internal working parts, including stems, shall not contain more than 2% aluminum nor more than 7% zinc, in accordance with ASTM B763 Alloy C99500, except that stem bronze shall have a minimum tensile strength of 60,000 psi, a minimum yield strength of 30,000 psi, and a minimum of 12% elongation in 2-inches. O-ring seals and Type 304 or 316 stainless steel body bolts conforming to ASTM F 593 shall be provided by the Contractor. A 2-inch AWWA operating nut for buried installations and a hand wheel for aboveground or in vault installations shall be provided.

Interior and exterior surfaces of gate valves shall have a factory applied, minim average dry film thickness of 8 mil, fusion-bonded epoxy coating in conformance with AWWA C504.

Valve ends shall be push-on type conforming to AWWA C111 except where flanged ends are required in exposed or above-ground applications. The end flanges of flanged gate valves shall be compatible with the connecting piping as required by AWWA C110.

All valves shall be provided with manual operators equipped with a wrench nut conforming to the requirements of AWWA C509.

The direction of rotation of the wrench nut to open the valve shall be to the left (counterclockwise). Each valve body or operator shall have cast thereon the word "*Open*" and an arrow indicating the direction to open.

All exposed bolts and nuts below grade that connect the pipe to the valve, shall be 316 stainless steel, with a hexagonal head, ANSI B18.2.2, heavy semi-finished pattern.

**5007 TAPPING SLEEVES AND VALVES.** Tapping sleeves shall be of Type 304 stainless steel construction with two half sleeves and flanged outlet. Sleeve halves shall be bolted together with 304 stainless steel bolts and nuts. Tapping valves shall have 304 stainless steel nuts and bolts. Gaskets shall completely surround the pipe to be tapped and be the same length as the sleeves. Gaskets shall be Styrene Butadiene Rubber (SBR) conforming to ASTM D2000. Flanged outlet shall be flat faced conforming to ANSI B16.5, Class 250. Tapping machines and cutting tools which have been specifically designed for the type of pipe to be tapped shall be used for all pipe connections.

Water service connection and inspection details are located in the Technical Specifications.

**5008 VALVE COATINGS.** All ferrous metal surfaces of valves and accessories, both interior and exterior, shall be shop-painted with fusion-bonded epoxy coating that meets or exceeds all applicable requirements of AWWA C550 Standard and is certified by ANSI/NSF 61.

Lining and coating shall be 100% solids, thermosetting, fusion-bonded, dry powder epoxy resin in accordance with the Approved Materials List. Epoxy lining and coating shall meet or exceed the requirements outlined in Table 5008-1.

*Table 5008-1 - Epoxy Lining and Coating Requirements*

| <b>Item</b>   | <b>Requirement</b>  |
|---|---|
| Hardness (minimum)  | Barcol 17 (ASTM D2583)<br>Rockwell 50 ("M" Scale)   |
| Abrasion Resistance (minimum)                                       | 1,000 cycles: 0.05 gram removed<br>5,000 cycles: 0.115 gram removed<br>ASTM D1044, Tabor CS 17 wheel, 1,000 gram weight |
| Adhesion (minimum)  | 3,000 psi (Elcometer)   |
| Tensile Strength  | 7,300 psi (ASTM D2370)  |
| Penetration   | 0 mil (ASTM G17)  |
| Adhesion Overlap Shear,<br>1/8-inch steel plate,<br>0.010 glue line | 4,300 psi (ASTM D1002)  |
| Impact (minimum)  | 100 inch-pounds<br>(Gardner 5/8-inch diameter tap)  |

**5009** **VALVE BOX AND EXTENSION STEM ASSEMBLY.** All buried valves shall be installed in 2-piece adjustable screw type valve boxes. Valve boxes shall be suitable for the depth of cover required by the drawings. Valve boxes shall be made of gray cast iron, ASTM A 48, Class 35, conform to the Standard Details, minimum of five (5) inches in diameter and shall have a minimum thickness of 3/16-inch at any point. Covers shall have cast thereon the word "Water."

Valve box and extension stem assemblies shall conform to the Approved Materials List.

Valves and valve boxes shall be set plumb. Each valve box shall be placed directly over the valve it serves, with the top of the box brought flush with the finished grade. After being placed in the proper position, gravel backfill shall be filled in around each valve box and thoroughly tamped on each side of the box up to within twelve (12) inches of finished grade.

In undeveloped areas, each valve box shall be marked with a fiberglass marking stake, furnished, and installed by the Contractor, identifying it as a City of Gardner water valve.

**5010** **FIRE HYDRANTS.** Fire hydrants shall be ductile iron cast and shall be furnished with a six (6) inch auxiliary gate valve. The fire hydrants shall be pressure rated for a minimum of 150 psi working pressure and 300 psi test pressure. Hydrants shall be traffic models with breakaway flange or coupling. Fire hydrants shall conform to AWWA C502. Table 5010-1 summarizes the fire hydrant requirements:

*Table 5010-1 - Fire Hydrant Requirements*

| Ite                          | Requireme   |
|------------------------------|---|
| Type of Shutoff              | Compression   |
| Size of Hydrant              | 5.25 inches   |
| Inlet Connection             | 6 inches  |
| Outlet Nozzles               | 2-2.5 inch hose and 1-4.5 inch pumper   |
| Outlet Nozzle Threads        | ANSI B26  |
| Direction to Open            | Counterclockwise  |
| Stem Seals                   | O-ring  |
| Drain Outlet                 | Required  |
| Paint System                 | Hydrant elbow, nozzle section, bonnet, weather shield, break flanges and nozzle caps shall be powder coated for corrosion protection. Coating shall be free of VOCs and shall be applied by the Manufacturer. See approved materials list for color specifications. |
| Weather Cap on Operating Nut | Required  |

Hydrants shall be restrained joint and furnished with all joint gaskets required for installation. Hydrants shall be set so that at least the minimum pipe cover is provided for the branch supply

line. Each hydrant shall be set on a concrete foundation at least twelve (12) inches square, six (6) inches thick, and shall be suitably anchored. Hydrants shall be installed using a maximum of one (1) vertical pipe extension. Extensions greater than eight (8) feet below finished grade shall require upsizing the extension one (1) nominal pipe diameter.

Hydrant drainage shall be provided by installing at least ½-cubic yard of ¾-inch rock around the hydrant and below the top of the hydrant supply pipe.

Fire hydrant installations shall conform to Standard Details. All hydrants shall stand plumb. The pumper-nozzle shall be aligned perpendicular to the major thoroughfare.

The hydrant barrel and shoe shall be secured using 316 stainless steel nuts and bolts. All exposed nuts and bolts below the ground level shall be 316 stainless steel and wrapped with polyethylene material, hexagonal, ASME B18.2.1, heavy semi-finished pattern.

Immediately before installation of a hydrant, the following operations shall be performed:

- The hydrant shall be thoroughly inspected.
- The hydrant interior shall be thoroughly cleaned.
- The hydrant shall be opened and closed as many times as may be necessary to determine if all parts are in proper working order, with valves seating properly and the drain valve operating freely.
- The packing gland shall be checked to determine if the packing is in place and the gland nut properly tightened.

**5011 FLUSHING ASSEMBLIES.** Flushing assemblies shall be provided at the locations shown on the drawings. Each installation shall be complete with all piping, the gate valve, valve box, covers and lids as required, and shall conform with the Standard Details.

**5012 MECHANICAL JOINT RESTRAINTS.** These shall be such that they can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA A21.11 and ANSI/AWWA C153/A21.53. Glands shall be manufactured of ductile iron conforming to ASTM A 536-80 and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. The device shall have a working pressure of at least 250 psi. Approved is the EBAA Iron, Inc., Megalug 1100 PV series for C900 pipe.

**5013 FLANGED JOINTS.** Flanges shall conform to ANSI B16.1, 125 pound or U.S. Pipe "Flange-Tyte." Bolts shall be ASTM A307, chamfered or rounded ends projecting 1/4- to 1/2-inch beyond the outer face of the nut which shall be ASTM A307, hexagonal, ANSI B18.2, heavy semi-finished pattern. Gaskets shall conform to ASTM D1330, Grade I, red rubber, ring type, 1/8-inch thick or U.S. Pipe "Flange-Tyte", 1/8-inch thick.

The pipe end and flange face shall be machine-finished in a single operation. Flange faces shall be flat and perpendicular to the pipe centerline.

When bolting flanged joints, care shall be taken to ensure that there is no restraint on the opposite end of the pipe or fitting which would prevent uniform gasket compression or which would cause unnecessary stress in the flanges. One flange shall be free to move in any direction while the flange bolts are being tightened. Bell and spigot joints shall not be packed or assembled until all flanged joints affected thereby have been tightened. Bolts shall be tightened gradually and at a



uniform rate, so that gasket compression is uniform.

- 5014 RESTRAINED JOINTS.** Restrained joints shall be push-on type. Where restrained joints are required or specified, the Mega-Lug, Field Lok® gasket, Fast Grip gasket or approved equal shall be used. Field Lok gaskets shall be used in approved Tyton® Joint, Starr, and Union Tite by Tyler Bells. Fast Grip gaskets shall be used in Fastite Bells. Both assemblies shall be capable of deflection of up to 5 degrees after assembly.

Restrained joint pipe shall be used where shown on the drawings and shall be installed in accordance with the recommendations of the pipe manufacturer. Each restrained joint shall be capable of resisting the thrust of the pressures to be applied.

- 5015 RETAINER GLANDS.** Retainer glands shall be manufactured by American "Mechanical Joint Retainer Glands" or Clow "F-1058" and may be used on 12" or smaller pipe for making connection to existing lines provided their installation is in accordance with the recommendations of the pipe manufacturer.

Retainer glands shall not be used on any new or relocated mains where restrained joints are indicated on the drawings.

- 5016 HANDLING.** Pipe, fittings, and accessories shall be handled in a manner that will ensure installation in a sound, undamaged condition. Equipment, tools and methods used in unloading, reloading, hauling, and laying pipe and fittings shall be such that the pipe, pipe coating and fittings are not damaged. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. Pipe and fittings in which the cement lining has been broken or loosened shall be replaced at the expense of the Contractor. The City Engineer shall make the final decision regarding the integrity of the cement lining.

All rejected pipes shall be replaced, with new pipe, at the Contractor's expense.

- 5017 CLEANING.** The interior of all pipe and fittings shall be thoroughly cleaned of foreign matter prior to installation and shall be kept clean until the work has been accepted. Before jointing, all joint contact surfaces shall be wire brushed if necessary, wiped clean, and kept clean until accepted.

- 5018 INSPECTION.** Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation. Spigot ends shall be examined with particular care since they are vulnerable to damage from handling. All defective pipe and fittings shall be removed from the site.

- 5019 ALIGNMENT.** Deflections from a straight line or grade shall not exceed the quantities stipulated in Table 1 or Table 2 of AWWA C600.

Either shorter pipe sections or fittings shall be installed where required by the alignment or grade.

- 5020 DEAD END LINES.** Fire Hydrants shall be installed at the end of all water mains which will have a future six (6) inch and larger water main extension, and at all other dead end lines in accordance with the Standard Details.

- 5021 CONNECTIONS TO EXISTING WATER MAINS.** Connections to existing water mains shall not be allowed for new water main extension projects until all testing and disinfection

requirements have been met and the connection has been approved by the City Engineer.

Contractor shall furnish and install the fittings necessary for connections between new water mains and existing water mains. The fittings shall be as indicated on the approved plans, unless otherwise authorized by the City Engineer. When the fittings consist of tapping sleeves and valves, the Contractor shall perform the actual tapping operation of the mains. The City Engineer shall provide the inspection of the Contractor's tapping procedure on all projects.

No connections to existing mains shall be started without prior approval of the City Engineer, and each connection with an existing main shall be made at a time and under conditions which will least interfere with service to customers. All existing ductile iron dead end line assemblies shall be removed prior to the continuation/extensions of waterlines.

When water supply is to be shut-off, the Contractor shall adhere to City of Gardner Waterline Shut-Down and Notice procedure, which is available at [www.gardnerkansas.gov](http://www.gardnerkansas.gov). Contractor must follow procedure to meet specification requirements. City personnel will not perform or allow shut down unless procedure is followed.

**5022 SANITARY SEWER LINE CROSSINGS.** Sanitary sewers and water lines shall be constructed a distance of 10 feet apart when they are to be installed parallel to each other. Exceptions to this requirement shall be granted only upon written approval by the Kansas Department of Health and Environment.

Where water lines are to be constructed over and across sanitary sewer lines, at least 2 feet shall be maintained between the bottom of the water pipe and the top of the sewer pipe. At locations where a 2-foot clearance cannot be maintained, the sewer pipe shall be constructed with casing pipe for a distance of at least 10 feet in each direction from the crossing. The casing pipe joints shall be located as far as practical from the pipe crossing.

Where water lines are to be installed under and across sanitary sewer lines, the sanitary sewer lines shall be constructed with casing pipe for a distance of at least 10 feet in each direction from the crossing. The casing pipe joints shall be located as far as practical from the pipe crossing.

**5023 RESTORATION OF SURFACE CONSTRUCTION.** See the City of Gardner Technical Specifications.

**SECTION 5100 – WATERLINE TESTING AND DISINFECTION**

**5101 GENERAL.** This section covers hydrostatic pressure testing, leakage testing, disinfection, and flushing of all new mains and appurtenances. All waterlines installed shall be tested as specified herein.

All testing work shall be done in the presence of the City Engineer. The contractor shall notify the City at least two (2) working days prior to testing.

Temporary discharge piping shall be provided for discharge of test water at a suitable location. Discharge of test water into sanitary sewers shall not be permitted.

**5102 TESTING EQUIPMENT AND FACILITIES.** The contractor shall provide all necessary equipment, materials, and facilities required for testing.

The Contractor shall provide a backflow device approved by the City Engineer for flushing activities.

Test pressures shall be applied by means of a force pump capable of maintaining the required pressure for the duration of each test.

The pressure gauge used shall be calibrated and acceptable to the City Engineer.

All pipe, fittings, valves, pipe joints, and other materials which are found to be defective shall be removed and replaced with approved material at the expense of the contractor.

**5103 PRESSURE AND LEAKAGE TESTING OF PVC WATER MAINS.** Pressure and leak testing shall meet the requirements set forth in the latest edition of KDHE'S *Policies, General Considerations and Design Requirements for Public Water Supply Systems in Kansas*.

The hydrostatic pressure during testing shall be 150 PSI and in no case, shall the test pressure exceed the pressure rating for the pipe, valves, and appurtenances. Test pressure shall be maintained for a minimum of 2 hours.

Leakage measurements shall not be started until test pressures have sufficiently stabilized. The Contractor shall furnish and install a water meter for testing on the pressure supply piping of the force pump.

Allowable loss for the minimum 2-hour test shall be computed as follows:

$$\text{For PVC: } L = \frac{SD(P^{0.5})}{148,000}$$

L = Allowable leakage, in gallons per hour  
 S = Length of pipe tested, in feet  
 D = Nominal diameter of the pipe, in inches  
 P = Average test pressure during the leakage test, in pounds per square Inch (gauge) (PSIG)

Line leakage shall be the total amount of water introduced into the line as measured by the meter during the leakage test.

The test pressure shall be restored whenever it drops 5 psi. A calibrated recorder shall be used during the test and the results of the test shall be provided to the City Engineer. The amount of water needed to re-pressurize the line shall be measured each time re-pumping is required.

In the event that the system contains pipe of more than one size, the allowable leakage shall be calculated separately for each segment of pipe and then summed to obtain the total allowable leakage from the entire system.

**5104 PRESSURE AND LEAKAGE TESTING OF HDPE WATER MAINS.** Pressure and leak testing of HDPE water mains shall be in accordance with ASTM F2164 and the manufacturer’s recommendations. The Contractor shall furnish a calibrated water meter for the purpose of measuring the water introduced into the line where required.

The hydrostatic pressure during testing shall generally be 150 PSI and in no case shall the test pressure exceed the pressure rating for the pipe, valves and appurtenances. If the temperature of test section is greater than 80 degrees Fahrenheit, the test pressure shall be multiplied by the factors shown in Table 5104-1.

**Table 5104-1 – Elevated Temperature Multiplier**

| Test Section Temperature (°F) | Test Pressure Factor |
|-------------------------------|----------------------|
| ≤ 80                          | 1.00                 |
| ≤ 90                          | 0.90                 |
| ≤ 100                         | 0.80                 |
| ≤ 110                         | 0.75                 |
| ≤ 120                         | 0.65                 |
| ≤ 130                         | 0.60                 |
| ≤ 140                         | 0.50                 |

The maximum test duration, including time to pressurize, time for initial expansion, time at test pressure, and time to depressurize shall be less than 8 hours.

**5105 DEFECTS.** All joints in piping shall be watertight and free from visible leaks during the prescribed leakage test and throughout the duration of the two (2) year maintenance period.

Leaks in mechanical and push on joints shall be repaired by dismantling, cleaning, realigning gland and gasket, and re-bolting. The gland bolts shall not be tightened beyond the allowable torque limits.

Wrap-around bands shall not be used for repairs.

**5106 TAPPING SLEEVES AND VALVES.** The tapping sleeve and valve will be tested in place with water for 30 minutes. Test pressure must not exceed rated working pressure (150 psig). No leaks will be permitted.

**5107 DISINFECTION.** Materials, methods and procedures for disinfection work shall conform to the requirements of the latest revision of AWWA C651, *Standard for Disinfecting Water Mains*, except as modified herein.

**General:** Water in reasonable amounts for proper completion of flushing or disinfection work shall be furnished at existing fire hydrants at the Contractor's expense. The Contractor shall furnish all necessary labor, pipe, hose, nozzles and tools. The Contractor shall schedule testing at least two (2) working days prior to testing. The City Engineer shall determine the flowrate and duration of each withdrawal from the distribution system.

All hydrants and valves involved in the disinfection operation shall be bagged by the Contractor as "Out of Service".

**Disinfection:** The pipelines shall be disinfected by the continuous feed method. The chlorine feed shall be proportional to the rate of flow into the pipe so that the entering water contains at least 25 mg/L of chlorine. The chlorine solution shall be retained in the pipeline for at least twenty-four (24) hours and the free chlorine residual at the end of the period shall equal to or greater than 10 mg/L.

Prior to flushing the line, a test shall be conducted to verify the chlorine residual. Such test shall be performed by the City Engineer using the DPD (N, N Diethyl-1, 4 Phenlenediamine) method in accordance with EPA approved methodology (Standard Method 4500-Chlorine-G). The Contractor shall dispose of chlorine and flushing water in a proper manner at no cost to the City. The Contractor shall prevent the chlorine solution from entering the supply system during the disinfection process. The Contractor shall ensure a flushing outlet is open at all times during the pumping process to prevent pressure from building in the line being disinfected.

Prior to flushing the pipe of chlorinated water, the discharge environment shall be inspected. Sodium bisulfite or an approved equal neutralizing chemical shall be applied to the chlorinated discharge to assure thorough neutralization of the chlorine residual in environmentally sensitive discharge locations in accordance with the latest revision of AWWA C655. The chlorinated water shall be neutralized, and the free chlorine shall be non-detectable unless the City Engineer deems dechlorination is not necessary.

During disinfection, all valves and hydrants shall be operated to ensure that all appurtenances are disinfected. During final flushing operations, valves shall be manipulated in such a manner that the chlorine solution will not flow back into the supply line.

Following the successful disinfection process, the disinfection corporation shall be removed and replaced with a brass plug. Saddles shall not be allowed unless otherwise approved by the City Engineer on PVC water lines.

**Flushing:** All flushing work shall be done in the presence of the City Engineer. All flushing and sampling must be completed utilizing a combination blowoff and sampling tap in accordance with Standard Details. The Contractor shall notify the City Engineer at least twenty-four (24) hours in advance of the flushing operation.

Flushing of waterline and appurtenances, after the disinfection process, shall be performed with a minimum velocity of at least three (3) feet per second. All flushing shall be performed after the hydrostatic test is completed and accepted.

Below is Flushing Table 3 from AWWA C651 for Continuous-Feed Method for Chlorination.

**Table 3 Required flow and openings (either taps or hydrants) to flush pipelines at 3.0 ft/sec (0.91 m/sec) (40 psi [276 kPa] residual pressure in water main)\***

| Pipe Diameter |             | Flow Required to Produce 3.0 ft/sec (approx.) Velocity in Main |                | Size of Tap Used, <i>in. (mm)</i> |         |        | Number of Hydrant Outlets |                 |
|---------------|-------------|--|----------------|-----------------------------------|---------|--------|---------------------------|-----------------|
|               |             |  |                | 1 (25)                            | 1½ (38) | 2 (51) |                           |                 |
| <i>in.</i>    | <i>(mm)</i> | <i>gpm</i>   | <i>(L/sec)</i> | Number of Taps Required on Pipe†  |         |        | 2½-in. (64-mm)            | 4½-in. (114 mm) |
| 4             | (100)       | 120  | (7.4)          | 1                                 | —       | —      | 1                         | 1               |
| 6             | (150)       | 260  | (16.7)         | —                                 | 1       | —      | 1                         | 1               |
| 8             | (200)       | 470  | (29.7)         | —                                 | 2       | —      | 1                         | 1               |
| 10            | (250)       | 730  | (46.3)         | —                                 | 3       | 2      | 1                         | 1               |
| 12            | (300)       | 1,060  | (66.7)         | —                                 | —       | 3      | 2                         | 1               |
| 16            | (400)       | 1,880  | (118.6)        | —                                 | —       | 5      | 2                         | 1               |

\*With a 40-psi (276-kPa) pressure in the main with the hydrant flowing to atmosphere, a 2½-in. (64-mm) hydrant outlet will discharge approximately 1,000 gpm (63.1 L/sec); and a 4½-in. (114-mm) hydrant outlet will discharge approximately 2,500 gpm (160 L/sec).

†Number of taps on pipe based on 3.0-ft/sec discharge through 5 ft (1.5 m) of galvanized iron (GI) pipe with one 90° elbow.

**Bacteriological Tests:** After chlorine solution has been flushed out of the line, and before the line is placed in service, samples shall be collected by the City Engineer to confirm the presence or absence of coliform organisms. The samples shall be collected and tested in accordance with EPA sampling and preservation techniques.

Flushing of the waterline between two consecutive bacteriological testing samples shall not be allowed except for a minimum amount to flush the sampling taps. Two consecutive sets of acceptable samples, taken at least 24 hours apart, shall be collected from the new main.

At least one set of samples shall be collected from every 1,200 ft. of the new water main, plus one set from the end of the line and at least one set from each branch. The test results shall be provided to the City Engineer and the Contractor. These initial tests shall be made at no cost to the Contractor. A certified testing laboratory may be used if approved by the City Engineer.

If initial disinfection testing fails, the new main may be flushed and shall be re-tested. If the second set of tests also fails, the main shall be disinfected and flushed until satisfactory test results are obtained. All disinfection, repetitive testing and sampling costs incurred shall be at the expense of the Contractor.

**5108 CUTTING INTO EXISTING WATERMAINS.** If the trench is wet, liberal quantities of hypochlorite shall be applied to the open trench to reduce risk of contamination.

When connections of pipe equal to or less than 20-feet in length are made to an existing system, the exposed pipe and fitting interiors shall be sprayed or swabbed with a minimum 1% chlorine disinfection solution.

When connection length is greater than 20-feet, the piping shall be assembled aboveground and shall meet the requirements of these Technical Specifications. Between the time of satisfactory bacteriological samples and installation, the ends of the piping must be sealed or capped.

## **SECTION 5200 - WATER SERVICE CONNECTIONS**

**5201 GENERAL.** The contractor shall supply all materials, labor and equipment necessary for water service reconnection as indicated on the plans. This shall include tapping of the main, boring of road crossings, compaction and resodding of the established lawns.

The Contractor shall notify the City of the intent to perform this work a minimum of forty-eight (48) hours in advance of water service outages and shall notify any customers that will be affected twenty-four (24) hours in advance of water service disruption. City crews shall operate all necessary valves to assist in the main tap, when necessary. For further information on water taps please see the Water Taps Policies and Procedures.

Water services will not be allowed for any parcels outside the City Limits without prior approval from the City Engineer.

**5202 APPROVED MATERIALS FOR RECONNECTION TO DUCTILE IRON PIPE.**

Contractor shall be required to use the materials shown on the City of Gardner Approved Materials List unless otherwise specified or approved by the City Engineer. The approved Materials List is available on the City of Gardner public website at [www.gardnerkansas.gov](http://www.gardnerkansas.gov).

**5203 APPROVED MATERIALS FOR RECONNECTION TO PVC PIPE.** Contractor shall be required to use the materials shown on the City of Gardner Approved Materials List unless otherwise specified or approved by the City Engineer. The approved Material List is available on the City of Gardner public website at [www.gardnerkansas.gov](http://www.gardnerkansas.gov).

**5204 METER INSTALLATION.** All meter setters shall be located at the direction of the Engineering Division.

Water meter pits shall be placed at the property/right-of-way line of the service address. Alternate locations must have prior approval by the city engineer.

All meter setters shall be set in the meter tile so that the face of the meter is at least 16 inches, but not more than 22 inches, below the finished grade.

Meter pits shall not be located in driveways, walkways or cast-in concrete without prior approval from the city engineer. Traffic model rings and lids shall be installed when required for these instances.

All meter tiles shall be set plumb, backfilled and compacted with earth.

Each meter tile shall be centered directly over the meter that it serves.

The top of the tile cover shall be flush with the finished grade.

**5205 HDPE SERVICE LINES.** HDPE for service Lines shall be pigmented blue throughout. For Sizing requirement see table 5205-1.



Table 5205-01: Service Connections

| Size Standard | Size Range    | Material Specification           |
|---------------|---------------|----------------------------------|
| CTS           | 1" – 3"       | AWWA C901 4710 DR9 PC250         |
| IPS           | 2" – 3"       | AWWA C901 4710 DR11 PC200        |
| IPS           | 4" and larger | AWWA C906 3408/4710 DR13.5 PC160 |

Stiffeners must be used in the ends of HDPE. Approved Tracer Wire must be used: #12 AWG Copperhead Reinforced Trace Wire (Blue in color).

All taps 1 ½" and larger to the water main are to be five (5) feet minimum from any pipe joint in the water main or other taps on the water main.

All 1" taps to the water main are to be 18" from any pipe joint in the water main or other taps on the water main.

The applicant shall furnish and install HDPE from the corporation stop to property line with exact forty-two (42) inch depth at the meter pit. All other points shall have a minimum cover of forty-two (42) inches except for gooseneck.

Piping shall be one continuous line with no intermediate couplings unless approved by the City Engineer.

Only compression type couplings shall be used underground.

The piping between the water main and the water pit shall be in line with the corporation stop and perpendicular to the main. Horizontal bends or offsets are not allowed. The minimum separation between the water service line and any other utility or sewer line shall be three (3) feet, and a minimum of ten (10) feet of separation from any parallel sanitary sewer.

No fitting shall be installed under pavement unless approved by the City Engineer.

Water service lines shall not be placed within a casing under street crossings.

Backfill shall be compacted immediately after placement of the service line. Uncompacted meter pits shall not exceed eight (8) locations. Backfill shall be in accordance with the Technical Specifications.

**5206 RESIDENTIAL (5/8" through 1") INSTALLATIONS.** The water meter and corporation stop for 5/8" and 1" services shall be provided by the City. Contractor shall supply appurtenant materials required to install the meter. If the water main is HDPE, the contractor shall have a certified fuser to fuse the saddle onto the water main. The City Engineer shall be present for the fusion of the saddle.

The meter face must be between 18" and 22" from the finish grade to reduce the chance of freezing and allow easy access for maintenance.

All service lines must have a 6" to 8" gooseneck from the tap and must remain in contact with the ground. PB-2 backfill must be placed around the looped section.

**5207 RESIDENTIAL AND INDUSTRIAL (3” and larger meter) INSTALLATION.**

**Plan Submittal:** Plans, shop drawings and material specifications for all work shall be submitted to the City Engineer for approval prior to construction. Plans shall include the

location of proposed work, location of property lines and the location of other existing or proposed utilities.

**Materials:** The following chart indicates the minimum lay length based on meter size. The lay length is summing of the meter, flanged adapter, and plain end by flanged end pipe lengths. AWWA Manual M6 provides more installation guideline for large meter.

*Table 5207-01: Meter Lay Lengths*

| Water Meter |                    |
|-------------|--------------------|
| Meter size  | Minimum lay length |
| 3 in        | 48 in              |
| 4 in        | 50 in              |
| 6 in        | 62 in              |
| 8 in        | 67 in              |

All piping shall be DIP (Ductile Iron Pipe) sized. All valves and fittings within the meter pit shall have flanged ends. A flanged adapter shall be used on the outlet end of the water meter. All valves and fittings outside the meter pit shall be connected using mechanical joints.

Pipe supports shall be installed to support the pipe as needed. Under no condition shall there be more than three (3) fittings between supports. The supports shall be galvanized, or stainless-steel construction fastened to a concrete footing with a locking nut.

Tapping sleeves shall be designed for a minimum working pressure of 200 psi and shall be flanged outlet type and provided with mechanical joints and end gaskets at each end. All connections shall have polyethylene encasement in accordance with the Technical Specifications. Anchoring pipe shall be factory fabricated from Class 54 Ductile Iron pipe.

**Meter Vault Design:** Meter vaults are not to be covered or placed in a driveway/traffic area. The vault lid must be removable and have 4 recessed lifting eyes placed approximately two feet from each corner to ensure the lid can be removed for maintenance. The lid shall be sealed with a butyl sealant to prevent water seepage. The meter lid should be placed directly over the meter and an additional 36” access lid for vault entry in accordance with the Standard Details.

*Table 5207-02: Water Meter Vaults*

| Water Meter |                    | Meter Vault General Dimensions |                 |                        |                 |
|-------------|--------------------|--------------------------------|-----------------|------------------------|-----------------|
| Meter Size  | Minimum Lay Length | Minimum Length of Vault        | Inside of Meter | Minimum Width of Vault | Inside of Meter |
| 3 in        | 48 in              | 8.2 ft                         |                 | 4.4 ft                 |                 |
| 4 in        | 50 in              | 8.8 ft                         |                 | 4.4 ft                 |                 |
| 6 in        | 62 in              | 10.6 ft                        |                 | 4.7 ft                 |                 |
| 8 in        | 67 in              | 11.5 ft                        |                 | 5.2 ft                 |                 |

**5208** **INSPECTION.** All materials and workmanship shall be subject to inspection and testing by the City. Defective material and workmanship shall be repaired or replaced as directed by the City Engineer. The Contractor shall furnish all materials necessary for all testing.

A hydrostatic test shall be performed prior to making a connection. A hydrostatic test shall be conducted and must hold 150 psi or 1.5 times the operating pressure, whichever is greater, for a minimum of two (2) hours prior to connection. The City will have a representative available for the test.

**5209** **TAPPING.** The Contractor shall make all taps on the new water main and shall be inspected by the City. Dry tapping of water mains will not be allowed. Contractor shall not schedule tapping of water service until pressure and bacteriological testing have met City and State requirements.

The contractor shall expose the water main immediately prior to tapping.

Excavation and backfilling of the main must be done in the same eight-hour day between 8 A.M. and 5 P.M. It must be filled immediately after the tap is made and inspected.

Taps shall not be performed when the temperature is at or below 32° F or during inclement weather. All taps and water meters shall be protected from freezing. If damage caused by freezing, replacement is required at the expense of the Contractor.

Any irrigation or other taps made on the customers service line should be a minimum of three (3) feet outside the water meter pit on the customers service line. Any connections made less than three (3) feet of the water meter pit will be disconnected and replumbed at the contractor's expense.

All barricades and warning devices shall be provided and maintained by the contractor.

**5210** **SALVAGE MATERIALS.** All usable items salvaged from the existing distribution system, including fittings, valves, meters, etc., shall be field-cleaned and transported by the Contractor to the City's designated storage yard and shall remain the property of the City.

## **SECTION 6000 – PIPELINE EXCAVATION, TRENCHING AND BACKFILLING**

**6001 SCOPE.** This section covers the excavation, trenching, bedding, backfilling and other appurtenant work required for underground pipeline installations.

**6002 GENERAL REQUIREMENTS.** Excavation work shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards. Excavations shall provide adequate working space and clearances. In no case shall excavation faces be undercut for extended footings.

Excavations for manholes and similar structures shall provide sufficient clearance for exterior work such as pipe installation and wrapping of manhole section joints.

Backfilling during freezing weather shall not be permitted, unless otherwise approved by the City Engineer. No backfill material shall be installed on frozen surfaces, nor shall frozen materials, snow or ice be placed in any backfill.

**6003 CLASSIFICATION OF EXCAVATED MATERIALS.** When specifically indicated in the approved plans, classification of excavated materials will be made as follows:

- a. Rock. In accordance with the Technical Specifications.
- b. Earth. All material not classified as rock.

**6004 CLEARING.** The contractor shall clear all areas necessary for access, storage of pipeline materials and construction of the pipeline and appurtenant structures in conformance with the Technical Specifications.

**6005 DEWATERING.** The contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and ground water entering excavations and trenches. Dewatering operations shall continue throughout embedment preparation until the pipe installation is completed and no damage from hydrostatic pressure, flotation or other cause will result.

All excavations for trenches, which extend down to or below groundwater, shall be dewatered by excavating adjacent to the trench. The dewatering excavation shall lower the groundwater elevation to twelve (12) inches or more below the bottom of the trench.

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 shall be responsible for maintaining any pipe utilized for drainage purposes, and all such pipes shall remain clean and free of sediment.

**6006 SHEETING AND SHORING.** Sheet piling and shoring shall conform to the requirements in the Technical Specifications.

**6007 ALIGNMENT AND GRADE.** The alignment and grade or elevation of each pipeline shall be maintained as shown on the approved plans.

**6008 MINIMUM COVER (Water Mains and Service Lines).** Where pipe grades or elevations are not definitively fixed by the approved plans, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill covering the top of the pipe of forty-two (42) inches in unpaved areas and forty-eight (48) inches in paved areas. Greater pipe cover depths may be necessary on vertical curves or to provide necessary clearance beneath existing pipes, conduits, drains, drainage structures or other obstructions encountered at normal pipe grades. Measurement of pipe cover depth shall be made vertically from the outside top of pipe to finished ground or pavement surface elevation.

**6009 STABILIZATION.** Trench bottoms which become unstable during construction operations shall be stabilized, at the expense of the Contractor. Stabilization shall be achieved using crushed rock or other suitable material as necessary to provide a firm and stable base. Not more than one-half (1/2) inch depth of mud shall be allowed to remain on the stabilized trench bottom when the granular pipe bedding is installed.

**6010 TRENCH EXCAVATION.** The contractor shall not open more trench in advance of laying pipe than is necessary to expedite the work. One hundred-fifty (150) feet shall be the maximum length of open trench on any line under construction. The Contractor shall backfill all open trenches by the end of the work day, except as necessary for inspection or continuation of the work.

Except where alternate methods of construction are shown on the approved project plans, all trench excavations shall be open cut from the surface, unless otherwise approved by the City Engineer.

The Contractor shall be responsible for the safety of the excavation, which shall comply with all OSHA regulations pertaining to trench safety. All open trenches shall be provided with adequate protective devices.

**6011 LIMITING TRENCH WIDTHS.** Trenches shall be excavated to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing, and embedment. Rock encountered during excavation shall be removed to provide a clearance of six (6) inches below and on each side of all pipes. These distances are minimum clear distances which will be permitted between part of the pipe and any part, projection, or point of such rock.

Cutting trench banks on slopes to reduce earth load to prevent sliding and caving will be permitted only in areas where the increased trench width will not interfere with surface features or encroach on right-of-way limits. Slopes shall not extend lower than one (1) foot above the top of the pipe.

Trench widths below an elevation of one (1) foot above the exterior top of the installed pipe shall be not less than fifteen (15) inches nor more than twenty-four (24) inches greater than the nominal outside diameter of the pipe.

**6012 UNAUTHORIZED TRENCH WIDTHS.** Where the width of the lower portion of the trench exceeds the widths permitted in these Technical Specifications, special pipe embedment shall be used as determined by the City Engineer at the expense of the Contractor.

**6013 MECHANICAL EXCAVATION.** The use of mechanical equipment shall not be permitted in locations where its operation could cause damage to trees, buildings, culverts or other existing property, utilities or structures above or below ground.

Mechanical equipment used for trench excavation shall be capable of excavating the trench to the depth, width and alignment required to install the pipeline in accordance with the approved plans and Standard Details. Undercutting the trench sidewall to obtain clearance will not be permitted.

**6014 ARTIFICIAL FOUNDATIONS IN TRENCHES.** As directed by the City Engineer, the Contractor shall over excavate and stabilize the trench with suitable material to provide a stable foundation. All concrete or other foundations shall be installed as directed by the City Engineer. Compensation for extra excavation, concrete, or other foundations, except where provided by contract unit prices, shall be made in accordance with the contract provisions for extra work.

**6015 PIPE BEDDING.** The pipe shall be laid in a flat-bottom trench which has been graded and shaped to provide continuous support along the full length of the pipe and pipe joints. Blocking of the pipe will not be permitted. It shall be permissible to slightly disturb the finished subgrade surface by withdrawal of pipe slings or other lifting tackle.

After each pipe has been graded, aligned, placed and jointed on the bedding material, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations.

Embedment material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement. Spreading and compacting of the embedment material above the top of the pipe shall be done in a manner that does not damage or compromise the shape of the pipe.

Granular material used for embedment shall meet KDOT Standard Specification 1107, PB-2 gradation. The embedment material shall not contain clay lumps or organic matter.

**A. Water Mains:** Bell holes shall be excavated in the bottom of the trench to provide ample working space and ensure proper pipe support. No part of the bell shall be in contact with the trench bottom.

Granular embedment material is required for all pipe installations, including rock excavations, and shall conform to the Standard Details.

**B. Sanitary Sewers:** Granular embedment material conforming to the Standard Details is required for all pipe installations. Granular embedment material shall completely envelope all sanitary sewer mains, service connections and lateral lines (to the right-of-way).

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

Groundwater barriers shall be provided to impede the conveyance of groundwater along the pipe at approximately the midpoint of the pipe when the distance between manholes exceeds 280 feet. Groundwater barriers for sewer lines shall be flowable fill consisting of one four (4) feet long, impervious plug spanning the full width and depth of the trench. The flowable Fill shall have a maximum 28-day compressive strength of 100 psi and conform to KDOT Standard Specification Section 843 for Low-Strength Mixture. The 4-foot groundwater barrier shall not be located within a proposed street.

**C. Storm Sewers:** Pipe embedment for storm sewers shall conform to the Standard Details.

**6016 PIPE INSTALLATION.** All work shall be in accordance with the following standards or as specified herein. Prior to backfill, all pipe installations shall be inspected by an authorized representative of the city. All pipe not inspected prior to installation shall be uncovered and inspected.

Flexible Thermoplastic Pipe; ASTM D2321

Ductile Iron Water Mains; AWWA C600

Polyvinyl Chloride Water Mains, C900

High-Density Polyethylene Pipe, ASTM D2321

Reinforced Concrete Pipe

Joints for reinforced concrete pipe shall conform to Section 7 of ASTM C361, except that gaskets shall have a circular cross section and shall be confined in a groove in the pipe spigot. Pipe with collars in lieu of integral bells will not be acceptable.

Core holes and handling holes in concrete pipe shall be repaired by cementing a properly-shaped concrete plug in place with epoxy cement or by other methods acceptable to the engineer.

Lateral displacement of the pipe shall be prevented during embedment operations. Pipe shall not be laid in water, nor under unsuitable weather or trench conditions.

All joint preparation and jointing operations shall comply with the instructions and recommendations of the pipe manufacturer.

Hooks shall not be permitted to contact joint surfaces. Care shall be exercised in handling all pipes to prevent damage to pipe ends. Damaged pipe or pipe damaged in laying shall be replaced by and at the expense of the contractor.

**6017 TRENCH BACKFILL.** The requirements of this section refer to the portion of the trench that is located above the embedment material.

**Future Street Crossings:** All future street crossings, from back of the curb to back of the curb, shall be backfilled with flowable fill as measured from the top of pipe embedment to the bottom of the future subgrade.

Flowable fill used for backfilling shall meet KDOT Standard Specification Section 843.

**Existing Street Crossings:** All existing street crossings, from four (4) feet back of the curb to four (4) feet back of the curb, shall be backfilled with flowable fill from the top of pipe embedment to the bottom of street patch and shall conform to the Standard Details. The flowable fill shall have a maximum 28-day compressive strength of 100 psi and conform to KDOT Standard Specification Section 843 for Low-Strength Mixture.

**All Other Locations:** Compacting backfill shall be required for the full depth of the trench above the embedment at all other locations unless otherwise specified or directed by the City Engineer. The backfill material for trenches located within the right-of-way shall be compacted to ninety-five (95) percent of maximum density at optimum moisture. Trenches located outside of the right-of-way or other paved areas shall be compacted to ninety (90) percent of maximum density at optimum moisture unless otherwise specified or directed by the City Engineer.

At the option of the Contractor, compacted backfill may be job-excavated material or graded gravel unless otherwise specified or directed by the City Engineer. Job-excavated material may be used for compacted trench backfill when the job-excavated material is finely divided and free from debris, organic material, cinders or other corrosive material. Job-excavated material may contain rubble and detritus from rock excavation, stones, and boulders but none shall be placed within three (3) feet of the top of the pipe or in the upper eighteen (18) inches of the trench. The material resulting from rock excavation may be placed in the remaining area of the trench providing the material is of sufficient gradation to prevent future trench settlement. Job-excavated material used for trench backfill shall be approved by the City Engineer prior to use.

Compact masses of stiff clay or other consolidated material more than one (1) cubic foot in volume shall not be permitted to fall more than five (5) feet into the trench unless cushioned by at least three (3) feet of backfill material placed above the top of the pipe.

Backfill shall not be placed when material contains frost, is frozen or a blanket of snow prevents proper compaction. Backfill shall not contain waste material, organic material or debris of any kind.

The top portion of the backfill beneath established sodded areas shall be finished with at least six (6) inches of topsoil corresponding to, or better than, the adjacent topsoil. Topsoil shall be approved by the City Engineer prior to placement, and unless otherwise directed, shall be material previously excavated and stockpiled for that purpose during excavating and grading operations. Grades on areas to receive topsoil shall be established and maintained as a part of the grading operations. Immediately prior to spreading topsoil, the surface shall be loosened by discing or scarifying to a depth of two (2) inches to permit bonding of the topsoil to the underlying surface.

**6018 FLOWABLE FILL.** No material shall be used until it has been checked or tested for compliance with these specifications and approved by the engineer. Representative samples of all materials proposed for use under these specifications shall be submitted to a private laboratory by the contractor, at the contractor's expense, for testing and preparation of trial mixes to determine the mix design. All tests necessary for determining conformance with the requirements specified herein shall be at the contractor's expense. KCMMB mix design for flowable fill shall be submitted to the city for approval.

Laboratory test specimen(s) of the slurry mix, combined in proportions of the job mix design,



shall be prepared and tested and shall meet the following requirements:

Removable:

28-day Compressive Strength            200 psi (1400 kPa) (maximum)  
Final Set, ASTM C266                    2 hrs. (maximum)

Mix Design (+/-):

Cement.....144 lbs.  
Water.....396 lbs.  
Sand.....2698 lbs.  
A/E.....13%

At the time of delivery, the slurry shall not be less than 60 degrees F (16 degrees C) nor more than 80 degrees F (27 degrees C).

Slurry shall not be placed on frozen material nor be used to displace water. It shall be placed to fill the voids and to the grades shown on the plans or as directed by the engineer. It shall not be used to displace or replace pavement materials.

**6019 STRUCTURE BACKFILL.** Backfill around structures shall be compacted to ninety-five (95) percent of maximum density at optimum moisture, unless otherwise approved by the City Engineer. Granular material conforming to KDOT Standard Specification Section 1107 Aggregates for Backfill, PB-2, shall be used to backfill structures located within the street to four (4) feet back of the curb unless otherwise specified or approved by the City Engineer. Weep holes for storm sewer structures shall not be obstructed with impervious backfill.

The required moisture content shall adhere KDOT MR3-3. A maximum of 3 percentage points above optimum, and a maximum of 3 percentage points below optimum.

Material for soil backfill shall be composed of earth only and shall contain no wood, grass, roots, broken concrete, stones, trash or debris of any kind. The backfill material shall require the approval of the City Engineer prior to placement, and shall not be deposited or compacted in water.

Backfilling of structures shall not occur prior to three (3) days after form removal or until the concrete has attained design strength in accordance with the Technical Specifications.

**6020 DENSITY TESTING.** In-place field density testing to determine compliance with specified compaction requirements must be performed every lift every one thousand (1000) feet unless otherwise requested by the contractor at the recommendation of a Geotech and approved by the City Engineer. If, as a result of this field testing, the City Engineer determines that further compaction is required, the contractor shall revise his compaction procedures to obtain the results specified or remove and replace the backfill material with flowable fill.

**6021 TUNNEL AND CASING PIPE INSTALLATION.** Steel casing for bored and jacked construction shall have a smooth wall and minimum yield strength of 35,000 psi, conforming to ASTM A-139. Casing pipes installed under railroads and highways shall conform to the jurisdictional agency's requirements. All other casing installations shall be Grade A. Steel casing pipe shall have welded joints in accordance with AWWA C-206 and shall have minimum wall thickness as indicated in Table 6021-1.

**Table 6021-1 - Steel Casing Pipe Wall Thickness**

| <b>Casing Diameter<br/>(inch)</b> | <b>Minimum Wall Thickness without Exterior<br/>Coating</b> |
|-----------------------------------|--|
| 14 and under                      | 0.188  |
| 16                                | 0.188  |
| 18                                | 0.250  |
| 20                                | 0.281  |
| 22                                | 0.281  |
| 24                                | 0.281  |
| 26                                | 0.312  |
| 28                                | 0.312  |
| 30                                | 0.312  |
| 32                                | 0.344  |
| 34                                | 0.344  |
| 36                                | 0.344  |
| 38                                | 0.344  |
| 40                                | 0.375  |
| 42                                | 0.375  |
| 44                                | 0.438  |
| 46                                | 0.438  |
| 48                                | 0.438  |
| 50                                | 0.500  |
| 52                                | 0.500  |
| 54                                | 0.500  |
| 56                                | 0.500  |
| 58                                | 0.500  |
| 60                                | 0.500  |
| 62                                | 0.625  |
| 64                                | 0.625  |
| 66                                | 0.625  |
| 68                                | 0.750  |
| 70                                | 0.750  |
| 72                                | 0.750  |

Boring and jacking operations shall be performed by experienced crews using a rotary type boring machine. The casing shall be jacked into place as the boring proceeds. Earth displaced by the installation of the casing shall be removed through the interior of the casing by hand, auger or other acceptable means. There shall be no voids between the earth and the exterior of the casing. Any voids that do occur shall be filled by pressure grouting with a grout mix approved by the City Engineer. The steel casing shall be cleaned of all debris after its installation is complete. Alternate methods of boring for casing pipe shall not be performed without the approval of the City Engineer.

Casing spacers with plastic runners shall be secured to the barrel of the pipe with metal bands in such a manner to support the weight of the pipe along its full barrel length on the skids without any of the weight supported by the pipe bell, and in such a manner as to properly position the

carrier pipe to the specified elevation and alignment. Stainless steel casing spacers with plastic skids shall be as specified on the Approved Materials List. The location of the spacers on the carrier pipe shall be determined by the Design Engineer and as recommended by the spacer manufacturer. End seals shall be used at each end of the casing and shall be the single-piece pull over, synthetic rubber type, using stainless steel bands.

**6022 DRAINAGE MAINTENANCE.** Trenches across roadways, driveways, walks, or other trafficways adjacent to drainage ditches or water courses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the trafficway. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by the Contractor. Water shall 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 original section, grades and contours of ditches or water courses shall be restored. Surface drainage shall not be obstructed longer than necessary.

**6023 PROTECTION OF TRENCH BACKFILL IN DRAINAGE COURSES.** Where trenches are constructed in ditches or other water courses, backfill shall be protected from surface erosion. When the grade of the ditch exceeds one (1) percent, ditch checks shall be installed. Unless otherwise shown on the drawings or directed by the City Engineer, ditch checks shall be concrete. Ditch checks shall extend not less than two (2) feet below the original ditch or water course flowline for the full bottom width, at least eighteen (18) inches into the side slopes and shall be at least twelve (12) inches thick.

**6024 DISPOSAL OF EXCESS EXCAVATED MATERIALS.** Except as otherwise permitted, all excess excavated materials shall not be disposed on the project site.

Excess earth from excavations located in unimproved property shall be distributed directly over the pipe trench and within the pipeline right-of-way to a maximum depth of six (6) inches above the original ground surface elevation. The excess material shall be graded to a uniform surface without obstructing drainage at any point. Wasting of excess excavated material in the above manner will not be permitted where the trench crosses or is within a railroad, public road or highway right-of-way. The disposal of waste and excess excavated materials, including hauling, handling, grading and surfacing shall be a subsidiary obligation of the Contractor and no separate payment will be made therefore.

**6025 SETTLEMENT.** The Contractor shall be responsible for all settlement of backfill, fills, and embankments which occur within two (2) years of time after final acceptance of the work.

A suitable maintenance bond in an amount approved by the City Engineer shall be furnished to the City of Gardner by the Contractor guaranteeing the maintenance of the construction under which the contract was performed. Said bond shall remain in effect for two (2) years from the date of final acceptance by the City Council.

The Contractor shall repair settlement deficiencies within thirty (30) days after notice from the City Engineer.

## **SECTION 6100 - BLASTING**

**6101 GENERAL.** Blasting will be permitted. Blasting shall be done only by people experienced in the handling of explosives, and in accordance with the recommendations of the AGC Manual of Accident Prevention in Construction and OSHA regulations. In locations where flying rock may be present, additional overburden shall be ready for use and/or in place before denotation. All trenching operations utilizing explosives shall be suitably backfilled to prevent any fly rock endangerment to persons or property. The use of these procedures does not relieve the contractor of responsibility for damage to life and property but acts only as an added assurance to the owner that damage will not occur.

The Gardner Public Safety Department will be known as the "authority having jurisdiction" regarding the storage, handling, use and control of explosives used in construction projects. All permits for this use will be issued by the Public Safety Department. Control of the right-of-way remains with the Engineering Division.

Requirements of the International Fire Code regarding explosives and blasting agents shall be considered part of these specifications. All explosives and related material shall be in conformity with the requirements of the authority having jurisdiction, and the specifications contained herewith, whichever is more stringent. Blasting will not be permitted within eighty feet (80') of any building structure.

All blasting operations shall be conducted under the direction of a Kansas certified blaster. Certificates of blaster certification shall be carried by blasters or shall be on file at the Public Safety Department during blasting operations. A blaster and at least one other person shall be present at the firing of a blast. Persons responsible for blasting operations at a blasting site shall, as a minimum, conform to the criteria as outlined.

The contractor shall be responsible for all damage caused by his blasting operations and shall be responsible for responding to all complaints. Suitable methods shall be employed 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

All blasting by the contractor and his subcontractors shall be in conformity with the requirements having jurisdiction over the right-of-way, or the specifications contained herewith, under the International Fire Code and Public Safety Department, whichever is more stringent.

The blast design shall be submitted to the Public Safety Department for review prior to any blasting operations. The blast design shall contain sketches of the drill patterns, delay periods, and decking and shall indicate the type and amount of explosives to be used, critical dimensions, and the location and general description of structures to be protected, as well as a discussion of design factors to be used, which protect the public and meet the applicable airblast and ground vibration standards. The blast design shall be prepared and signed by a certified blaster. The Public Safety Department may request changes to the design submitted.

**6102 PREBLASTING SURVEY.** At least 30 days before initiation of blasting, the surveyor shall notify, in writing, all residents or owners of dwellings or other structures located within 600 feet of the blasting area of the intent to conduct a preblasting survey. The Public Safety

Department may identify alternate preblast survey distances.

The surveyor shall promptly conduct a preblasting survey of the dwellings or structures and promptly prepare a written report of the survey. An updated survey of any additions, modifications, or renovations shall be performed by the surveyor if requested by the contractor or Public Safety Department.

The surveyor shall determine the condition of the dwelling or structure and shall document any existing damage and other physical factors that could reasonably be affected by the blasting. The surveyor shall examine the interior as well as the exterior structure and shall document any damage by means of photographic or video cassette methods. Structures such as pipelines, cables, transmission lines, cisterns, wells, and other water systems warrant special attention; however, the assessment of these structures may be limited to surface conditions and other readily available data. The interior of the existing sanitary sewer shall be surveyed by means of a permanently recorded closed circuit video camera prior to blasting operations and after blasting has been concluded in the area of the existing sewer.

The written report of the survey shall be signed by the person who conducted the survey. Copies of the report shall be promptly provided to the contractor and to the Public Safety Department. All surveys shall be completed by the surveyor before the initiation of blasting. All surveys shall be conducted by a disinterested third party, regularly engaged in performing preblast surveys.

The contractor shall submit with the bid, a detailed preblast survey method to be reviewed by the Public Safety Department. The preblast survey shall not commence until the survey method has been reviewed by the Public Safety Department for completeness.

- 6103 PUBLIC NOTIFICATION.** Before blasting is started, the contractor shall inform all residents within a radius of 1500 feet of the blasting location by means of printed information sheets.
- 6104 WARNING SYSTEM.** The contractor shall provide suitable warning by siren or whistle prior to all blasts.
- 6105 OVER-BLASTING.** The requirements presented herein shall not relieve the contractor from responsibility to avoid disturbing earth or rock beyond indicated and specified lines and levels.
- 6106 NOTIFICATION.** The contractor shall notify the owner of all gas, water, and petroleum pipe lines in any area where blasting will be utilized. A representative of the pipeline owner shall be allowed to be present to observe preparations and blasting.
- 6107 TECHNICAL ASSISTANCE.** When necessary, the Public Safety Department can render technical assistance in controlling ground vibration and fly rock at the request of the blaster and/or the Engineering Division.
- 6108 BLASTING SCHEDULE.** The contractor shall conduct blasting operations at times approved by the Public Safety Department and City Engineer, and announced in the blasting schedule.

All blasting shall be conducted between 8:30 a.m. and 4:30 p.m. The Public Safety Department or engineer may specify more restrictive time periods for blasting.

**6109 BLASTING SIGNS, WARNINGS, AND ACCESS CONTROL.** Contractor shall provide all adequate warnings necessary to ensure a safe blasting site is maintained at all times.

Warnings and all-clear signals of different character or pattern that are audible within a range of 1,000 feet from the point of the blast shall be given.

Access shall be controlled to prevent livestock or unauthorized persons from entering the blasting area until an authorized representative of the Contractor has reasonably determined that no unusual hazards, such as imminent slides or un-detonated charges, exist.

**6110 CONTROL OF ADVERSE EFFECTS.** Blasting shall be conducted to prevent injury to persons, damage to public or private property outside the permit area, adverse impacts on any underground mine, and change in the course, channel, or availability of surface or ground water outside the permit area.

**A. Airblast.** Airblast shall not exceed the maximum limits listed on the next page at the location of any dwelling, public building, school, church, or community or institutional building outside the permit area, except as provided in this section.

| Lower frequency limit of measuring system, in Hz (+3 dB) | Maximum level, in dB |
|--|----------------------|
| 0.1 Hz or lower--flat response <sup>1</sup>              | 134 peak.            |
| 2 Hz or lower--flat response                             | 133 peak.            |
| 6 Hz or lower--flat response                             | 129 peak.            |
| C-weighted--slow response <sup>1</sup>                   | 105 peak dBC.        |

<sup>1</sup> Only when approved by the Public Safety Department.

If necessary to prevent damage, the Public Safety Department or engineer can specify lower maximum allowable airblast levels than those of listed in this section for use in the vicinity of a specific blasting operation.

The contractor shall conduct periodic monitoring to ensure compliance with the airblast standards. The measuring systems shall have an upper-end flat frequency response of at least 200 Hz.

**B. Ground Vibration.** The maximum ground vibration for protected structures listed in this section shall be established in accordance with either the maximum peak-particle-velocity limits, the scaled-distance equation, the blasting level chart, or by the Public Safety Department. All structures in the vicinity of the blasting area, such as water towers, pipelines and other utilities, tunnels, dams, impoundments, and underground mines, shall be protected from damage by establishment of a maximum allowable limit on the ground vibration, 1.0 inches per second, the Public Safety Department may specify a more restrictive limit in the interest of the public safety, or the Public Safety Department may approve a higher limit if justified by the contractor.

The maximum ground vibration shall not exceed the following limits at the location of any dwelling, public building, school, church, or community or institutional building outside the permit area.

|  | MAXIMUM   |  |
|--|---|--|
|  | ALLOWABLE   | SCALED PEAK  |
| Distance (D) from the blasting site in feet. | Particle velocity (Vmax) for ground vibration in inches/second <sup>1</sup> | Factor to be applied without seismic monitoring <sup>2</sup> |
| 0 to 300                                     | 1.00  | 50   |
| 301 to 5,000                                 | 1.00  | 55   |
| 5,001 and beyond                             | 0.75  | 6  |

<sup>1</sup> Ground vibration shall be measured as the particle velocity. Particle velocity shall be recored in three mutually perpendicular directions. The maximum allowable peak particle velocity shall apply to each of the three measurements.

<sup>2</sup>Applicable to the scaled-distance equation.

A seismographic record shall be provided for each blast.

A contractor may use the scaled-distance equation,  $W=(D/Ds)$ , to determine the allowable charge weight of explosives to be detonated in any 8-millisecond period, without seismic monitoring; where W=the maximum weight of explosives, in pounds; D=the distance, in feet, from the blasting site to the nearest protected structure; and Ds=the scaled-distance factor, which may initially be approved by the engineer using the values for scaled-distance factor listed.

The contractor may use the ground-vibration limits in Figure 1 this section to determine the maximum allowable ground vibration.

The maximum allowable ground vibration can be reduced by the Pubic Safety Department beyond the limits otherwise provided by this section, if determined necessary to provide damage protection.

The contractor shall conduct seismic monitoring of all blasts.

**6111 RECORDS OF BLASTING OPERATIONS.** The contractor shall retain a record of all blasts for at least three (3) years. Upon request, copies of these records shall be made available to the engineer and to the public for inspection. Such records shall contain the following data:

- A. Name of the contractor conducting the blast.
- B. Location, date, and time of the blast.
- C. Name of the licensed blaster conducting the blast.
- D. Identification, direction, and distance, in feet, from the nearest blast hole to the nearest dwelling, public building, school, church, community or institutional building outside the permit area, except those described herein.
- E. Whether conditions, including those which may cause possible adverse blasting effects.

- F. Type of material blasted.
- G. Sketches of the blast site.
- H. Diameter and depth of holes.
- I. Types of explosives used.
- J. Total weight of explosives used per hole.
- K. The maximum weight of explosives detonated in an 8-millisecond period.
- L. Initiation system.
- M. Type and length of stemming.
- N. Mats or other protections used.
- O. Seismographic and airblast records, shall include:
  - 1. Type of instrument, sensitivity, and calibration signal or certification of annual calibration;
  - 2. Exact location of instrument and the date, time and distance from the blast;
  - 3. Name of the person and firm taking the reading;
  - 4. Name of the person and firm analyzing the seismographic record; and
  - 5. The vibration and/or airblast level recorded.

**6112 BLASTER.** The Blaster shall be trained and knowledgeable in all necessary blasting applications. The Blaster shall be licensed by the State of Kansas and shall be responsible for obtaining all necessary permits required for blasting operations.



**SECTION 7000 - RESTORATION OF SURFACE CONSTRUCTION**

- 7001 SCOPE.** This section covers restoration of concrete and asphalt pavement, gravel surfacing, sidewalks, drive approaches, curbs, and other features removed or damaged during construction.
- 7002 GENERAL.** All pavement or other features which are removed or damaged beyond the construction limits during the progress of the work shall be restored to original or better condition by the Contractor, at his expense, unless otherwise specified in the contract documents. All restoration work shall be subject to acceptance by the City Engineer. All materials used for restoration work shall be new.
- 7003 REFERENCE STANDARD.** Materials and construction methods shall comply with the applicable sections of these Technical Specifications and the City of Gardner *Design Criteria for Public Improvements*.
- 7004 PAVEMENT REPLACEMENT.** Street restoration shall be in accordance with all applicable Standard Details. Materials and workmanship shall conform to Table 7004-1, or as approved by the City Engineer.

*Table 7004-1 - Street Restoration Material Specification References*

| <b>Surface Material</b> | <b>Applicable Technical Specification</b> |
|-------------------------|---|
| Concrete                | Section 2000                              |
| Asphalt                 | Section 1300                              |
| Trench Backfill         | Section 6000 - Low-Strength Flowable Fill |

All temporary surfacing placed to maintain traffic until the street restoration work can be completed shall be cold mix asphalt at a minimum. Required thickness of the temporary surfacing will be determined by the City Engineer. Maintenance of the temporary surface is the responsibility of the Contractor and is a subsidiary item unless noted otherwise in the contract documents.

- 7005 CONCRETE WALKS.** Concrete sidewalk removed in connection with, or damaged as a result of construction operations, shall be replaced with new concrete and associate materials. The work shall conform to the Technical Specifications and all applicable Standard Details.

The surface finish of concrete sidewalk replaced, unless otherwise approved, shall match as closely as possible, the existing adjacent concrete sidewalk surfaces.

- 7006 CONCRETE CURBS AND GUTTERS.** Concrete curbs and gutters that have been removed or damaged shall be replaced with new concrete and associated materials conforming to the Technical Specifications and all applicable Standard Details.

Dimensions, elevations and surface finish of curb and gutter that is replaced, unless otherwise approved by the City Engineer, shall conform to, and shall match as closely as possible, the existing adjacent concrete curb and gutter.

- 7007 GRAVEL SURFACING.** Existing gravel drives, roadways, and parking areas that have had the gravel surfacing removed or damaged during the progress of the work shall be replaced with an

aggregate surfacing at least as thick as that removed, but in no case shall it be less than four (4) inches.

New aggregate surfacing shall match the existing adjacent surfacing as nearly as possible in size, gradation, color, and compaction.

**7008 MISCELLANEOUS REPAIR WORK.** All existing items and construction, which are removed or damaged as a result of construction operations, shall be repaired or replaced unless otherwise approved by the City Engineer. The costs of replacing or repairing surfaces outside the construction limits shall be the responsibility of the contractor.

Repair or replacement shall be in accordance with these specifications or as otherwise directed by the City Engineer.

When trenching in the roadway occurs a steel plate shall be required prior to opening the roadway to traffic. Steel plates must be a minimum of ¾" thick and large enough to span over 1' onto the undisturbed roadway in all directions. Steel plates shall be pinned and ramped with Hot mix asphalt (HMA) on all sides. Advanced warning signs of the street plate shall be installed. The costs for installing and maintaining the street plates shall be the responsibility of the Contractor.

**SECTION 7100 - CHAIN LINK FENCING**

**7101 SCOPE.** This specification covers chain link fencing and gates.

**7102 FENCE TYPE.** Fencing shall conform to the alignment and details shown on the drawings and shall consist of galvanized or aluminum-coated steel fabric, steel posts, top rail, and bottom rail or tension wire. Posts shall be set in concrete.

**7103 MATERIALS.** All steel or malleable iron parts and accessories shall be hot-dip galvanized or aluminum coated after fabrication.

|  |  |
|--|--|
| Fabric   | 9 gauge, 2-inch mesh; galvanized ASTM A392, Class II or aluminum-coated ASTM A491, Class II.   |
| Posts  | Steel H-Section, 0.35 percent carbon; steel pipe, ASTM A120, standard weight (Schedule 40); or steel hollow structural tubing, ASTM A500 or A501.  |
| Line Posts   |  |
| For 6-foot Fencing   | H-Section 4.10 pounds per foot; 2 3/8 inch OD pipe, 3.65 pounds per foot; or 2 inch square, 3.85 pounds per foot.  |
| For 42-inch Fencing  | H-Section, 2.70 pounds per foot; or 1 7/8 inch OD pipe, 2.72 pounds per foot.  |
| Terminal Posts   | End, corner, and pull posts.   |
| For 6-foot Fencing   | 2 7/8 inch OD pipe, 5.79 pounds per foot; or 2 1/2 inch square, 5.59 pounds per foot.  |
| For 42-inch Fencing  | 2 3/8 inch OD pipe, 3.65 pounds per foot; or 2 inch square, 3.85 pounds per foot.  |
| Gate Posts   | Gate or leaf 6 foot or less, 2 7/8 inch OD pipe, 5.79 pounds per foot; or 2 1/2 inch square, 5.59 pounds per foot; gate or leaf over 6 foot, 4 inch OD pipe, 9.10 pounds per foot; or 3 inch square, 9.10 pounds per foot. |
| Top Rail   | 1 5/8 inch OD steel tubing, 1.40 pounds per foot.  |
| Rail Couplings   | Sleeve type, 6 inches long.  |
| Post Tops (when barbed wires are required at the top of the fence) | Pressed steel, malleable iron, with pressed steel extension arm, or hole for top rail, designed to prevent entry of moisture into tubular posts.   |
| Posts Tops   | Pressed steel, malleable iron, or cast aluminum; designed to prevent entry of moisture into tubular posts.   |

|                         |   |
|-------------------------|---|
| Barbed Wire             | Galvanized, ASTM A121, Class 2 or aluminum coated ASTM A585, Class II; two 12 1/2 gauge steel wires with 4 point barbs. |
| Stretcher Bars          | Steel, 3/16 inch by 3/4 inch, or equivalent area.   |
| Fabric Ties             | Aluminum bands or wires.  |
| Gate Frames             | Steel tubing, 1 7/8 inch OD, 2.09 pounds per foot; or 2 inch square, 2.10 pounds per foot.                              |
| Tension Wire            | Galvanized or aluminum coated coil spring wire, 7 gauge.  |
| Handrail-Setting Cement | Hallemitte "Por-Rok Cement".  |

**7104 GATES.** Gates shall be swing type, hinged to swing 90° from closed to open, complete with frames, latches, stops, keepers, hinges, and fabric. Gate leaves shall have intermediate members and diagonal truss rods as required for rigid construction. Joints between frame members shall be made by welding or by means of heavy fittings, and shall be rigid and water tight. Gate fabric shall be same as fence fabric and shall be attached to frame ends by stretcher bars, bolt hooks, or other mechanical means.

Hinges shall be heavy pattern with large bearing surfaces and shall not twist or turn under the action of the gate. Latches shall be plunger bar type, full gate height, and arranged to engage the gate stop, except single gates less than ten feet (10') wide may be provided with a forked latch. Latches shall be arranged for padlocking with the padlock accessible from both sides of the gate. Stops shall consist of a roadway plate with anchor set in concrete and arranged to engage the plunger. Keepers shall consist of mechanical devices for securing and supporting the free end of gates when in the full-open position.

Gates shall be installed so that they cannot be removed without disassembly of the hardware. Hardware attachment bolts shall be peened so that removal will be difficult.

**7105 FENCE CONSTRUCTION.** The installed fence shall conform to the alignment and finish grade indicated. All posts shall be plumb and unless otherwise shown or required shall be spaced ten feet (10') apart for 6-foot fencing and six feet (6') apart for 42-inch fencing. Where necessary, the fence grade shall be adjusted to fit the ground contour by slipping the fence fabric links. Ground surface irregularities shall be graded as required to maintain not more than a two inch (2") clearance below the bottom of the fence fabric.

Where posts are set in earth, concrete foundations thirty-six inches (36") deep shall be provided. If bedrock is encountered, post excavation shall be continued to the thirty-six inch (36") depth or eighteen inches (18") into the rock, whichever is less. Concrete foundations shall be circular in horizontal section, not less than ten inches (10") in diameter for line posts, and with a diameter not less than the post OD plus nine inches (9") for terminal and gate posts,

except that foundations in bedrock shall be a minimum of six inches (6") larger than the outside dimension of the post. Foundations shall extend above the ground surface and shall be crowned approximately one inch (1"). Concrete for foundations shall conform to the requirements of the Technical Specifications. Each foundation shall be cured for at least seventy-two (72) hours before further work is done on the post.

Top rails and bottom tension wires shall be installed before the fabric. Top rails shall be furnished in at least eighteen foot (18') lengths and shall be securely connected to gate and terminal posts. Tension wires shall be installed approximately six inches (6") above grade and shall be attached to each post and securely anchored at terminal and gate posts. Straight runs between braced posts shall not exceed 1500 feet. A terminal post shall be provided at each change in slope.

Fabric shall be attached to the top rail, bottom rail, and bottom tension wire at twenty-four inch (24") centers and to the line posts at fifteen inch (15") centers. Barbed wire shall be fastened to each extension arm by internal clips or external fabric ties. Each stretcher bar shall be threaded through the fabric and anchored to the post at fifteen inch (15") center by positive mechanical means.

Each gate and terminal post shall be braced by horizontal pipe brace and an adjustable truss extending to an adjacent line post. Corner posts shall be braced in both directions.

Fabrics shall be stretched taut and anchored so that a pull of 150 pounds at the middle of a panel will not lift the bottom of the fabric more than six inches (6").

**SECTION 7200 - SEEDING AND SODDING**

**7201 SCOPE.** This section covers the furnishings of all labor, equipment, tools and materials necessary for installation of seeding and sodding operations as required by the project plans and specifications.

**7202 GENERAL.** The seeding work shall consist of furnishing and sowing seed by an experienced seeding contractor utilizing equipment manufactured expressly for the purpose, such as a seed drill, mulch chopper and blower for each phase of the seeding operation. Contractor may also use a hydroseeder as an alternative seeding method, if approved by the City Engineer.

For public improvement projects, sodding shall be required for all areas within the right-of-way disturbed by construction operations. Seeding and mulching shall be required at all locations shown on the plans and for all grass covered areas that are disturbed by construction operations, which are not designated to be replaced with sod.

Disturbed areas within established lawns shall be sodded by an experienced Contractor.

**7203 MATERIAL.** The sod shall be Fescue or densely-rooted Kentucky Bluegrass. The sod shall contain a growth of not more than 10 percent (10%) of **other** grasses and clovers, shall be free from all prohibited and noxious weeds, and shall be three-fourths (3/4”) to one and one-fourth inch (1-1/4”); each strip containing at least one (1) square yard. Sod shall be cut in strips not less than twelve inches (12”) wide.

Commercial fertilizer for seeded or sodded areas shall be as shown on the Approved Materials List. It shall be uniform in composition, free flowing, and delivered to the site in standard size bags, showing weight, chemical composition and name of manufacturer. All fertilizer stored on site shall be kept dry until the time of application.

Seed mixes for cover crops shall be as specified herein unless otherwise specified or approved by the City Engineer. Seed mixes shall be free of prohibited weed seeds and shall not have more than one (1) percent noxious weed seeds. Seed mixes shall be delivered to the site in labeled containers bearing the name of the producer. A certificate showing the percentage of the purity and germination of each kind of seed specified shall be submitted to the City Engineer for approval.

The following formula shall be used to determine the amount of commercial seed required:

$$\text{Pounds of Commercial Seed Required} = \frac{10,000 \times \text{Rate of Pure Live Seeds (lbs/acre)}}{\text{Purity \%} \times \text{Germination \%}}$$

Where seeding is required on shoulders, slopes and any other areas which will be regularly maintained, the pounds of live seed per acre are outlined in Table 7203-1.

**Table 7203-1 – Pounds of Live Seed Per Acre In Regularly Maintained Areas**

|                                     | MINIMUM PURE  | RATE OF PURE LIVE SEED |
|-------------------------------------|---------------|------------------------|
| KIND OF SEED                        | LIVE SEED (%) | POUNDS/ACRE            |
| Perennial Rye (Derby or equivalent) | 80%           | 65                     |
| Turf-type Tall Fescue               | 80%           | 175                    |
| Annual Rye                          | 85%           | 10                     |
|                                     |               | Total 250 lbs/Acre     |

Where seeding is required in areas that are not regularly maintained, the seed mixture will be as defined in Table 7203-2.

**Table 7203-2 – Pounds of Live Seed Per Acre in Minimally Maintained Areas**

|              | MINIMUM PURE  | RATE OF PURE LIVE SEED |
|--------------|---------------|------------------------|
| KIND OF SEED | LIVE SEED (%) | POUNDS/ACRE            |
| Annual Rye   | 85%           | 110                    |
|              |               | Total 200 lbs/Acre     |

Where seeding is required in areas off street right-of-way that are not maintained periodically, the seed mixture will be defined in Table 7203-3.

**Table 7203-3 – Pounds of Live Seed Per Acre in Street Right-of-Way**

|   | MINIMUM PURE  | RATE OF PURE LIVE SEED |
|---|---------------|------------------------|
| KIND OF SEED  | LIVE SEED (%) | POUNDS/ACRE            |
| Alta Fescue or Kentucky 31 Fescue (Festuca Elatior) Var. Arundinacea) | 75%           | 90 lbs.                |
| Rye Grass (Lolium Perenne or L. Multiflorum)                          | 80            | 50                     |
|   |               | Total 140 lbs./Acre    |

Preferred mulch materials for application to seedbed areas are smooth brome grass hay, Sudan grass hay or prairie hay. Prairie hay shall consist chiefly of bluestem grasses, switchgrass, Indian grass and other desirable native perennial grasses. Mulch shall be free of prohibited and noxious weed seeds. Other mulching materials may be used with the approval of the City Engineer.

**7204 TIME OF SEEDING OR SODDING.** Seeding and fertilizing shall be performed between August 15 and October 15 for fall planting and between February 15 and April 30 for spring planting. Sod may be placed outside of the listed dates at the discretion of the City Engineer. Seeding and fertilizing shall not be done during periods of such severe drought, high winds, or excessive moisture, as determined by the City Engineer, that satisfactory results are not likely to be obtained.

Sod may be placed between March 1 and June 1 and between September 15 and November 15. Sod shall not be placed on frozen ground.

Any seeding or sodding during periods other than those previously designated will require a written request from the Contractor to extend the permissible period for performing such work. The Contractor shall explain the reason for the variance and shall include a guarantee of satisfactory results at the end of the fourth week of the subsequent growing season, as defined above. The Contractor shall perform any necessary re-seeding or re-sodding at that time.

**7205 APPLICATION OF FERTILIZER.** Commercial fertilizers shall be applied by drilling into the previously prepared soil with fertilizer attachment on the seed drill. A commercial grade broadcast spreader may be used to spread the fertilizer in areas where it is not practical to use a seed drill. The fertilizer shall be spread uniformly after the soil has been prepared and prior to the seeding and sodding. The rate of application for the fertilizer shall be one (1) pound of actual nitrogen per one thousand (1,000) square feet of planting area.

**7206 PREPARATION OF SOD BED.** The sod bed shall have a uniform surface free from washes and depressions and shall conform to the finished grade profile or cross section shown on the plans. The soil, except where fresh top soil has just been applied and compacted, shall be thoroughly tilled to a depth of two (2) inches. Freshly-graded areas, which have set long enough to become dry and crusted over shall be tilled as specified above, preparatory to placing the sod. **The contractor must have the prepared sod-bed inspected and approved by the city prior to any sod being placed. Any sod placed prior to the sod-bed being inspected and approved by the city is subject to being removed, the deficiencies corrected, and the sod replaced at the contractors expense.**

Sod placed next to existing grassy areas, curbs, sidewalks or like boundaries shall be cut-in to match like grades.

**7207 PLACEMENT OF SOD.** Sod shall be transplanted within twenty-four (24) hours from the time it is harvested. All sod in stacks shall be kept moist and protected from exposure to the sun and from freezing.

The sod beds shall be in a lightly compacted condition with relatively fine texture at the time of sodding. Sod shall be moist when it is placed. The use of dry sod will not be permitted. Sod strips shall be placed parallel to the contour lines, commencing at the lowest point of the area and working uphill. The transverse joints of sod strips shall be staggered and the sod carefully placed to produce tight joints. The sod shall be rolled immediately after it is placed with a roller weighing not less than sixty (60) nor more than ninety (90) pounds per linear foot of roller. On steep slopes, the sod may be compacted with hand tools. The compacting process shall pack the sod roots firmly into the prepared soil. The Contractor shall discontinue rolling sod that contains excess moisture, and is required to wait until the moisture has been reduced before resuming rolling operations. Sod displaced by the rolling operation will not be accepted.

The contractor shall water installed sod immediately after installation and shall water all sod twice daily for a minimum of twenty-one (21) days from initial laying, except on those days where a minimum of 1/4 inch (1/4") of rain falls in a twenty-four (24) hour period.

**7208 PREPARATION OF THE SEED BED.** The area to be seeded shall be thoroughly tilled to a depth of at least three inches (3") by discing, harrowing or other approved methods until the soil is well pulverized. After completion of the tilling operation, the surface shall be cleared of all stones, stumps, or other objects larger than 1-1/2 inches (1-1/2") in thickness or diameter, and of roots, wire, grade stakes, and other objects that might be a hindrance to maintenance operations. Areas tilled shall then be brought to the desired line and grade and maintained until seeding and mulching is complete to ensure a smooth area with no gullies or depressions.

Any objectionable undulations or irregularities in the surface resulting from tillage or other operations shall be removed before planting operations are begun. Seedbed preparation shall be



performed only during periods when satisfactory results are likely to be obtained. When results are not satisfactory because of drought, excessive moisture or other causes, the work shall be stopped until such conditions have been corrected to the satisfaction of the engineer.

**7209 PLACEMENT OF SEED.** Seeding may be accomplished by means of approved mechanical power-drawn drills followed by packer wheels, or by broadcast-type seeders or hydraulic type seeders in small areas not accessible to machine methods, or as approved by the city engineer. Mechanical power-drawn drills shall have depth bands set to maintain a planting depth of at least one-quarter inch (1/4") but not to exceed one-half inch (1/2"). All seed sown by broadcast-type seeders shall be "raked in" or otherwise covered with soil to a depth of at least one-quarter inch and rolled to obtain a firm seed bed. Water shall be applied when necessary.

Hydraulic seeding equipment shall include a pump capable of being operated at 100 gallons per minute and at 100 pounds per square inch pressure, unless otherwise directed. The equipment shall have an acceptable gauge and a nozzle adaptable to hydraulic seeding requirements. Storage tanks shall have a means of agitation and a means of estimation of the volume used, or remaining in the tank.

Seed shall not be drilled or sown during windy weather or when the ground is frozen or otherwise untillable. When a seed drill is used, it shall be set to space the rows not more than 4 inches (4") apart.

**7210 MULCHING.** Straw or hay mulch shall be applied uniformly to seeded areas at the rate of not less than two (2) tons per acre. Baled straw or hay shall be broken up and loosened sufficiently before being fed into the blower hopper to avoid the placing of matted or unbroken clumps. The use of wet straw or hay is prohibited.

Mulching shall be performed within twenty-four (24) hours after seeding, but not be done during windy or rainy weather or when such weather is imminent. Mulching shall be started at the windward side of relatively flat areas, or at the upper part of steep slopes and shall continue uniformly until the entire area is covered.

The mulching material shall be disced or punched into the soil so that it is partially covered. Several passes may be required, if a straight disc is used, in order to mix the mulching material with the topsoil sufficiently to ensure protection from erosion by either wind or water. The mulch tilling operation shall be performed parallel to the ground contours.

**7211 MAINTENANCE.** All seeded areas shall be protected against damage by vehicle and pedestrian traffic by the use of barriers and appropriate warning signs. If at any time before completion and acceptance of the seeding work any portion of the seeded area becomes gullied or otherwise damaged, such damaged areas shall be repaired by filling with soil to original grade, re-seeding and re-mulching. All costs of repair work shall be borne by the contractor.

Contractor shall be responsible for watering areas seeded for a period of five (5) weeks after the time of seeding, except when thoroughly wetted by rain. Sprinkling of the seeded areas shall be carefully done in such manner as to avoid standing water, surface wash, scour or other erosion.

All sodded areas shall be thoroughly watered twice daily for a period of twenty-one (21) days after placing, except when thoroughly wetted by rain of 1/4-inch (1/4") or more in a 24-hour period.

**7212 GUARANTEE.** The Contractor shall guarantee all sod for twenty-one (21) days from the date of installation. At the end of the twenty-one (21) day period, the City Engineer will inspect all sod. Any sod that is dead at the end of the twenty-one (21) day period shall be replaced by the Contractor at his expense and is subject to an additional twenty-one (21) day warranty period. All healthy sod at the end of the twenty-one (21) day period will be accepted by the City Engineer and turned over to the property owner for maintenance. The Contractor is not required to guarantee any healthy sod accepted by the City Engineer after the twenty-one (21) day period. Sod placed outside of the approved dates must be healthy in the spring.

The Contractor shall guarantee all seeded areas for a minimum of five (5) weeks or until there is a minimum of seventy (70) percent coverage of healthy grass, whichever is greater.

**7213 RECORD KEEPING.** The Contractor shall maintain a log of his watering operations and rain events to demonstrate compliance with the watering requirements of the Technical Specifications. The Contractor shall submit the records to the City Engineer at the end of the required maintenance period. The seeded and/or sodded areas shall not be accepted until the submittal has been approved by the City Engineer.

## **SECTION 7300 - EROSION CONTROL**

The City of Gardner erosion and sediment control technical specification and design criteria shall conform to the Kansas City Metropolitan Chapter of the American Public Works Association (KC-APWA) *Section 2150 – Erosion and Sediment Control* and *Section 5100 – Erosion and Sediment Control*, latest edition, and Title 14 of the Gardner Municipal Code, unless otherwise directed by the City Engineer.

## **SECTION 7400 – TREES, SHRUBS AND GROUNDCOVERS**

**7401** **SCOPE.** This section covers the furnishing of all labor, equipment, tools, and materials necessary for the installation of all trees, shrubs and groundcovers as required by the project plans and specifications. Groundcover planting shall mean all woody ground cover plants as well as annual and perennial plant materials.

**7402** **GENERAL.** The planting of trees, shrubs and ground covers shall consist of furnishing and installing all plant materials by an experienced Contractor familiar with planting in the Midwest. All plant material delivered to the site for approval and installation shall be identified and tagged, so as to ensure the plants are as specified and indicated on the contract documents.

Prior to planting, the Contractor shall locate all existing underground utilities and irrigation systems. The Contractor shall request direction from the City Engineer when there are conflicts between existing or proposed underground utilities and the location of the planting material.

The Contractor shall maintain all plant material until final acceptance of the project. Plant material guarantees shall be as stipulated in the warranty section of this document.

**7403** **MATERIALS.** All plant material shall be nursery-grown stock, unless specified otherwise, and shall be equal to or larger than the sizes specified. It shall be certified by all federal and state regulations, conform to the American Standards for Nursery Stock Document (ANSI Z60.1) latest edition and shall be free of disease and hazardous insects.

Plants shall comply with USDA Plant Hardiness Zone 6a, or farther north. Plants shall be typical of their species or variety, and shall have a normal habit of growth. They shall be sound, healthy, vigorous, well-proportioned and well-branched. Evergreens shall have full foliage; other plants shall be densely foliated when in leaf. All plant material shall have healthy, well-developed root systems. Plants shall be free from mechanical injury, cultural injury, injury by animals and free of noticeable injury due to insect attack or blight.

The Contractor shall apply a commercial root stimulator approved by the City Engineer at rates recommended by the manufacturer following the initial plant watering.

Composted soil material shall be a well-rotted mix of organic materials free of any deleterious materials including stones over one (1) inch diameter, twigs, trash, etc.

Wood mulch material shall be shredded wood material free of dirt, rocks, weeds or other deleterious materials.

Transplant additive shall be a mycorrhizal fungal transplant inoculant containing the minimum mixture of appropriate species of mycorrhizal fungi and bacteria fungi stimulant, water retaining agents, mineral and organic nutrients and inert ingredients shown in Table 7403-1.

**Table 7403-1 - Transplant Additive Mixture Rates**

| Additive  | Rate                 |
|---|----------------------|
| <b>Ectomycorrhizal Fungi</b>                            | <b>95 million</b>    |
| <b>spores/lb</b>  |                      |
| Pisolithus. Tintorius                                   | 95 million spores/lb |
| <b>VA Mycorrhizal Fungi</b>                             |                      |
| Entrophospora columbiana                                | 1,325 spores/lb      |
| Glomus clarum   | 1,325 spores/lb      |
| Glomus etunicatum                                       | 1,325 spores/lb      |
| Glomus intraradices                                     | 1,325 spores/lb      |
| <b>Rhisosphere Bacillus spp.</b>                        |                      |
| Bacillus licheniformis                                  | 54 million           |
| cfu/lb Bacillus megaterium                              | 54 million           |
| cfu/lb Bacillus polymyxa                                | 54                   |
| million cfu/lb Bacillus subtilis                        | 54                   |
| million cfu/lb Bacillus thuringiensis                   | 54                   |
| million cfu/lb Paenibacillus azotofizans                | 54                   |
| million cfu/lb  |                      |
| <b>Terra-Sorb Hyrdogel (potassium polycarcrylamide)</b> | <b>33.3%</b>         |
| <b>Formononetin</b>                                     | <b>0.007%</b>        |
| <b>Microbian Nutrients</b>                              | <b>39.4%</b>         |
| Kelp Mean   | 23.60%               |
| Humic Acids   | 10.50%               |
| Maltodextrin  | 3.70%                |
| Soluble Yucca Extract                                   | 1.60%                |
| <b>Inert Ingredients</b>                                | <b>27.293%</b>       |
| Greensand   | 17.60%               |
| Leonardite (other than hulmic acids)                    | 5.80%                |
| Clay  | 1%                   |
| Talc  | 0.023%               |
| USPS Mineral Oil  | 2.87%                |

The Contractor shall demonstrate installation of all transplant additives, and shall provide the actual quantity of transplant additive product applied to the City Engineer.

The number of transplant additive packets per tree/shrub shall be applied according to the manufacturer’s recommended rates and instructions. The packet mix shall be evenly distributed into the upper eight (8) inches of backfill soil next to the rootball. Additive mixture shall not be placed in the bottom of the planting pit.

Tree stakes shall be studded steel fence posts. No wood stakes shall be used when staking trees.

**7404** **TIME OF PLANTING.** Trees and shrubs shall be installed within the following time periods, unless otherwise approved by the City Engineer:

|                   |                            |
|-------------------|----------------------------|
| Spring            | Fall                       |
| March 15 – May 15 | September 15 – November 15 |

Perennial/Annual plants shall be installed within the following time periods, unless otherwise approved by the City Engineer:

|                   |                            |
|-------------------|----------------------------|
| Spring            | Fall                       |
| April 15 – May 30 | September 15 – November 15 |

**7405** **EXECUTION.** Prior to planting operations, the Contractor shall schedule an onsite meeting with the City Arborist or representative to verify that subsoil and topsoil are properly prepared and ready to receive the planting material. The Contractor shall verify location of all underground and above ground utilities that may interfere with the installation of plant materials.

A. Excavation of planting pit for trees and shrubs:

The Contractor shall excavate a hole a minimum of four (4) feet in diameter or at least two times wider than the root ball diameter of the tree. There shall be a minimum of one (1) foot clearance on each side of the root ball. The depth of the pit shall be such that the top of the root ball where root flare begins is two (2) inches above finish grade with the root ball resting at the bottom of the pit.

B. Excavation of shrub planting bed(s):

All balled and burlapped or container-grown shrubs shall have a planting pit diameter sufficient in size to provide a minimum of six (6) inches clearance on each side of the container or ball of the shrub. The base of the plant shall be flush with the adjacent grade.

C. Excavation of groundcover planting bed(s):

The area designated for groundcover plantings shall be tilled to a minimum depth of twelve (12) inches in order to provide a plantable area for groundcovers.

D. Planting of trees and shrubs:

The top of the root ball where root flare begins shall be two (2) inches above the finish grade on all trees. All trees and shrubs shall be plumbed before backfilling and the Contractor shall maintain plumb while working backfill around roots. Remove all wire, twine and burlap from the top two-thirds of the root ball. Soil used in the tree pit shall consist of 3 parts excavated soil to 1 part compost, thoroughly mixed before planting. Firm the soil so the tree is plumb and adequately supported, but do not pack soil.

Saturate the entire backfilled soil with water, and add additional soil as needed to compensate for settling. Create a two (2) inch depression in the soil to hold water around the perimeter of the pit. Mulch a 5-foot diameter tree ring at the base of the tree with two (2) inches of mulch over root ball and three (3) to four (4) inches of mulch over the remainder of the tree ring. Do not allow mulch to cover the tree trunk by more than ½ inch. Pruning of broken or dead branches shall only be conducted by, or under the direct supervision of, a Certified Arborist.

Stake all trees with two steel studded fence posts driven a minimum of eighteen inches (18") into soil outside of the planting pit. The post height above the finish grade shall be a minimum of five (5) feet. The tree tie system shall be approved by the City Engineer prior to installation. Nylon straps shall be located above the first branch and shall typically consist of three (2) 12-gauge soft galvanized wire ties per tree. Where possible, stakes shall be installed on a northeast to southwest orientation.

For non-irrigated trees, install watering bag with the tree planting. Install two (2) 20-gallon slow-release watering bags for each shade or ornamental tree per the manufacturer's recommendations. For Evergreen trees, not irrigated, install similar bag which does not interfere with the lower branches of the unlimbed evergreen trees with similar dispersion rates.

For container plant material, the Contractor shall remove the container and spread-out roots horizontally in the planting pit. Plant the roots as shallow as possible in a flared-out, horizontal position. Slice or shave the roots vertically down the sides of the root ball to release container-bound root material. Follow the same soil backfill installation as above for trees.

All shrub beds shall have a shoveled edge unless otherwise noted. Edge shall be six (6) inches in depth with consistently straight lines and smooth curves

E. Planting of groundcovers:

The soil in areas designated for groundcovers shall be loosened by roto-tilling or other approved method to a minimum depth of twelve (12) inches prior to the planting operation. The backfill material shall be thoroughly mixed topsoil and composted peat moss. No more than 10% of the soil mix shall consist of clods one (1) inch or larger.

Plants shall be evenly spaced at the specified distance in a triangular pattern, unless otherwise noted on the plans. Spacing shall dictate the final quantity of plants per bed. Spacing from pavement, curb, similar hard surfaces and edges of plant bed shall be ½ the specified plant spacing. Spacing between different species shall be the sum of ½ the space for each species.

All groundcover beds shall have a shoveled edge unless otherwise noted. Edge shall be six (6) inches in depth with consistently straight lines and smooth curves.

All mulch shall be applied to a depth of two (2) inches in all ground cover planting bed areas and to a depth of three (3) inches in all annual, perennial, and shrub planting bed areas.

All ground cover beds shall be thoroughly watered immediately after planting is completed. For beds in areas of existing vegetation, the Contractor shall verify the location and remove all vegetation. An herbicide treatment may be necessary to eradicate existing vegetation. Round-up or similar herbicide shall be applied a minimum of two (2) weeks prior to planting, and plant material shall not be installed in planting beds within two (2) weeks of the herbicide treatment. All shrub and ground cover beds shall be roto-tilled as described above.

**7406** **MAINTENANCE.** Contractor shall maintain all planted areas until the final acceptance of the project.

For shrubs and groundcovers, without watering bags, each watering shall provide a deep soaking of the entire plant bed including the plant root zones and soil areas between the plants.

For plants with watering bags, each watering shall fill the watering bag to full capacity as recommended by the manufacturer.

Contractor shall guarantee that all plant material is alive and in an acceptable form at the time of final acceptance.

**7407 RECORD KEEPING.** Contractor shall maintain a log of his watering operations and rain events to show compliance with the watering requirements, and shall submit the records to the City Engineer at the end of the required maintenance period. The plantings shall not be accepted until the watering log has been approved by the City Engineer.

**7408 WARRANTY.** Contractor shall guarantee all plant material on the project for a minimum of one (1) year from final acceptance of the project. Any dead or dying plant material found during the guarantee period shall be removed from the project site by the Contractor and replaced. If the Contractor does not remove the plant material within a reasonable time, the City will remove the plant and add it to the list of replacement materials. The Contractor shall report to the City and log those removals and the specific locations of replacements. Replacement of any dead or removed material shall occur within the planting periods as described in these Technical Specifications.



## **SECTION 8000 - MATERIALS TESTING**

- 8001 SCOPE.** This section shall apply to all required testing services for soils, asphalt, concrete and other materials, as required by the City Engineer.
- 8002 GENERAL.** All materials testing shall be conducted by a testing laboratory qualified and approved by the city to perform the required sampling, analysis, testing and report writing services. Reports shall be prepared by or under the supervision of and bear the seal and signature of a professional engineer licensed in the state of Kansas. Improperly completed or certified reports will not be accepted.
- 8003 RESPONSIBILITIES OF THE CONTRACTOR.** The Contractor shall be responsible for all costs associated with the required sampling and testing unless otherwise specified. The Contractor shall allow the testing agency access to the job site and shall furnish any labor required to obtain and handle samples at the source of the material and at the project site. Adequate facilities shall be provided at the project site for the safe storage and proper curing of specimens. The use of a testing agency's service does not relieve the Contractor of the responsibility to furnish the required materials and to perform the required construction in full compliance with the City of Gardner *Technical Specifications for Public Improvement Projects*. The successful passing of a test does not constitute acceptance of the work or materials represented by the test or any portion of the work or materials. Final acceptance of the project shall be granted only through the acceptance of the Project Completion Certificate by the City Council and the expiration of the two (2) year maintenance period as established in these specifications.
- 8004 RESPONSIBILITIES OF THE TESTING AGENCY.** All testing agencies shall meet the requirements of ASTM E329. A representative shall inspect, sample, and test the materials and work as required by the City Engineer. Any material furnished or work performed by the Contractor failing to conform to the specification requirements shall be immediately brought to the attention of the City Engineer and the Contractor. Preliminary written field reports of all tests and inspection results shall be given to the Contractor and City Engineer immediately after they are performed. Results of all tests taken, including failing tests, shall be reported. The testing agency and its representative are not authorized to modify any requirement of the specifications, nor to approve or accept any portion of the work.
- 8005 ASPHALT TESTING.** Sampling and testing of the asphalt mix shall be required on all asphalt paving projects constructed in the city of Gardner.

Sampling and testing of asphalt mixes for modified Superpave surface and base shall be performed as required in the Technical Specifications.

Sampling and testing of asphalt mixes utilized for the construction of local and collector streets, bicycle paths, trails, parking areas, and other areas where modified Superpave is not specified shall be performed as follows:

Samples of the actual asphalt mix being used shall be acquired by a qualified testing laboratory technician at either the construction site or the batching plant per ASTM Standards D979 and D3665. These samples shall be used to perform the following tests:

- Aggregate Gradation in accordance with ASTM C136
- Asphalt Content on total mix basis with dust to binder ratio reported in accordance with ASTM D6307, Ignition or ASTM D2172, Extraction.
- Stability and Flow per ASTM D5581.
- Bulk Specific Gravity in accordance with ASTM D2726

A minimum of one complete group of tests shall be conducted on both the base material and the surface material for each paving project. Additional sampling and testing shall be as required by the City Engineer.

The Contractor shall be required to secure, at his expense, the services of an approved independent testing laboratory to verify the test results submitted by the Contractor’s laboratory. The Contractor’s laboratory will coordinate with the laboratory performing verification testing to ensure the samples are taken at the same location and time. A minimum of one verification test shall be conducted on both the base material and the surface material for each paving project. Additional verification testing shall be as required by the City Engineer. The Contractor’s laboratory shall furnish the verification laboratory other items such as the Job Mix Formula (JMF) mix gradation, plant setting, bulk specific gravity of the aggregate and specific gravity of the asphalt. Laboratories shall compare final test results when the mix is out of specification. The test results shall indicate whether adjustments are required to bring the mix design into conformance with specification tolerances.

In-place density tests shall be conducted with a nuclear density gauge during the course of the work. Density tests may be performed by City Engineer to verify compliance with compaction requirements. The asphalt shall be compacted to a density equal to or greater than 95% of maximum density as determined by the fifty (50) blow Marshall procedure. The number and locations of tests to be taken shall be determined by the City Engineer. Tests performed with a nuclear density gauge shall be conducted in accordance with ASTM D2950.

**8006 CONCRETE TESTING.** Sampling and testing shall be required on all concrete work including curb and gutter, sidewalk, slope paving, retaining walls, inlets, manholes or any other structures. See table 8006-1 for frequencies and required tests.

*Table 8006-1 - Portland Cement Concrete Testing Requirements, Methods and Frequencies*

| Type of Construction   | Required Test   | Method  | Frequency  |
|--|---|---|--|
| Portland Cement Concrete structures and miscellaneous construction | Temperature<br>Slump<br>Air Content<br>Unit Weight<br>Cylinders (4 per set)           | KT-17<br>KT-21<br>KT-18 or KT-19<br>KT-20<br>KT-22          | Minimum of 1 set per 50 cubic yard placed or fraction thereof as directed by the City Engineer   |
| Portland Cement Concrete pavement                                  | Temperature<br>Slump<br>Air Content Unit<br>Weight Cylinders (4 per set) Profilograph | KT-17<br>KT-21<br>KT-18 or KT-19<br>KT-20<br>KT-23<br>KT-46 | Minimum of 1 set per 100 cubic yard placed or fraction thereof as directed by the City Engineer. Profilograph as required by the City Engineer |

If samples of fresh concrete have not been obtained and tested, a minimum of three (3) cores shall be taken per ASTM C42 and broken as directed by the City Engineer. Air content in accordance with ASTM C457 and cement content per ASTM C1084 shall also be determined. The test results will be considered adequate if the average strength of the cores is equal to a minimum of 95% of the specified strength (f'c) and if the strength of any single core is not less than 80% of f'c. All core holes shall be completely filled with a low-slump, high strength concrete at the Contractor’s expense.

All reports by testing laboratories shall include the type of structure or pavement and information on obtaining, transporting, storing, curing, time between obtaining and casting cylinders (when applicable), supplier, finisher and batch as well as the specific test data.

**8007 SOIL TESTING.** Sampling and testing shall be required on all subgrade preparation for street construction and all trench backfilling operations within the city of Gardner.

Prior to beginning any work on street subgrade the Contractor shall secure the services of a qualified testing agency to acquire samples of the material to be used for subgrade construction. These samples shall be analyzed to determine Proctor values, liquid limits and plasticity index. The technician will take the samples at locations determined by the City Engineer. Copies of the analysis shall be provided to the City Engineer for review prior to commencing any subgrade preparation.

Tests for subgrade material requiring fly-ash modification shall be in accordance with the requirements of the Technical Specifications.

The City Engineer shall designate the locations and depths at which a qualified technician shall perform moisture-density testing of the subgrade material in accordance ASTM D698 for cohesive soils and ASTM D4253 and D4254 for non-cohesive soils. The number of tests taken shall be as directed by the City Engineer. Reports for moisture-density tests shall include the following:

- Project name and number
- Date
- Location of test
- Depth or elevation of test
- Soil/Proctor description
- Proctor density
- Density-% of Proctor
- Wet density
- Dry density
- Optimum moisture %
- Actual moisture %
- Weight of water

Results of these tests shall indicate whether or not the performance specifications stated in the Technical Specifications have been achieved. If the tests indicate the compaction is not sufficient, the Contractor shall rework the area to achieve satisfactory compaction. Tests performed with a nuclear density gauge shall be conducted per the requirements of ASTM D6938.

During trench backfilling, in-place density tests may be required by the City Engineer. The number and locations of tests to be taken shall be determined by the City Engineer. Results of these tests shall indicate whether or not the performance specifications stated in the Technical Specifications have been achieved. If the tests indicate the compaction is not sufficient, the Contractor shall rework the material to achieve satisfactory compaction.

## **SECTION 9000 - STREET LIGHTING**

- 9001 SCOPE.** This section applies to all street light construction and shall consist of furnishing all labor, materials and equipment for the complete installation of street lighting systems. A complete list of pre-approved street lighting materials is available on the City of Gardner public website at [www.gardnerkansas.gov](http://www.gardnerkansas.gov).
- 9002 GENERAL.** The standard street light details that accompany these specifications shall be considered a part thereof. These standard details are available on the City of Gardner public website at [www.gardnerkansas.gov](http://www.gardnerkansas.gov).

When a conflict arises with the plans or specifications and the proposed work, the Contractor shall immediately notify the City Engineer. The City Engineer will review the plans and provide direction to the Contractor.

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 approved by the City Engineer.

The Contractor shall always have a signed copy of the plans and specifications at the job location.

Prior to the acceptance of the work, the Contractor shall submit an "as-built" or corrected plan showing all construction changes in detail, including location and depth of conduit. As-builts shall be provided in Adobe pdf format.

- 9003 GRADES.** All work shall conform to line, elevation and grades as shown on the plans.
- 9004 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 Electric Code (NEC), the Standards of the American Society for Testing Materials (ASTM), the American Standards Association (ASA), the Illuminating Engineering Society (IES) and all local ordinances.

The approved plans and applicable codes adopted at the time of advertisement for bids shall govern the work unless otherwise required by the City Engineer.

- 9005 PRELIMINARY SCHEDULE OF EQUIPMENT AND MATERIAL.** Within twenty (20) days following the date of the approval of a final plan, the Contractor shall submit a complete schedule of materials and equipment proposed for installation. This schedule shall include catalog cuts, diagrams, drawings, and other data as may be required. In the event any material or equipment contained in the schedule fail to comply with specification requirements, such items may be rejected.

In lieu of submitting catalog cuts, the Contractor may utilize pre-approved materials as shown on the City of Gardner Approved Materials List. The Contractor shall then list the materials from the pre-approved list that are proposed for use and submit to the City for approval.

- 9006 REJECTED MATERIALS.** Rejected materials shall be immediately and permanently removed from the project site by the Contractor. 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.
- 9007 EXISTING UTILITIES.** The Contractor shall locate all utilities, whether above, on, or below the ground, and shall be responsible for any and all damages arising from his negligence to protect existing utilities.
- No new fixture shall be constructed which is in conflict with any existing utility facilities or the approved plans, unless otherwise approved by City Engineer.
- 9008 PERMITS.** The Contractor shall have a set of plans signed by the City Engineer before the commencement of any work, which will authorize the Contractor to work within the right-of- way.
- 9009 NOTIFICATION.** The Contractor shall notify the City Engineer five (5) days before beginning work on the project. The Contractor shall provide the City Engineer weekly, or more frequent as requested, written progress reports with estimated completion dates. The City Engineer may require any work completed without inspection to be dismantled for inspection and reassembled as required.
- 9010 PROTECTION OF WORK AND CLEANUP.** The Contractor shall be responsible for all work until final completion and acceptance by the City. All damage done to existing infrastructure shall be repaired by the Contractor. The Contractor shall remove all surplus material and rubbish from the work site as it accumulates and before the Contractor makes application for the acceptance of the work.
- 9011 TRAFFIC CONTROL.** All traffic control shall be in conformance with the General Provisions of the City of Gardner *Technical Specifications and Design Criteria for Public Improvement Projects.*
- 9012 TURN ON AND TESTING.** The Contractor shall contact the City of Gardner, Public Works Department, for an electrical inspection as soon as the control center(s) is/are installed. Prior to the inspection, the Contractor shall coordinate with the electrical service provider to ensure electric service is available to energize the system.

All street lighting system elements shall function properly as a complete system for a minimum period of fifteen (15) consecutive days before acceptance by the City. Any malfunction observed or recorded shall stop the test period as of the time of the malfunction, and the test period shall not resume until all components are satisfactorily operating.

- 9013 BONDING.** The Contractor shall submit a performance and maintenance bond on all projects

before beginning construction. The amount of the bond shall be for the full amount of the project and shall remain in effect for a period of two (2) years after the date of completion and acceptance by the City Council.

**9014 MAINTENANCE.** During a period of two (2) years from the date of project acceptance by the City, the Contractor shall make all needed repairs resulting from defective workmanship or materials. If within ten (10) days after providing written notification the Contractor neglects to make or to undertake with due diligence the required repairs, the City shall make such repairs at Contractor's expense. In case of an emergency where, in the judgment of the City Engineer, delaying the repair would cause serious loss, hazard, or damage, repairs may be made without notifying the Contractor, at Contractor's expense.

**9015 GENERAL MATERIAL SPECIFICATIONS.** All materials used in the fabrication or assembly of the items listed below shall comply with approved plans and Standard Details.

All lighting equipment shall be new and shall be approved by the City Engineer.

**9016 ALUMINUM STANDARDS.** The type of pole and length of luminaire arm (if any) shall be as specified on the approved plans. This pole specification is in addition to the Standard Details, which describes the material specifications and pertinent design details.

### **30', 20' and 40' Poles**

1. Shaft. The aluminum lighting shaft assembly shall be constructed from one piece of seamless tubing with a 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 six (6) inches above the handhole to the top of the shaft. The shaft shall have no longitudinal or circumferential welds, except to join the shaft to the base. The assembly shall be tire wrapped with a non-staining paper during shipping.

Pole dimensions shall be as specified on the Standard Details. It is the responsibility of the fabricator to verify and attest that the poles are structurally adequate and in full compliance with this specification and the Standard Details.

2. Handhole. Each shaft shall be equipped with a minimum 4" x 6" (clear opening) handhole with frame and cover, and a grounding lug located opposite the handhole. The handhole opening shall be clear of any interference from the handhole reinforcing frame.
3. Shoe Base. 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 one weld shall be on the inside of the base at the end of the shaft, while another 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 the Standard Details.

4. Luminaire Arm. 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 2-inch slipfitter for mounting the luminaire. The single member arm shall be designed to meet all 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 2-inch slipfitter for mounting the luminaire. The outboard end of the lower arm (brace) shall be covered by an end cap.

Luminaire Arm for all 20' poles shall be specified within the most recent approved products list for streetlights.

5. Breakaway Support. All 30 foot and 40 foot poles shall be equipped with breakaway supports. The support shall be a frangible base approximately nine (9) inches tall with a door on one side for both single and double arm poles.

## **14' Pole**

1. Shaft The 14' aluminum lighting shaft shall be spun from one piece of seamless tubing and 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 six (6) inches above the handhole to the top of the shaft. The shaft shall have no longitudinal or circumferential welds, except to join the shaft to the base. The shaft shall be tire wrapped with a non-staining paper during shipping.

Pole dimensions shall be as specified on the Standard Details. It is the responsibility of the fabricator to verify and attest that the proposed poles are structurally adequate and in full compliance with this specification and the Standard Details.

The pole shall have a three (3) inch outside diameter (O.D.) slipfitter end, without a tenon, for mounting the post-top luminaire.

2. Handhole. Each shaft shall be equipped with a minimum 4" x 6" (clear opening) handhole with frame and cover, and a grounding lug located opposite the handhole. The handhole opening shall be clear of any interference from the handhole reinforcing framing.
3. Shoe Base. The aluminum shoe base shall be a permanent mold casting. The base shall be solution heat-treated and artificially aged to produce a final T6 temper. 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 one weld shall be on the inside of the base at the end of the shaft while another 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 the Standard Details.

## **9017 ILLUMINATION EQUIPMENT.**

### **LED Roadway Luminaire**

LED luminaires with shorting caps shall be installed on all collector and arterial roadways in accordance with the Approved Materials List.

### **Post-Top Luminaires**

Post-top luminaires shall be in accordance with the Approved Materials List.

### **Lamp**

Lamps shall be in accordance with the Approved Materials List.

## **9018 ELECTRICAL MATERIAL**

### **Secondary Cable and Power Lead-in Cable**

Power lead-in cable shall be 2/0 A.W.G. and secondary cable shall be #4 A.W.G. stranded annealed copper ground wire clearly marked the entire length for operation at 600 volts maximum. All secondary cable shall be installed in a 2-inch minimum inside diameter (I.D.) conduit conforming to the Standard Details and these Specifications. 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 Insulated Cable Engineers Association (I.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.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.C.E.A. and listed by U.L. as Type U.S.E. RHW-75°C.

### **Pole and Bracket Cable**

Pole and bracket cable above the handhole in pole to luminaire(s) shall be single conductor with minimum 600 volt rating, No. 10 A.W.G. Type THHN/THWN. The conductor shall be stranded annealed copper.

### **Control Center and Service Disconnect Pedestal**

Control centers and service disconnect pedestals shall be in accordance with the Approved Materials List.

1. Control Center. The control center (street light cabinet) shall be an underground service type, rated for 200 A (as specified on the plans) and 240 volts. The pedestal shall be heavy-gauge aluminum raintight construction with an individual meter, panel,



conductor, and rear service pull compartments. The panel compartments shall have piano-hinged doors and include a Corbin Lock accessible with a #2 Traffic Signal key. The meter base shall be of the type used by the local utility. The panelboard shall have a copper bus and shall accept twelve 1-inch plug-in breakers in accordance with the Standard Details. The panelboard compartment shall contain a photocell and test switch. All factory installed wire shall be copper. The control center shall be U.L. listed. The pedestal finish shall be natural aluminum.

2. Service Disconnect Pedestal. The service disconnect pedestal (meter pedestal) shall be an underground service type, rated for 200 A and 240 volts for KCP&L services only, in accordance with the Standard Details.

### **Conduit**

Rigid nonmetallic conduit shall be High Density Polyethylene (HDPE) Schedule 40 or Schedule 40 polyvinyl chloride (PVC) conduit. PVC will only be used for sweeping 90-degree bends at pole bases, control centers and boxes. All nonmetallic conduits shall be gray, black or red in color. The conduit shall bear an Underwriters' Laboratories label and shall conform to Federal Specification W-C-1094A (latest version).

- 9019 EXCAVATION**. The Contractor shall perform all excavations for installing underground conduits, cable, boxes and pole bases to the depths indicated on the drawings unless otherwise approved by the City Engineer. During excavation, material suitable for backfilling shall be stockpiled in accordance with the Technical Specifications. All excavated materials not required or unsuitable for backfill shall be removed from the site by Contractor.
- 9020 BACKFILLING**. All areas excavated shall be backfilled and compacted in accordance with the City of Gardner *Technical Specifications and Design Criteria for Public Improvement Projects*.
- 9021 SODDING**. All areas will be sodded in accordance with the City of Gardner *Technical Specifications and Design Criteria for Public Improvement Projects*.
- 9022 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 Contractor shall be replaced or reconstructed with the same kind of materials as found on site or with materials of equal quality. The replaced improvements shall be left in a serviceable condition satisfactory to City Engineer. Whenever a part of a square or slab of existing concrete sidewalk, driveway or pavement is damaged, the entire square or slab shall be removed and replaced at the Contractor's expense.
- 9023 FOUNDATION ANCHORS**. Screw-in foundation anchors shall be in accordance with the Standard Details. All anchors shall include an integral theft device. The anchors shall be screwed into the ground; pre-drilling holes for the anchor shall not be permitted. During installation, the foundation shall be plumbed with a level and the base plate shall be level.

Minor leveling adjustments on poles shall 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 (1) shim or washer shall be allowed at any one anchor bolt, with a maximum of two (2) on any pole.

If installation of a screw-in foundation anchor is not feasible for any reason, concrete foundations shall be installed at Contractor's expense.

**9024 CONCRETE FOUNDATIONS.** The bottom of the concrete foundations shall rest on firm ground, and foundations shall be poured monolithically. The exposed portions shall be formed and finished to present a neat appearance and shall be true to line and grade. The top of footing elevation shall be established using the finished curb or sidewalk unless otherwise directed by 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. The forms and ground which will contact the concrete shall be thoroughly moistened before placing concrete.

Concrete for pole base and control center foundations shall be KDOT Grade 4.0 AE.

Concrete shall not be placed until forms and reinforcing steel have been approved by the City Engineer. Placement of concrete shall be inspected by the City Engineer during construction.

Concrete pole bases 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 properly consolidate concrete. 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 foundation shall have four (4) conduits for exiting cable. The direction of the exiting conduit and the orientation of the control center shall be determined by the City Engineer.

**9025 CONDUIT.** Conduit shall be of a rigid type conforming to the provisions and diameters specified in the approved plans. Installation shall conform to the appropriate articles of the National Electric Code. All street lighting cable shall be installed in two (2) inch Schedule 40 HDPE except two (2) inch Schedule 40 PVC will be used for sweeping 90-degree bends at pole bases, control centers and boxes. Where conduits connect from more than one direction, they should terminate in a Type II junction box in accordance with the Standard Details.

It shall be the option 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. No reducing couplings will be permitted.

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 together throughout the entire circumference of the joint. Slip joints will not be permitted for coupling conduit. All couplings shall be fitted and tightened until the ends of the conduits are firmly joined.

The location of street crossings of all conduits installed or used on the project shall be marked by a saw cut arrow placed in the face of curb, gutter, or wall, directly above the conduit in accordance with the Standard Details.

All joints in PVC conduit shall be glued. HDPE to PVC adapters shall be permitted to connect HDPE and PVC conduits.

Conduit bends, except factory bends, shall have a radius of not less than six (6) times the inside diameter of the conduit. Where factory bends are not used, conduit bends shall be made without crimping or flattening, using the longest radius practicable.

Conduit shall be jacked under pavement sections at a depth of thirty-six (36) inches below bottom of pavement. Conduit installed in trenches in unpaved areas, shall be laid to a depth of thirty-six (36) inches below natural ground level.

Conduit shall be placed under existing pavement by approved jacking or drilling methods. Pavement shall not be disturbed without the written permission of City Engineer. Jacking or drilling pits shall maintain two (2) feet clear distance from the edge of any type of pavement. Excessive use of water shall not be permitted.

Conduit set in standard bases shall extend vertically approximately three (3) inches above the foundation. 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.

Conduit entering junction boxes shall be continuous into the box, and conduit elbows shall be provided to bring the conduit up into the box.

Wherever the end of a conduit is installed within five (5) feet of another conduit or junction or service box, the conduit shall be made continuous between the conduits or into the box.

Existing underground conduit to be incorporated into a new system shall be cleaned with a mandrel and blown out with compressed air.

The location of conduit runs shown on the plans are for bidding purposes only and may be changed with permission of City Engineer to avoid underground obstructions.

**9026 SERVICE AND JUNCTION BOXES.** Service boxes and junction boxes shall be installed at the locations shown on the plans in accordance with the Standard Details. The Contractor may install, at his own expense, additional boxes with written approval from the City Engineer.

Service boxes and junction boxes shall be installed on eighteen (18) inches and eight (8) inches of KDOT PB-2 aggregate, 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.

**9027 WIRING.** Roadway lighting conductor cables shall be installed inside conduit, suitable for a

240 volt system in accordance with the approved plans. Wiring shall conform to the appropriate articles of the National Electric Code. Cable shall be laid to a minimum depth of thirty-six (36) inches below the bottom of the pavement or the natural ground level, whichever is applicable, and be installed in continuous lengths. 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 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 water tight splice connectors in accordance with the Standard Details.

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. Wires shall be color-coded (Black = hot, green = ground) and circuits permanently identified in accordance with the approved plans.

All splices in light pole bases shall be made with multiple tap molded. The Contractor shall install in-line fused disconnects in each pole base. Fuseholders in all poles shall be crimped. Fuses shall be KTK, or approved equal, high interrupting fuses. Eight (8) amp fuses shall be used in poles with twin luminaires and five (5) amp fuses shall be used in poles with single luminaire. The multiple-tap connectors and fuse holders shall be installed convenient to the handhole at the base of the pole. One (1) foot of surplus cable shall be coiled at the line side of the multiple-tap connector, between the multiple-tap connector and the fused disconnect, and on the load side of the fused disconnect. The unfused connectors for the ground shall be installed with the female end of the connector on the line side.

Luminaires not equipped with terminal blocks shall be connected to the pole and bracket cable with the appropriate wire nut connectors.

**9028 GROUNDING.** All poles shall be bonded to form a continuous system. At each multiple service point, two (2) grounding electrodes shall be installed at least six (6) feet apart. The electrodes 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 rods by a No. 4 A.W.G. copper wire enclosed in a one (1) inch diameter conduit.

**9029 LOCATION.** Unless otherwise noted on the plans, or otherwise approved by the City Engineer, equipment shall be located as follows:

- Cable shall be kept a minimum of two (2) feet and a maximum of four (4) feet behind the back-of-curb.
- Street light poles shall be installed on property lines at a distance of three (3) feet, plus or minus one (1) foot, behind the back-of-curb.

- Junction boxes shall be installed a minimum of two (2) feet and a maximum of four (4) feet behind the back-of-curb and no closer than two (2) feet to any street light pole.
- Control centers shall be located adjacent to the sidewalk or a minimum of five (5) feet and a maximum of six (6) feet behind the back of curb if no sidewalk exists.

**9030 STREET LIGHTING COMPLETION TIME**

The street lights shall be installed and accepted prior to issuance of any occupancy permits.

## **SECTION 9100 - PAVEMENT MARKINGS**

**9101** **SCOPE.** This section discusses the requirements for pavement markings.

**9102** **DEFINITIONS.** *Longitudinal markings* shall include pavement markings parallel to the path of travel and include such items as centerlines, lane lines, edge lines, and barrier lines. Lines may be either continuous (solid) or broken.

*Transverse markings* shall include pavement markings perpendicular to the path of travel and include such items as channelizing lines, stop bars, crosswalk lines, railroad crossing approaches, parking limit lines, turn arrows, and word or symbol messages.

**9103** **GENERAL.** All pavement markings shall be in accordance with the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD). All words and symbols shall conform to the latest edition of *Standard Highway Signs* printed by the US Department of Transportation, Federal Highway Administration. All pavement marking material shall be included on the City of Gardner *Approved Materials List*, latest edition.

Contractor shall be required to layout the location of all longitudinal pavement markings before the surface lift of asphalt is paved. Layout shall include reference lines that result in the proper lane widths and ensure the pavement markings will be located the proper distance from pavement joints. The layout will need to be approved by the City Engineer prior to pavement marking installation.

All turn arrows and legends shall be centered in their respective traffic lanes. Pavement markings, either temporary or permanent, are required at all times if the roadway is open to traffic. All existing markings that conflict with the proposed markings shall be completely removed. The edge of pavement markings paralleling the longitudinal pavement joints shall be located four (4) inches to eight (8) inches from the pavement joint unless otherwise approved by the City Engineer.

All longitudinal markings shall be HPS-8 Integrated Multi-Polymer Pavement Markings (HPS-8) or cold tape (hot-inlaid) per the manufacturer's recommendations and the following requirements:

- Application of HPS-8 shall only occur from April 1 to Nov 1 and shall comply with all manufacturer's recommendations, unless otherwise approved by the City Engineer. Pavement markings installed outside these dates, or when HPS-8 cannot be installed due to manufacturer's recommendations, shall be cold plastic. Cold plastic pavement markings shall be hot-inlaid in conjunction with the paving operation. Application shall be done per manufacturer's recommendations, unless otherwise approved by the City Engineer.
- HPS-8 pavement markings shall not be applied within 24-hours of final paving to allow for proper curing of the pavement. HPS-8 pavement markings shall be installed within fifteen (15) calendar days of final paving, unless otherwise approved by the City Engineer.
- The material shall be 100% solids and shall be applied by standard thermoplastic application equipment at a thickness of 90 mil.

- The material shall be applied by truck mounted equipment unless otherwise approved by the City Engineer.
- A verifiable material certification report showing detailed analysis and compliance shall be provided by the material manufacturer and submitted to the City Engineer for approval prior to the Contractor performing the installation work.

Symbols and transverse markings shall be pre-formed thermoplastic. Application shall be done per manufacturer's recommendations, unless otherwise specified or approved by the City Engineer.

A manufacturer approved primer shall be used on existing asphalt pavement older than 12 months, or on concrete pavement.

Temporary markings shall be removable tape or paint, and shall be maintained throughout the duration of construction. Temporary markings shall be subsidiary to HPS-8 Pavement Markings unless stated otherwise in the approved plans.

The Contractor shall coordinate any pavement marking operations with the Project Inspector and Traffic Operations staff a minimum of twenty-four (24) hours in advance of installing any pavement markings.

## **SECTION 9200 - TRAFFIC SIGNAL**

**9201 DESCRIPTION.** These specifications are intended to describe the equipment, material, and construction requirements for the lump sum bid item Traffic Signal Installation. The installation shall include all poles, foundations, conduit, pull boxes, wiring, signal heads, detectors, control equipment and such other miscellaneous parts and materials as shown in the approved plans or as otherwise required by the City Engineer.

**9202 GENERAL CONSTRUCTION.** The traffic signal installation shall be constructed per the following specifications, as directed by the City Engineer, and the latest edition of the City of Gardner's *Technical Specifications and Design Criteria for Public Improvement Projects* (hereinafter referred to as "General Provisions" or "Technical Specifications"), the latest edition of the Kansas Department of Transportation *Standard Specifications for State Road and Bridge Construction* (hereinafter referred to as "Standard Specifications"), and the latest edition of the Kansas Department of Transportation Traffic Signal Specifications included in the standard details TE120A, TE120B, TE120C, and TE120D (hereinafter referred to as "KDOT Signal Specifications") that are either directly or by reference included herewith. All incidental parts which are not shown in the approved plans or in the Specifications and which are necessary to complete the traffic signal installation shall be furnished and installed as though such parts are shown in the approved plans. The traffic signal system shall be complete and in operation to the satisfaction of the City Engineer at the time of acceptance of the work. All signs, signals, and markings shall conform to the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD).

**9203 COORDINATION OF TECHNICAL SPECIFICATIONS, PLANS, SPECIAL PROVISIONS, AND PROJECT SPECIAL PROVISIONS.** Coordination of discrepancies between the Technical Specifications, Plans, and Special Provisions, shall be in accordance with the City of Gardner *Technical Specifications and Design Criteria for Public Improvement Projects*. In the case of a discrepancy within the Plans, the plan notes shall govern over the standard installation details, and the installation details shall govern over these specifications.

**9204 CERTIFICATION OF CONTRACTOR PERSONNEL.** All traffic signal installation work shall be done by, or in the presence of and under the responsible charge of a Contractor with proof of International Municipal Signal Association (IMSA) Level II Traffic Signal Construction Certification.

Before starting work, the Contractor shall provide the City Engineer with the names and certification credentials of the Level II Traffic Signal Electricians and/or Level II Traffic Signal Technicians assigned to perform traffic signal related work. If the Level II Traffic Signal Electricians or Level II Traffic Signal Technicians are dismissed from the project, all traffic signal installation work shall cease until the names and photocopies of certification cards for replacement personnel are provided to the City Engineer.



**9205 TRAFFIC SIGNAL PRODUCTS & MATERIAL LIST.** Prior to commencing traffic signal installation, the Contractor shall submit a complete list of traffic signal products and materials proposed for the installation. All equipment supplied for the traffic signal installation shall be listed on the most recent edition of the City of Gardner's Approved Products List (APL). Products not included on the APL shall be tested and approved in accordance with Section 9227 prior to construction.

**9206 LOCATION OF UNDERGROUND UTILITIES.** The location of underground utilities on the approved plans is not guaranteed. Additional existing utilities may also be encountered. The Contractor shall have all underground utilities marked and located, potholing where necessary, before beginning any construction excavation, and shall work around any existing utilities located within the right-of-way which do not conflict with the proposed construction. The Contractor shall be responsible for all damages to underground utilities due to his failure to preserve the utility markings.

**9207 NOTIFICATION OF LOCAL POWER COMPANY.** The Contractor shall notify the local power company prior to beginning work to determine the proper type and method of hook-up. The Contractor shall be responsible for payment of any fees assessed by the power company for the power hook-up, regardless of whether these costs have been listed in the approved plans. The fees may include, but are not limited to, service connection fees, conduit, lead-in wire, service pole, meter landing, and power used during installation and testing until the traffic signals are accepted.

**9208 STAKING OF POLES, PEDESTALS, PULL BOXES, CONTROLLER, AND LOOP LOCATIONS.** The locations for signal poles, pedestals, service boxes, junction boxes, controller and detector loops shall be staked by the Contractor. Staked locations shall be approved by the City Engineer prior to construction.

**9209 TRAFFIC SIGNAL IMPROVEMENT POLICIES.** The work included in this project may involve replacement and/or modification of existing traffic signal equipment at a location which is presently controlled by operating traffic signals. The following policies are to be observed during the proposed modifications and improvements:

**Existing Operation:** Unless otherwise noted in the approved plans, the Contractor shall provide continuous operation of the existing traffic signals during the signal modifications and improvements except for shutdowns as required for installation of the proposed improvements.

**Periods of Disruption:** The Contractor shall coordinate any planned disruption of signal operations with the City Engineer and Traffic Operations staff (913-971-5180) at least forty-eight (48) hours in advance of such disruption of operations.

**Disruption Times:** Planned disruption of signal operations shall be limited to the hours between 9:00 a.m. and 3:00 p.m., unless otherwise noted in the approved plans. Traffic control during signal disruptions shall be provided as directed by the City Engineer. The signal controls shall be operable during all other periods.

**Existing Wiring:** All existing wiring within existing controller cabinets shall be identified by the Contractor and each conductor properly labeled in accordance with the Standard Details prior to de-energizing the existing controller.

**9210 SALVAGED EQUIPMENT.**

**Reinstalled:** When salvaged equipment is to be reinstalled, the Contractor shall furnish and install all necessary new materials and equipment including anchor bolts, nuts, washers, concrete, etc. required to install the salvaged equipment in the existing or new location.

**Non-Reinstalled:** When salvaged equipment is not to be reinstalled, it shall be returned to the City of Gardner Traffic Operations Center (TOC) located at 309 N. Rogers Rd. The Contractor shall notify the TOC Supervisor within forty-eight (48) hours prior to delivery of the equipment. The stored equipment shall be the responsibility of the Contractor until it is delivered to the TOC.

**9211 REMOVAL OF EXISTING FOUNDATIONS.** Existing foundations for traffic signal poles, pedestals and controllers shall be removed a minimum of twenty-four (24) inches below finished grade, and the area backfilled in accordance with the Technical Specifications.

**9212 CONDUIT INSTALLATION.** Conduit shall be installed in accordance with the City of Gardner Technical Specifications and the Standard Details. The conduit shall be of the type indicated in the approved plans, and shall be of one type from outlet to outlet.

Conduit under existing pavement, sidewalk, or driveways shall be installed using an approved jacking or boring method.

All conduit installed above ground shall be metallic. Conduit attached to bridges shall have expansion fittings installed at the end of the bridge and at each expansion joint on the bridge. Any attachments to bridges on the state highway system must be approved by the applicable regulatory agency.

All metallic conduits shall be electrically bonded by a grounding bushing and ground wire as detailed in the approved plans.

High Density Polyethylene (HDPE) SDR9 conduit joints shall be made with either a Shur-Lock II coupler or fusion welder.

HDPE conduit shall be continuous from outlet to outlet, with no splices allowed. Bend radii shall not be less than the manufacturer's recommendations.

**9213 PULL BOXES.** Service box and junction box installations shall be per the Standard Details, and as noted below. The location of boxes may be adjusted during installation to clear obstructions and facilitate wiring as approved by the City Engineer but shall be installed no closer than twenty-four (24) inches from the back of curb. The quantity of boxes as shown in the Plans may not be reduced. Additional boxes may be provided at the Contractor's expense. Boxes shall not be located in sidewalk ramps. All boxes shall be free of trash, wire scraps, etc.

**Bedding:** An eighteen (18) inch thick layer of aggregate shall be provided under all pull boxes. The aggregate shall meet the requirements of PB-2 described in the Standard Specifications and shall be visually accepted by the City Engineer.

**Conduit Entrances:** The area around the conduit entrance in in-ground boxes shall not be larger than one (1) inch and shall be sealed with a mortar grout or a silicone sealant (spray foam is not allowed).

**Cable Hooks:** Cable hooks shall be installed in service boxes as detailed in the approved plans.

**Bridge Mounted:** Junction boxes mounted to bridges shall be mounted with wedge anchor bolts of sufficient size and strength to safely secure the box to the structure. The surface of the junction box which comes in contact with concrete shall be covered with aluminum colored butyl rubber sealant (caulking compound). Any attachments to bridges on the state highway system must be approved by the applicable regulatory agency.

**9214 FOUNDATIONS.** Concrete foundations for poles, pedestals and cabinets shall be constructed per the Standard Specifications, as modified below, and as detailed in the approved plans.

Reinforcing steel shall meet the requirements of the Standard Specifications, and shall be free of rust and dirt, and shall be of the size, quantity and dimensions shown in the approved plans.

Before placing the concrete for the foundation, the Contractor shall ensure that the appropriate anchor bolts are placed in proper orientation, elevation and verticality. This may be accomplished by using positioning plates and/or tying or welding the anchor bolt assembly to the reinforcing steel cage. "Stabbing" of anchor bolts will not be permitted.

The anchor bolt threads shall be protected from concrete fouling when the concrete is poured.

All piers for foundations shall be drilled and constructed in one pour. The top six (6) inches of pole and pedestal foundations shall be formed in a square and shall be level with the adjacent sidewalk, or approximately two (2) inches above finished grade if no sidewalk is present. The work apron on the controller pad shall be level with the adjacent sidewalk or approximately one (1) inch above finished grade if no sidewalk is present.

**9215 TRAFFIC SIGNAL POLES AND PEDESTALS.**

**Traffic Signal Poles:** The traffic signal poles shall be plumbed after the mast arm and other loads have been applied. Adjustment shall be made using the leveling nuts on the anchor bolts. The final distance between the top of the concrete foundation and the bottom of the leveling nuts shall not exceed one (1) inch. The nuts shall be thoroughly tightened to the manufacturer's recommendations and covered with the nut covers provided with the poles.

The mast arm and luminaire arm(s) (on combination poles) shall be attached to the pole by a suitable mast arm connection. Clamp on connections will not be accepted. Connections shall be installed to the manufacturer's recommendations.

All other attachments to the poles and mast arms shall be located in the field, and all wire entrances into the pole or mast arm shall be drilled or punched in the field. All drilled or punched surfaces shall be carefully reamed to remove any sharp edges or burs before application of a field coat of organic zinc rich paint as described in the Standard Specifications. The one (1) inch rubber grommets supplied with the poles shall be installed at all outlets for signal wiring before the wires are installed.

Poles shall not be installed until the utility company has installed power for the traffic signal. Contractor shall provide a screen to keep rodents from entering the pole through the gap at the base. The screen material shall be a stiff, welded steel wire mesh with ¼" square openings, and shall be wrapped around the pole anchor bolts, securing ends together with wire ties or other suitable banding material as approved by the City. The screen shall be wedged between the base of the pole and the surface of the foundation after the pole is plumb.

The end caps provided with the poles shall be securely installed on the end of the arms and the top of the pole prior to acceptance of the signals.

**Pedestals:** The cast aluminum pedestal bases shall be bolted to the concrete foundation using ¾" by 2" galvanized square washers and tightened to the manufacturer's recommendations.

All attachments to the pedestal shall be located in the field and all wire entrances into the pedestal shaft shall be drilled or punched in the field. All drilled or punched surfaces shall be carefully reamed to remove any sharp edges or burs. Plastic or rubber bushings shall be installed at each opening before the wires are installed.

The post cap and hand hole cover provided with the pedestal shall be securely installed prior to acceptance of the signals.

The pole shall be screwed into the pedestal base and have a pole and base collar assembly affixed, to prevent the pole from loosening.

**9216 TRAFFIC SIGNAL HEAD INSTALLATION.** The faces of all signal heads shall be completely covered with orange mesh lens covers until signal turn-on. Signal heads shall not be installed more than ten (10) days prior to the signal turn-on, or before power is installed, unless otherwise approved by the City Engineer. All heads shall be plumbed as viewed from the direction in which they face and in the vertical plane. The City Engineer shall direct the final positioning of the signal heads for optimum visibility.

**Mast Arm Mounting:** Mast arm signal head assemblies shall be rigidly mounted in accordance with the approved plans. The brackets shall be securely attached to the mast arm according to the manufacturer's recommendations. All conductors shall be concealed within the assembly.

All mast arm signal heads shall be attached to the mast arm prior to attaching the mast arm to the pole. Special care must be taken before drilling the arm for attaching the signal heads in order to assure that the signal heads will be in proper orientation over the intended traffic lanes.

Mast arm mounted signal heads shall be installed at a height of 17 to 19 feet from the pavement to the bottom of the signal head, with 17 feet being the desirable minimum height.

**Side-Of-Pole Mounting:** Side-of-pole signal heads shall be supported in accordance with the standard details. All members shall be plumb, symmetrically arranged, and securely assembled. Mounting brackets shall be attached to the pole with heavy duty stainless steel banding and buckles. All conductors shall be concealed within the assembly.

Side-of-pole traffic signal heads shall be installed at a minimum height of ten (10) feet from the base of pole to the bottom of signal head. Side of pole heads shall be back-mounted (opposite side of pole from traffic). Doors shall swing away from pole and, if inverted, shall have weep holes plugged to prevent moisture from entering head. Pedestrian signal heads shall be mounted at a minimum of seven (7) feet from the base of pole to the bottom of the signal head.

**9217 WIRE AND CABLE INSTALLATION.** Wire and cable shall be installed per the Standard Specifications, as modified herein, and in accordance with the wiring diagram in the approved plans. No splicing of conductors will be allowed except for the following:

**Loops:** The ends of the wire forming each loop shall be spliced in the nearest pull box to a detector lead-in cable. Splices between loops and lead-in cables shall be twisted and secured with a wire nut, and the splice shall be waterproofed, including the end of the loop wire tubing, using an approved loop splice kit. Taped splices will not be permitted. The splice shall be located in the upper seventy-five (75) percent of the box.

**Multi-conductor Cable in Pedestal Bases:** Multi-conductor cable runs to pedestal bases shall be spliced in the pedestal base to the multi-conductor cables running up the pedestal shaft to the signal heads. Each conductor shall be clearly labeled as to its function with a permanent label per the Gardner color code and the splices shall be waterproofed. The wires shall be arranged in the base to prevent the splices from coming into contact with the sides of the base or top of the foundation. Any unused conductors shall be taped.

**Pulling Wires and Cables through Conduit:** Separate three (3) inch conduits shall be provided for both low and high voltage wire bundles. When pulling wires into the conduit, a pulling sock or other similar device shall be used to equalize pulling strain on the conductors.

**Excess Cable:** A minimum of 6 feet of slack or excess multi-conductor cable, detector lead-in cable, loop detector wire, and lighting distribution wire shall be provided in each pull box. The excess cable in service boxes shall be logically grouped, taped, and neatly coiled and placed on the cable hooks. The excess cable in junction boxes shall be logically grouped, taped, and neatly coiled and placed in the bottom of the box. At least 6 feet of excess multi-conductor cable shall be left in each pole base to allow for connection to the terminal block.

**Termination of Field Wires In the Cabinet and Pole Bases:** The Contractor shall clearly identify the function of each field wire entering the cabinet or pole with a permanent label per the Gardner color code. Contractor shall leave 20 feet of slack

for cabinets and 6 feet of slack for poles, for termination. Refer to Bill of Materials for wire termination responsibility. If not defined in Bill of Materials, City of Gardner staff are responsible for termination, to be coordinated by contractor.

**Pole Wiring:** Each signal head shall have a separate run of multi-conductor cable from the terminal block in the pole base to the terminal block in the signal head. A separate seven-conductor cable shall run to each three-section signal head; a separate seven-conductor, cable shall run to each four- or five-section signal head; a seven-conductor, or three-conductor, cable shall run to each pair of pedestrian heads leaving 6 feet of spare cable out of the hand hole for termination; a separate two-conductor shall run continuously (no splices shall be allowed) from the pedestrian push button to the field terminal in the cabinet. All four-section heads shall have their own neutral run back to the cabinet. The ends of any unused conductors shall be taped.

- 9218 GROUNDING/BONDING.** The traffic signal system shall be grounded per the Standard Specifications and as specified herein. All traffic signal poles, pedestals, controller cabinets, and service circuit breakers shall be grounded using a ground wire bolted to the inside of these devices with a 0.5 inch internal ground lug. All ground wires shall be attached to the ground rod using a ground. Ground rods shall be installed as detailed in the approved plans.

The detector lead-in shielding and drain wire shall be electrically floating (not attached to earth ground) at the pull box. Grounding the cabinet shall be in accordance with the manufacturer's recommendations.

- 9219 DETECTOR LOOP INSTALLATION.** Detector loops shall be installed as close as practicable to the locations shown in the approved plans. Loops shall be centered in their respective lanes; or if they cover more than one lane, they shall be centered over the width of the intended zone of detection. The longitudinal orientation of loops installed in concrete pavement shall be adjusted such that no loop begins or ends within twelve (12) inches of a transverse joint.

**Pre-Formed Loops:** Pre-formed loops shall be installed in new pavement during the pavement construction in accordance with the manufacturer's recommendations.

**Saw-Cut Loops:** Saw-cut loops shall be installed in saw cuts as detailed in the approved plans. The location of each loop shall be clearly marked on the pavement and approved by the City Engineer prior to loop installation. The Contractor shall drill two (2) inch diameter holes centered on each point of intersection of the loop slots prior to cutting the slots. The slots shall be cut using a saw equipped with a depth gauge and horizontal guide to assure proper depth and alignment of the slot. The blade used for the saw cut shall provide a clean, straight, well-defined saw cut of the width and depth indicated in the approved plans without damage to adjacent areas. Where the loop changes direction, the saw cuts shall be overlapped to provide full depth at all points of intersection.

Before installing the loop wire, all rough edges and protrusions shall be removed from the saw cut. The slots must be cleaned and dried to remove cutting dust, grit, oil, moisture or

other contaminants. Cleaning shall be achieved by flushing the slot with a high-pressure water jet stream. The slot shall then be cleared of water and dried using oil-free compressed air.

Loop wire shall be installed in the slot using a dull edge wooden paddle or wheel to prevent damage to the loop jacket. Conductors of each loop shall be run continuously from the nearest pull box with no splices permitted. All loops shall be wound in the same direction with the start and end of each clearly marked with a permanent label at the pull box. The loop conductors running from the loop to the adjacent pull box shall be twisted a minimum of 3 turns per foot/10 turns per meter. In addition, each loop conductor shall be permanently identified by the loop number shown in the approved plans. Paired loops shall be joined in the pull box in series or parallel as recommended by the manufacturer to obtain optimum sensitivity at the sensor unit.

After the conductors are installed in the slots, the loops shall be tested for continuity and shorts with a meg-ohm-meter set at 500 volts. Any defective wire shall be replaced. After testing, the slots shall be filled with an approved loop sealant to within 0.125 inches of the pavement surface. Before setting, surplus sealant shall be removed from the adjacent road surfaces without the use of solvents.

The Contractor may, at his own expense, use approved pre-formed loops instead of saw cut loops.

The loop conductors for each loop shall be spliced in the pull box to a detector lead-in cable in accordance with Section 9217 of these specifications. The detector lead-in cable shall run continuously from the pull box to the field terminal in the cabinet with no splices permitted.

## **9220 SIGNS.**

**Overhead Street Name Signs:** Street name signs shall be installed on mast arms after all other loads are applied to the mast arm. The signs shall be located in accordance with the Standard Details. Signs shall be mounted so that the legend is level. The final location shall be determined by the City Engineer.

Installation of signs on mast arms shall be accomplished with suitable stainless steel banding, clamps, and brackets capable of withstanding 100 mph winds. Street name signs over eighteen (18) inches in height shall be installed using approved sign mounting brackets in accordance with the approved plans. All bolts inserted through sign faces shall be stainless steel with flat fiber washers installed between the reflective sheeting and bolt heads. Bolt holes shall be drilled in the field.

**Regulatory Signs:** The R10-Series signs shall be mounted on the mast arm to the right of the left turn signal head using an approved sign mounting bracket in accordance with the Standard Details.

**R10-3E Pedestrian Push-Button Signs:** Pedestrian push-button signs shall be mounted to

the traffic signal pole above the appropriate pedestrian push-button. Mounting shall be accomplished using suitable stainless steel banding, clamps and brackets capable of withstanding 100 mph winds. As an alternative, the pedestrian sign mounting bracket may be constructed integral to the pedestrian push-button assembly.

**9221 PEDESTRIAN PUSH-BUTTONS.** Pedestrian push-buttons shall be installed on the poles or pedestals indicated in the approved plans at a height of 3.5 feet above the adjacent sidewalk (or ground if no sidewalk is present). The push-button shall be located on the side of pole nearest the pedestrian walkway, and perpendicular to the intended crossing direction. The push button shall be installed on a level landing area, not in an ADA ramp, and located within twenty-four (24) inch maximum (12" desirable) of the level landing area.

**9222 TRAFFIC SIGNAL TURN-ON.**

**Flashing Operation:** At locations without previous traffic signal control, the new traffic signals shall be flashed 2 to 3 business days prior to full signal system turn-on.

**System Turn-On:** The signal system turn-on shall not occur on Mondays, Fridays, weekends, or holidays and shall be completed prior to 3:00 p.m. on the day of the turn-on.

**Supplier Representative:** The supplier of the control equipment shall have a representative present at the signal system turn-on.

**Traffic Engineering Notification:** The City Engineer shall be notified at least one week in advance of the date of signal turn-on.

**9223 TEST PERIOD.** Following completion of all electrical apparatus hook-ups and the system turn-on, the signals shall operate satisfactorily for thirty (30) days under normal conditions prior to acceptance by the City Engineer. During the test period, the signals shall operate trouble-free with no failures of the controller or its components. Should any defect develop under normal and proper operating conditions during the testing period and prior to acceptance by the City Engineer, this malfunction shall be corrected by and at the expense of the Contractor, including all labor, materials and associated costs. Minor failures, such as loop detector re-tuning, will not be the basis for starting a new test period provided the failures are repaired immediately and the same failures do not recur during the remainder of the test period. A major malfunction or failure of the controller and its components will result in a new thirty (30) day test period being implemented after the repairs have been made.

**9224 GUARANTEE.** All equipment furnished on a project by the Contractor shall be guaranteed against any imperfections in workmanship and materials. The customary manufacturers' warranties shall be assigned to the City.

**9225 MANUALS.** A minimum of two (2) manuals shall be provided for each controller and shall include complete nomenclature, wiring diagrams, schematics showing test voltages, functional description of circuits, parts list and cross reference to standard part numbers, appropriate testing procedures, and other pertinent data.



**9226 MATERIALS DESCRIPTION.** These specifications cover the general materials and miscellaneous hardware for the installation of a traffic signal to be constructed in accordance with and at locations indicated in the contract, shown in the approved plans or designated by the City Engineer.

**9227 MATERIAL REQUIREMENTS.**

**General:** All equipment supplied for the traffic signal installation shall be listed on the most recent edition of the City of Gardner's APL. In the case of a discrepancy between the product specifications listed below and the APL, the APL shall govern over these specifications. All materials used in the fabrication or assembly of the items listed below shall be new, shall be of the best quality and workmanship and shall be the manufacturer's latest approved design. Major items of electronic equipment installed under this contract shall be of the same type and consist of products supplied by the same supplier.

The traffic signal shall be complete, and the Contractor shall furnish and install all equipment necessary for the satisfactory operation of the signal system whether specifically mentioned or not.

All electrical devices shall be purchased within 90 days of install.

**Responsible Parties:** Any reference to the State, State of California, or Agency shall mean the local agency responsible for maintaining the traffic signal. Any reference to the Contractor shall mean equipment manufacturer or supplier.

**Cabinets:** The pole mounted cabinets shall be Model 336A, and the pad mounted cabinets shall be either Model 332BPDA2 single cabinet or Model 332DBLPDA2 double cabinet, in accordance with Chapter 6 of the Caltrans Traffic Signal Control Equipment Specifications (TSCES) with the following additions or modifications.

Finish The cabinet finish shall be black in color.

Lift Eyes The cabinet lift eyes shall be removable and shall be turned down after installation of the cabinet.

Light Fixtures Cabinets shall be furnished with LED light fixtures with a length of 21.5 inches, including lamps, over the front and back doors that are controlled by door- activated switches.

AC Surge Suppression The cabinet shall be furnished with a RackPro 20Amp rack mounted AC surge suppressor model 35319 or equivalent. The unit shall be 1U in height and 19" wide, having a minimum 8 rear outlets and 1 front outlet.

Plan Drawer/Work Surface A drawer shall be mounted in the EIA rack between the controller and the top input file. It shall be mounted on sliding tracks with lockout and quick-disconnect features. The drawer shall extend a minimum of 14 inches, and shall be capable of supporting a 40 lb. load when fully extended. The drawer shall be provided with a hinged aluminum top covered with a chemical proof Formica-type plastic sheet. The interior of the drawer shall have nominal dimensions of 1 inch high, 13 inches deep and 15.75 inches wide.

Additional Model 336s Requirements The Model 336S cabinets shall be furnished with a continuously welded bottom of the same material as the cabinet, and all of the hardware necessary to accommodate mounting to a 12 inch outside diameter pole.

Additional Model 332B Requirements The Model 332B cabinets shall be furnished with the power distribution assembly #2 in lieu of the power supply and power distribution #1 assemblies. The cabinets shall be supplied with the circuit breaker option per Section 6.4.3.9 of the Caltrans TSCES. The cabinet shall be furnished with anchor bolts, nuts and washers.

Additional Output File #1 Requirement The output file #1 supplied with the cabinet shall be modified to provide compatibility with the red monitoring features of the conflict monitor.

Input File Requirements The input files shall be split input files equipped with an RJ-45 connector on the backside of the input file.

**Controller:** The controller shall be in accordance with the APL.

**Conflict Monitor:** The conflict monitor shall be in accordance with the APL.

**Flasher:** The flasher shall meet the requirements of a Model 204 flasher per Chapter 3 of the Caltrans TSCES.

**Load Switch:** The load switch shall have modular switches that can be easily replaced using a screwdriver, and meet the requirements of a Model 200 switch pack per Chapter 3 of the Caltrans TSCES, and shall also be dual indication.

**Flash Transfer Relays:** The flash transfer relays shall be heavy duty relays meeting the requirements of the Model 430 per Section 6.4.6 of the Caltrans TSCES.

**Surge Protector:** The surge protector shall be as per City of Gardner Specifications.

**DC Isolator:** The DC isolator shall meet the requirements of a Model 242 two-channel DC isolator per Chapter 5 of the Caltrans TSCES.

**AC Isolator:** The AC isolator shall meet the requirements of a Model 252 two-channel AC isolator per Chapter 5 of the Caltrans TSCES.

**Detector:** The detector sensor units provided shall be a Reno A&E Model C-1103-SS or approved equal.

**Battery Back-Up System:** The BBS / UPS system shall be comprised as noted below and shall include, but not limited to: inverter/charger (UPS), power transfer switch (PTS), batteries, a separate manually operated non-electronic bypass switch, 30 amp 4 prong external reverse service plug with weatherproof cover for connection to generator, and all necessary hardware and interconnect wiring. The BBS shall meet the following requirements:

- The BBS shall be capable of powering the intersection in normal operation for a minimum of three (3) hours. Intersection loads shall be calculated to assess proper battery size and quantity to meet this requirement; 850W for three (3) hours shall be the minimum allowed capacity. The system shall be capable of providing power for full run-time operation, flashing mode operation, and a combination of both full and flash mode operation of an intersection. The operation of the flash mode shall be field programmable to activate at various times, battery capacities, or alarm conditions locally using the pad or using a standard PC interface.
- The BBS shall make available a minimum of four (4) dry contacts rated at 1 Amp 120 VAC. Each relay shall be programmable with a minimum being the following: "On Batt", "Low Batt" (40% remaining charge), "Timer", and "Alarm".
- BBS Batteries. Batteries shall be hot-swappable.

**Signal Heads:** All signal heads on a project shall be supplied by one manufacturer. The signal heads shall be in general conformance with the latest edition of the Equipment and Materials Standards of the Institute of Transportation Engineers - Vehicle Traffic Control Signal Heads, and as specified below.

Standard Vehicle Traffic Signal Heads - The housing for each vehicle traffic signal section shall be made of a durable polycarbonate. The housing shall be yellow, or black, with black doors. The visors for each signal section shall be of the tunnel type, and be made of a durable black polycarbonate of not less than 0.1 inch/2.5 mm in thickness.

Arrow indications shall have an incandescent look.

Pedestrian Traffic Signal Heads - All pedestrian traffic signal heads shall include a countdown display (IDC Model LEDP-HMC-002 or approved equal). The housing shall be a one piece polycarbonate, yellow with a flat black one piece polycarbonate door, without the standard Z-Crate visor. Head units shall be installed with the clamshell 2 mounting (Model 4805). The pedestrian signal indications shall be in general conformance with the latest edition of the E.T.L. and Institute of Transportation Engineers - Pedestrian Traffic Control Signal Indications. Pedestrian lenses shall be rectangular, with a dimension of 16 x 18 inches. The message shall consist of a Don't Walk "HAND" symbol in portland orange, and a Walk "WALKING PERSON" symbol in lunar white and have an incandescent look. The pedestrian symbols shall be a minimum of 9 inches high. The lens housing shall be designed to accommodate 16-inch LEDs.

Pedestrian Light Emitting Diodes (LED) Walk and Don't Walk indications, when specified on the plans, shall be sealed and the hand and walking man shall be filled completely. No

outlines will be accepted.

**Signal Lamps:** All red, yellow, and green vehicle traffic signal indications in each signal head shall be a 12- inch LED lens meeting the requirements of the ETL (<http://www.intertek.com/marks/etl/>) verified certification program and latest ITE Specifications for LED's for Vehicle Traffic Signals. In addition they shall be the product of one manufacturer and be pre-approved by the City of Gardner.

**Signal Mounting Brackets:**

Mast Arm Bracket - The mast arm signal mounting brackets shall be fabricated of high strength aluminum, and shall provide for rigid mounting of the traffic signal heads while allowing signal aiming adjustment in all planes. The brackets shall be designed to strap to the mast arm using aircraft-type cable which shall be pinned to the bracket at one end and which shall provide a turnbuckle style tightening adjustment on the other skybracket adjustable steel banding. The brackets shall incorporate wiring channels so that after installation, all signal cables shall be protected from the effects of exposure to the weather.

Side-Of-Pole Brackets - Side-of-pole signal mounting brackets shall be molded of yellow or black polycarbonate and shall incorporate a mounting arm and pole plate into a single member which shall include guides to correctly position the banding material on the pole plate. The dimensions of the mounting brackets shall be as required to provide proper signal head alignment. Each bracket shall have molded serrations to assure a positive lock with the signal head and allow positioning of the traffic signal heads in increments of five (5) degrees. The bracket shall be designed to provide a wiring raceway for signal cable exiting the support pole and entering the signal head.

**Backplates:** Backplates shall be of sufficient size to provide a minimum of 5 inches/125 mm of dark background for the signal indications and shall be fabricated from a minimum of 0.125 inch black ultraviolet stabilized ABS plastic. Backplates shall be capable of withstanding a 100 mph wind. Backplates shall be furnished with all necessary hardware to attach to the signal heads.

**Pedestrian Push-Button:** The pedestrian push button assembly shall be black in color, with a low profile mount. It shall contain a silicon or neoprene cover to body gasket. Cover screws shall be stainless steel. The switch and actuator shall be protected from dust and moisture with a silicon or neoprene cover. Assembly shall not possess an L.E.D. light.

**Pedestrian Sign:** The pedestrian information signs shall be MUTCD R10-3e as detailed in the approved plans. The sign blank shall be constructed of minimum 0.075 inch thick aluminum alloy. The sign face shall have a non-reflective black legend direct screened on high intensity prismatic sign sheeting. The sign shall be visually accepted by the City Engineer.

**Steel Traffic Signal Poles:**

Tapered Tubular Shafts - Steel traffic signal pole and mast arm shafts shall conform to Division 1600 of the Standard Specifications and the requirements in the approved plans. All pole and mast arm shafts shall be constructed of one of the following methods:

- No Transverse Welds. Pole and mast arm shafts shall be tapered tubular members made only of one length of structural steel sheet of not less than No. 7

Manufacturing Standard Gauge (Exception: Signal arms designed for lengths of 40 feet or greater may have arm extensions of not less than No. 11 gauge steel, with bolted telescopic field joints so as to develop full strength of the adjacent shaft sections to resist bending action). Round (Type I) members shall meet the requirements of the latest edition of A.S.T.M. A595 Grade A or B. Multi-sided (Type II) members have a minimum of 12 sides and meet the requirements of the latest edition of A.S.T.M. A570 or A.S.T.M. A572 with a minimum yield strength of 55,000 psi and a maximum silicone content of 0.06 percent. Only one longitudinal weld, and no transverse welds, shall be permitted in the fabrication of the tubular members consisting only of one length of structural steel.

- Transverse Welds. Pole and mast arm shafts shall be fabricated from hot rolled basic open hearth steel conforming to A.S.T.M. A570 for thickness of No. 11 and No. 7 Manufacturing Standard Gauge, A283 Grade D for No. 3 gauge and A36 modified for 0 gauge. The shaft shall be longitudinally cold rolled to flatten the weld and increase the physical characteristics so that the metal will have minimum yield strength of 48,000 psi. Where transverse full penetration circumferential welds are used, the fabricator of the shaft shall certify: (1) that all such welds have been magnetic particle tested by an independent testing laboratory using a qualified Nondestructive Testing (NDT) Technician and (2) that the NDT equipment has been calibrated annually.

Poles - The poles shall include a suitable connection for attaching the mast arm to the pole shaft, a reinforced hand hole with gasket cover located near the bottom of the pole and oriented 180 degrees from the mast arm, a grounding lug in the hand hole or inside the pole near the hand hole, a J or C hook wire support inside the pole near the top of the pole, 4 nut covers and a removable pole cap. The poles shall be pre-drilled for the mast arm attachments prior to galvanizing. Rubber grommets shall be furnished for all wire entrances into the pole. A clamp-on connector shall not be permitted.

Combination Poles - When combination lighting and signal poles are specified in the approved plans, the poles shall also have suitable clamps for attaching the luminaire arm to the pole shaft. The pole shaft shall be pre-drilled for the luminaire arm attachment prior to galvanizing, with the luminaire arm to be mounted in the same vertical plane as the signal arm. In addition, a reinforced nominal 3 inch by 5 inch hand hole shall be located 180 degrees from and just above the mast arm, and a J or C hook wire support shall be welded inside the pole immediately above the mast arm.

Mast Arms - All signal mast arms shall have suitable attachment devices for attaching to the pole shaft, and a removable end cap. Clamp-on connectors shall not be permitted. Rubber grommets shall be furnished for all wire entrances into the mast arm.

Luminaire Arms - Luminaire arms shall be either single tube or truss-type arms as indicated in the approved plans. All luminaire arms shall have suitable clamp-on

attachment devices for attachment to the pole shaft. Single tube arms shall be welded to one half of the luminaire arm clamp. Truss-type arms shall be furnished with two clamp- on simplex fittings in accordance with the Standard Details.

Galvanizing - The poles, mast arms, luminaire arms and all steel accessories shall be galvanized to the requirements of the latest edition of A.S.T.M. A123.

Epoxy Coating - When epoxy coating for steel poles, mast arms, luminaire arms and all other steel accessories is specified in the approved plans, the Contractor shall conform to Valmont F-306 Rev 1 specifications for epoxy top coat. Contractor shall repair any damage to the finish of any structure with the base primer and finish coat materials furnished by manufacturer. No other products shall be used unless otherwise approved by the City Engineer.

Design Load - All traffic signal poles shall be designed to accommodate the standard signal head, signing, and luminaire arm loadings established by the Bureau of Traffic Engineering. The design shall conform to the latest edition of AASHTO Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals handbook with a wind load of 90 mph / 145km/h and a minimum of 1.14 gust effect factor. The poles shall also accommodate wind loadings which may cause deflections of the mast arm in the vertical plane. These deflections shall never result in less than a 15 foot clearance between the roadway and the lowest point of the signal assembly.

Anchor Bolts - High strength anchor bolts, washers, and nuts, conforming to the Standard Specifications shall be included. The leveling nuts may be either Heavy Square or Heavy Hex nuts. Anchor bolt washers conforming to the requirements of the latest edition of A.S.T.M. F436 shall also be acceptable.

#### Basis of Acceptance

- Standard Shop Drawings - All traffic signal poles shall be detailed by the manufacturer on shop drawings. The drawings shall include the pole, mast arm and luminaire arm (on combination poles) dimensions, arm attachment details, hand hole details, and anchor bolt details, along with the signal weight, projected areas and mounting arrangement. Design calculations shall be submitted with the shop drawings. Approved shop drawings shall be included with the Pre-qualified Traffic Signal Materials List.

For traffic signal poles that are not covered by the approved manufacturer's standard shop drawings, the Contractor shall submit three copies of detailed shop drawings and an electronic copy as a PDF, along with the design calculations to the City Engineer for approval.

- Poles and Mast Arms - See the Design Criteria for the basis of acceptance.

- Anchor Bolts - See Design Criteria for the basis of acceptance of anchor bolts for traffic signal poles. If Type "B" certification is not provided according to the Design Criteria, the City Engineer may require testing of an anchor bolt.
- Traffic Signal Materials List - Along with the Traffic Signal Materials List, the Contractor shall submit the necessary traffic signal pole ordering information. The City Engineer will review the information for compliance with the plan dimensions for pole height, mast arm length and mounting height, and luminaire arm length and mounting height.

**Traffic Signal Pedestals:** Traffic signal pedestals shall consist of an aluminum shaft of the length specified in the approved plans, a cast aluminum base, anchor bolts with nuts and washers, and shall be provided with a pole cap.

The shaft shall be of Type 6061-T6, 6063-T6 or 6063-T832 aluminum alloy, and shall be a single piece of drawn seamless tubing having a nominal 4.5 inch outside diameter and 0.25 inch wall thickness. The shaft shall be threaded at one end for attaching the shaft to the base. The shaft shall have a uniform polished finish.

The pedestal base shall be AASHTO certified and be cast of Type 356.0-T6 aluminum alloy. It shall have a threaded collar with a set screw, and plastic hand hole cover.

Anchor bolts for traffic signal pedestals shall be of the dimensions detailed in the approved plans and shall meet the requirements of the latest edition of A.S.T.M. A36. The threaded ends of the anchor bolts, nuts, and 3/4" x 2" square washers shall be galvanized. Anchor bolts for traffic signal pedestals will be visually accepted by the City Engineer.

**Terminal Block:** Terminal blocks in the poles shall be U.L. recognized barrier type or dead-front type terminal strips having terminals of sufficient size and quantity to connect the individual conductor run between the cabinet and the pole to the conductor run between the pole and the signal heads. Terminal blocks shall be rated for at least 30 amps current.

**Junction Boxes (In-Ground):** The junction box shall be of sufficient size to facilitate the conduit and wiring as indicated in the approved plans. Junction boxes shall have nominal dimensions as shown on the approved plans. In-ground junction boxes shall be constructed of fiberglass reinforced polymer box and cover.

Type I and II boxes and covers shall support, without damage to the box or cover, a static load of 22,000 pounds distributed over a 10 inch by 10 inch area in the center of the cover.

The cover shall bear the logo "TRAFFIC SIGNAL" clearly and permanently molded or etched into the cover.

Type III and IV boxes and covers shall support, without damage to the box or cover, a static load of 22,000 pounds distributed over a 10 inch by 10 inch area in the center of the cover.

**Junction Boxes (Above-Ground):** Above ground junction boxes shall have the nominal dimensions of 12 inch by 12 inch by 6 inch. The junction box shall be made of minimum 0.075 inch/2 mm thick sheet metal (steel) with welded seams, knockouts and weather proof screw cover. Junction boxes shall be hot dipped galvanized in accordance with ASTM A-123 after fabrication.

**Service Boxes:** The service box shall have the minimum nominal internal diameter of 24 inches diameter with a minimum depth of 36 inches. Service boxes shall be provided with cable hooks as detailed in the approved plans. The box may be constructed of one of the following methods: polymer concrete with a polymer concrete cover or a fiberglass reinforced polymer body with a polymer concrete ring and cover. The ring shall be securely attached to the body.

The box and cover shall support, without damage to the box or cover, a static load of 22,000 pounds distributed over a 10 inch by 10 inch area in the center of the cover.

The cover shall bear the logo "TRAFFIC SIGNAL" clearly and permanently molded or etched into the cover.

**Luminaires:** Luminaires shall be in accordance with the Technical Specifications.

**Un-Fused Street Light Connector Kit:** Un-fused connector kits shall be of the set-screw type in accordance with the approved plans and shall be furnished with waterproof rubber boots.

**Fused Street Light Connector Kit:** Fused connector kits shall be in accordance with the approved plans and shall be supplied with molded rubber boots for waterproofing. The connector shall be capable of withstanding multiple disconnects without damage to the watertight seals or terminals. Each connector shall include all parts and materials necessary to complete its installation, such as fuses, lubricating compound, and assembly devices.

The fuse shall be a minimum of 5 amp cartridge type as recommended by the connector manufacturer.

**Overhead Street Name Signs:** Overhead street name signs shall bear the message indicated in the approved plans. The legend shall be centered on the sign face. The border shall be 0.75 inches wide.

Blank - The sign blank shall be of 0.125 inch thick Type 5052-H38 aluminum alloy. All corners on the sign blank shall be rounded.

Sheeting - The sign faces shall be either direct-applied white enclosed lens high performance



retro-reflective legend and borders on a green enclosed lens 3M high intensity prismatic sheeting background, or transparent green cuttable film over white enclosed lens 3M high intensity prismatic sheeting. The use of the transparent film shall in no way limit the manufacturer's warranty on the 3M prismatic sheeting over which it is applied. The green sheeting or film shall conform to Federal Color Standard 595A, Color No. 14109.

Lettering – The font size for the legends shall be as follows: 6 inch mm series E-Modified upper case for SW, ST, AV; 8 inch upper case with 6 inch lower case series E-Modified for names; 8 inch series E-Modified for numerals.

Acceptance - Before final fabrication and shipment, the manufacturer or supplier shall provide, for the City Engineer's approval, a layout of each sign showing the exact street name lettering to be placed on the sign. The signs shall be visually accepted by the City Engineer.

**Regulatory Signs:** The design details (color, letter height, and letter series) for all regulatory signs shall be as shown in the latest edition of the Standard Highway Signs Manual. Special signs not included in the Standard Highway Signs Manual shall be as shown in the approved plans. Sign blanks shall be a minimum of 0.075 inch thick aluminum alloy. The sign face shall be of 3M high intensity prismatic sheeting meeting the requirements of the Standard Specifications.

Regulatory signs shall be accepted in accordance with Section 9228 of these specifications, with additional certification stating that the retro-reflective sheeting used to manufacture the signs in accordance with the Standard Specifications.

**Entrance Head:** The entrance head shall be of cast aluminum and shall be of the clamp-on type for use with rigid conduit of the type specified in the approved plans. It shall be U.L. listed.

**Service Enclosure:** The service enclosure shall be A PUP meter pedestal, product no. USPAR-M2100-108C-OLA-AL or approved equal.

**Circuit Breakers:** The circuit breakers shall be standard plug-in, single pole, molded case, of the trip rating as shown in the approved plans.

**Ground Rod:** The ground rod shall be 0.75 inch diameter by 10 foot long copper bonded steel rod and bear the U.L. label.

**Ground Rod Clamp:** The ground rod clamp shall be a 0.75 inch clamp cast of high strength copper alloy and be U.L. listed for direct burial.

**Service Wire:** The service wire shall be Type USE-2 standard, annealed, copper wire meeting the requirements of ASTM B-8, and be of the size specified in the approved plans.

**Lighting Distribution Wire:** The lighting distribution wire shall be Type USE-2 stranded, annealed, copper wire meeting the requirements of ASTM B-8, and be of the size specified in the approved plans.

**Pole & Bracket Wire:** The pole and bracket wire shall be Type USE-2 stranded, annealed, copper wire meeting the requirements of ASTM. B-8 and be of the size specified in the approved plans.

**Ground Wire:** The ground wire shall be No. 6 AWG solid bare copper wire meeting the requirements of ASTM B-3.

**Multi-conductor Cable:** The multi-conductor cable shall meet the requirements of IMSA 19-1. Conductors shall be stranded No. 14 AWG. The quantity of conductors shall be in accordance with the approved plans.

**Shielded Detector Lead-In Cable:** Shielded detector lead-in cable shall be a stranded, four conductor, No. 18 AWG, using water blocking tape with drain wire. Conductors shall be color coded red, green, black, and white. Wire shall not be gel filled and must be pre-approved by the City Engineer.

**Detector Loop Wire:** The detector loop wire shall meet the requirements of IMSA 51-5. The conductor shall be No. 14 AWG, and the tube shall be polyethylene.

**Loop Sealant:** The loop sealant shall be a one-part polyurethane, moisture curing, elastomeric compound requiring no mixing or measuring, prior to or during application. It shall be specifically designed for sealing and protecting detector loop wires in both asphalt and concrete pavements. It shall not chemically attack or damage the pavement, yet shall sufficiently bond with the pavement to effectively seal the saw cut and prevent the infiltration of moisture into the slot. The cured loop sealant shall exhibit resistance to the normally encountered effects of weather, vehicular abrasion, motor oils, gasoline, antifreeze solution, brake fluid, deicing chemicals, and salt in such manner that the performance of the detector loop is not adversely affected. The loop sealant shall provide compressive yield strength to withstand normal vehicular traffic and prevent the intrusion of rocks, glass, and other road debris into the slot. It shall remain sufficiently flexible at all normally encountered temperatures to withstand normal movement in asphalt and concrete pavements while protecting the loop wire from fracture and shear.

**Pre-Formed Loops:** Pre-formed loops shall be factory assembled loops having the dimensions and number of turns of wire specified in the approved plans. The loops shall be constructed of a minimum No. 16 AWG Type TFFN/THWN copper wire meeting the requirements of A.S.T.M. B-8, and encased in heavy duty tubing compatible with the paving material being used on the project. The tubing shall be completely filled with asphalt sealant material after the wire is installed. The loop tail shall be of flexible tubing of the length specified in the approved plans and shall also be filled with asphalt sealant material. The detector wire within the loop tail shall be twisted a minimum of 3 turns per foot/10 turns per meter.

**High Density Polyethylene (HDPE) Conduit:** Polyethylene conduit shall be coil-able, smooth wall, SDR 9 rating, high density polyethylene duct meeting the requirements of NEMA Standard TC-7. Conduit joints shall be made with either a Shur-Lock II coupler

or a fusion welder. Conduit shall be black and be preapproved by the City Engineer.

**Expansion Fittings:** Expansion fittings shall be as detailed in the approved plans.

**9228 BASIS OF ACCEPTANCE.** Acceptance of materials furnished under these specifications shall be based upon the following: Any product called for in the Bill of Materials in the approved plans that is being furnished for the project must be approved. A manufacturer or supplier intending to supply traffic signal materials under these specifications shall submit an original copy of any catalog cuts, shop drawings, drawings, and/or data sheets certifying that the material meets the applicable specifications. This information shall be submitted to the City Engineer for approval.

**Visual Inspection:** Items will be visually inspected by the City Engineer at the job site for condition and conformance with the requirements of these specifications.

All poles, fixtures, and cabinets need to be black in color.

**Additional Requirements:** Additional requirements noted for specific material requirements are provided in Section 9227 of these specifications.