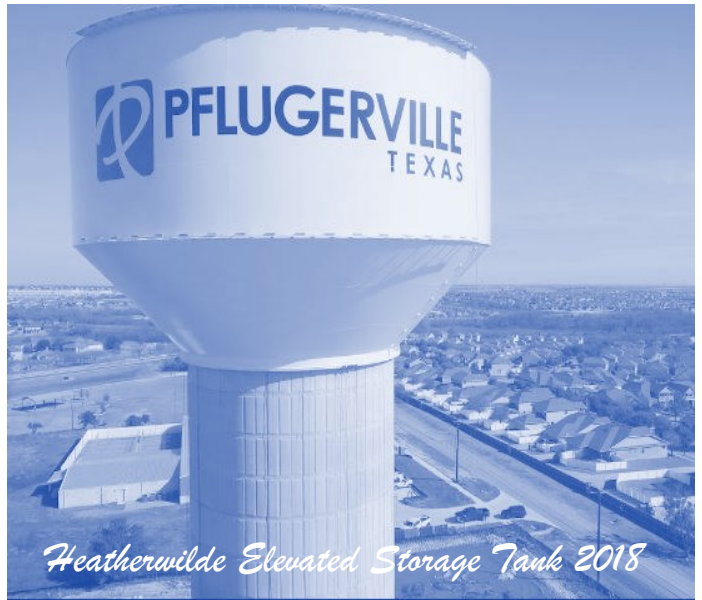




# ENGINEERING SPECIFICATIONS MANUAL

JANUARY 2021



## SERIES 100 - EARTHWORK

### ITEM NO. 101S - PREPARING RIGHT OF WAY

#### 101S.1 - Description

This item shall govern the preparation of the right of way for construction operations by removal and disposal of all obstructions from the right of way and from designated easements, where removal of such obstructions is not otherwise indicated as a separate pay item.

Such obstructions shall be considered to include, but not be limited to, remains of houses not completely removed by others, foundations, floor slabs, concrete, brick, lumber, plaster, cisterns, water wells, septic tanks and drain fields, basements; abandoned utility pipes, conduits, underground service station tanks, fences, retaining walls, outhouses, shacks and all other debris.

This item shall also include, but not be limited to, the removal of trees, stumps, roots, bushes, shrubs, curb and gutter, driveways, paved parking areas, miscellaneous stone, brick, sidewalks, drainage structures, manholes, inlets, abandoned railroad tracks, scrap iron, and all rubbish and debris whether above or below ground. Care should be taken to identify and protect existing infrastructure.

#### 101S.2 - Submittals

Not used.

#### 101S.3 - Construction Methods

Prior to commencement of this work, all required erosion controls and tree protection measures indicated in the City of Pflugerville Engineering Design Manual and Construction Standards, the City of Pflugerville Tree Technical Manual: Standards & Specifications, the City of Pflugerville Erosion and Sedimentation Control Notes, and/or as indicated on the Drawings shall be in place. The existing utilities shall be located and protected as specified in the City of Pflugerville Engineering Design Manual and Construction Standards and/or as specified on the Drawings.

After the construction permit has been issued and prior to beginning construction, the owner or his representative shall schedule a pre-construction conference between the City Engineer or designated representative, Contractor(s), Travis County (if in the ETJ), other utility companies, and any other affected parties. The City Engineer or designated representative shall be contacted to set up the meeting at least 3 business days prior to the proposed meeting time (512-990-6300) and after receiving both the required number of signed plans and the SWP3.

The contractor shall coordinate with local utility service requirements and comply with their instructions. A permit shall be required when utility adjustments are to be made in preparation for construction in the right-of-way. The contractor shall verify all depths and locations of existing utilities prior to beginning construction. Any discrepancies with the construction plans found in the field shall be brought to the attention of the City Engineer or designated representative immediately. The Design Engineer shall be responsible for revising the plans as appropriate and submitting a revision to the City Engineer or designated representative. Use One call utility System: Dial 1-800-344-8377, 48 hours BEFORE you dig. For City of Pflugerville water and wastewater utility locates, call 512-990-6400.

Conduct right of way preparation/site-clearing operations to ensure minimum interference with roads, streets, walks and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.

Areas within the construction limits shall be cleared of all obstructions, abandoned structures, and other items as defined above. Protect existing property and easement corners and pins. In the event that property or easement corners or pins are moved, disturbed or destroyed, the Contractor shall replace them at his own expense. They shall be replaced by a Registered Professional Land Surveyor registered in the State of Texas. All vegetation, except trees or shrubs indicated for preservation, shall also be removed. Trees and shrubs, which are scheduled for preservation, shall be carefully trimmed as directed and shall be protected from scarring, barking or other injuries during construction operations in accordance with the City of Pflugerville Tree Technical Manual: Standards & Specifications. All exposed cuts over 2 inches in diameter, exposed ends of pruned limbs or scarred bark shall be treated with an approved asphalt material within 24 hours of the pruning or injury.

Construction equipment shall not be operated, nor construction materials stockpiled under the canopies of trees, unless otherwise indicated on the Drawings and/or specified in the Contract Documents. Excavation or embankment materials shall not be placed within the drip line of trees until tree wells are constructed.

Culverts, storm sewers, manholes and inlets shall be removed in proper sequence for maintenance of traffic and drainage.

Unless otherwise indicated on the Drawings and/or Contract Documents, all underground obstructions, stumps and roots shall be removed to the following depths:

1. In areas to receive 6 inches or more embankment, a minimum of 12 inches below natural ground.
2. In areas to receive less than 6 inches of embankment, a minimum of 18 inches below the lower elevation of embankment, structure or excavation.
3. In areas to be excavated a minimum of 18 inches below the lower elevation of the embankment, structure or excavation.
4. In all other areas, a minimum of 12 inches below natural ground.

Holes remaining after removal of all obstructions, objectionable material, trees, stumps, etc. shall be backfilled with select embankment material and compacted by approved methods.

When a utility in service conflicts with the construction, it shall be modified as specified in the City of Pflugerville Engineering Design Manual & Construction Standards and/or as specified on the Drawings.

Where an abandoned underground piped utility is found, it shall be cut and plugged with 6 inches of concrete (in accordance with Specification Item 403, "Concrete for Structures") brick and mortar (in accordance with Specification Item 506, "Manholes") or a precast stopper grouted in place.

Material to be removed will be designated as salvageable or non-salvageable by the City Engineer or designated representative prior to removal from the construction site by the Contractor in a manner satisfactory to the City Engineer or designated representative. Unless otherwise provided, all materials as described above shall become the property of the Contractor and removed from the site and disposed of at a permitted disposal site. All material, which is located within the public right of way and is declared by the City Engineer or designated representative as salvageable, will remain the property of the City of Pflugerville and will be stored at the site or loaded on city trucks as directed by the City Engineer or

designated representative. All non-salvageable materials and debris shall become the property of the Contractor and shall be removed from the site and deposited at a permitted disposal site.

Restore all damaged work to condition existing prior to start of work.

#### 101S.4 - Measurement

The preparation of right of way for new construction, when included in the contract as a pay item, will be measured by the acre (hectare: 1 hectare equals 2.471 acres), 100-foot stations or lump sum, regardless of the width of the right of way.

Measurement for payment will be made only on areas indicated and classified as "Preparing Right of Way".

#### 101S.5 - Payment

The work and material presented herein will not be paid for directly but shall be included in the unit price bid for the item of construction in which this item is used unless specified as a separate pay item in the contract bid form. When included for payment, it shall be paid for at the contract bid price for "Preparing Right of Way." This price shall include full compensation for work herein specified, including the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the work.

Payment, when included as a contract pay item, will be made under one of the following:

<b>Pay Item No. 101S-A:</b>	Preparing Right of Way - Roadway	Per Acre.
<b>Pay Item No. 101S-B:</b>	Preparing Right of Way - Development	Per 100-foot Station.
<b>Pay Item No. 101S-C:</b>	Preparing Right of Way -	Per Lump Sum.

**END**

## ITEM NO. 104S - REMOVING PORTLAND CEMENT CONCRETE

### 104S.1 - Description

This item shall govern the demolition, removal and satisfactory disposal of existing Portland Cement (PC) concrete, as classified, at locations indicated on the Drawings or as directed by the Engineer or designated representative.

### 104S.2 - Submittals

The submittal requirements of this specification item may include:

- A. A permit when utility adjustments are made in the right-of-way, and
- B. A plan for removal and deposition of all 'broken up' existing PC concrete materials and debris.

### 104S.3 - Classification

Existing PC concrete, when removed under this section, will be classified as follows:

1. Concrete Curb will include curb, curb and gutter and combinations thereof,
2. Concrete Slabs will include, but not be limited to, house slabs, patio slabs, porch slabs, concrete riprap and concrete pavement,
3. Sidewalks and Driveways will include concrete sidewalks and driveways,
4. Concrete Walls will include all walls, regardless of height, and wall footings,
5. Concrete Steps will include all steps and combinations of walls and steps,
6. Abandoned Foundations will include abandoned utility foundations,
7. Miscellaneous Concrete shall include all other concrete items, which are not identified in items 1 through 6 above.

### 104S.4 - Materials

Mortar shall conform to mortar specified in Standard Specification Item No. 403, "Concrete for Structures".

### 104S.5 - Construction Methods

Prior to commencement of this work, all required erosion control and tree protection measures shall be in place. The existing utilities shall be located and protected as specified in the City of Pflugerville Engineering Design Manual & Construction Standards. A permit shall be required when utility adjustments are to be made in preparation for highway construction.

The existing PC concrete shall be broken up, removed in accordance with Item No. 101S, "Preparing Right of Way" and disposed of by the Contractor and deposited at a permitted disposal site.

When it is specified that only a portion of the existing PC concrete is to be removed and that the remaining PC concrete will continue to serve its purpose, special care shall be exercised to avoid damage to that portion which will remain in place. Unless otherwise established by the Engineer or designated representative, existing PC concrete shall be cut to the neat lines, that are indicated on the Drawings, by sawing with an appropriate type circular concrete saw to a minimum depth of 1/2 inch. Any reinforcing steel encountered shall be cut off 1 inch inside of PC concrete sawed line. Any existing PC concrete, which is damaged or destroyed beyond the neat lines so established, shall be replaced at the

Contractor's expense. Remaining PC concrete shall be mortared to protect the reinforcing steel and provide a neat clean appearance.

When reinforcement is encountered during the removal of portions of existing structures to be modified, a minimum of 1 foot of steel length shall be cleaned of all old PC concrete and left in place to tie into the new construction where applicable. All unsuitable material shall be removed and replaced with approved material. All foundations, walls or other objectionable material shall be removed to a minimum depth of 18 inches below all structures and 12 inches below areas to be vegetated.

**104S.6 - Measurement**

When included in the contract as a separate pay item, the removal of PC concrete curb and PC concrete wall as prescribed above will be measured by the lineal foot in its original position regardless of the dimensions or size. The removal of PC concrete slabs, PC concrete sidewalks and driveways, as prescribed above, will be measured by the square foot in original position, regardless of the thickness and existence of reinforcing steel. PC concrete steps removed will be measured per lineal foot of each individual step tread including the bottom step. The removal of PC concrete foundations will be measured per each individual foundation. The removal of miscellaneous concrete will be measured per lump sum.

**104S.7 - Payment**

The work and materials presented herein will generally not be paid for directly but shall be included in the unit price bid for the item of construction in which this item is used. When specified in the contract bid form as a separate pay item, the item will be paid for at the contract unit bid price(s) for "Remove PC Concrete Curb", "Remove PC Concrete Slab", "Remove PC Concrete Sidewalks and Driveways", "Remove PC Concrete Walls", "Remove PC Concrete Steps", "Remove PC Concrete Foundations" and "Remove Miscellaneous PC Concrete". The bid prices shall include full compensation for all Work herein specified, including the disposal of all material not required in the Work, the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the Work.

Payment will be made under one of the following:

<b>Pay Item No. 104S-A:</b>	Remove PC Concrete Curb	Per Lineal foot.
<b>Pay Item No. 104S-B:</b>	Remove PC Concrete Slab	Per Square foot.
<b>Pay Item No. 104S-C:</b>	Remove PC Concrete Sidewalks and Driveways	Per Square foot
<b>Pay Item No. 104S-D:</b>	Remove PC Concrete Wall	Per Lineal foot.
<b>Pay Item No. 104S-E:</b>	Remove PC Concrete Steps	Per Lineal foot.
<b>Pay Item No. 104S-F:</b>	Remove PC Concrete Foundations	Per Each.
<b>Pay Item No. 104S-G:</b>	Remove Miscellaneous PC Concrete	Per Lump Sum.

**END**

## ITEM NO. 110S - STREET EXCAVATION

### 110S.1 - Description

This item shall govern: (1) the excavation and proper utilization or otherwise satisfactory disposal of all excavated material, of whatever character, within the right of way or other limits of the work indicated and (2) the construction, compaction, shaping and finishing of all earthwork on the entire project in accordance with the specification requirements herein outlined, in conformity with the required lines, grades and typical cross sections indicated on the Drawings or as directed by the Engineer or designated representative. When not otherwise included in the Contract Documents, this item shall include the Work described in specification Item Nos. 101S, "Preparing Right of Way", 104S, "Removing Portland Cement Concrete", 132S, "Embankment", 201S, "Subgrade Preparation" and 236S, "Proof Rolling".

### 110S.2 - Submittals

The submittal requirements of this specification item may include:

- A. A permit when utility adjustments are made in the right-of-way,
- B. A plan for removal and deposition of all 'Waste' materials, and

### 110S.3 - Classification

All excavation shall be unclassified and shall include all materials encountered regardless of their nature or the manner in which they are removed.

### 110S.4 - Construction Methods

Prior to commencement of this work, all required erosion control and tree protection measures shall be in place. The existing utilities shall be located and protected as specified in the City of Pflugerville Engineering Design Manual & Construction Standards and/or indicated on the Drawings. A permit shall be required when utility adjustments are to be made in preparation for construction in the right-of-way.

Construction equipment shall not be operated, nor construction materials stockpiled under the canopies of trees, unless otherwise indicated on the Drawings. Excavation or embankment materials shall not be placed within the drip line of trees until tree wells are constructed.

All street excavation shall be performed as specified herein and shall conform to the established alignment, grades and cross sections. The Contractor will be required to set blue-tops for the subgrade along centerlines, at quarter points and curb lines or edge of pavement at intervals not exceeding 50 feet. Suitable excavated materials shall be utilized, insofar as practicable, in constructing any required embankments. The construction of all embankments shall conform to Item No. 132S, "Embankment".

All earth cuts for base and/or pavement structure construction shall be scarified to a uniform depth of at least 6 inches below the required finished subgrade elevation for the entire roadbed width. The material shall be mixed, reshaped by blading, sprinkled and then rolled in accordance with Section 2 of the City of Pflugerville Specification Item 132S, "Embankment".

High PI materials (i.e. PI 20%) which exhibit a Plasticity Index (PI) greater by 5 % than the surrounding materials or any materials with a moisture content greater than 2 percent (%) in excess of optimum moisture shall be classified as unsuitable and must be removed or manipulated to meet the above criteria before use.

Unsuitable excavated materials or excavation in excess of that needed for construction shall be known as "Waste" and shall become the property of the Contractor. Unsuitable material encountered below the subgrade elevation in roadway cuts, when declared "Waste" by the Engineer, shall be replaced with material from the roadway excavation or with other suitable material as approved by the Engineer or designated representative. It shall become the Contractor's responsibility to dispose of this material off the limits of the right of way in an environmentally sound manner at a permitted disposal site.

**110S.5 - Measurement**

All accepted street excavation will be measured by either Method A or B as follows:

**A. Method A**

Measurement of the volume of excavation in cubic yards by the average end areas. Cross sectional areas shall be computed from the existing ground surface to the established line of the subgrade over the limits of the right of way or other work limits shown on the Drawings, including parkway slopes and sidewalk areas.

**A. Method B**

Measurement of the volume of excavation in cubic yards, based upon the average end areas taken from pre-construction cross sections and planned grades. The planned quantities for street excavation will be used as the measurement for payment of this item.

**110S.6 - Payment**

This item will be paid for at the contract unit bid price for "Street Excavation", as provided under measurement Method A or B as included in the bid. The bid price shall include full compensation for all work herein specified, including subgrade preparation, unless specified otherwise, and the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the work.

Payment will be made under one of the following:

<b>Pay Item No. 110S-A:</b>	Street Excavation	Per Cubic yard.
<b>Pay Item No. 110S-B:</b>	Street Excavation, Plan Quantity	Per Cubic yard.

**END**



## ITEM NO. 111S - EXCAVATION

### 111S.1 - Description

This item shall govern: (1) the excavation and proper utilization or satisfactory disposal of all excavated materials, of whatever character, within the limits of the Work and (2) construction, compaction, shaping and finishing of all designated earthwork areas in accordance with the specification requirements outlined herein and in conformity with the required lines, grades and typical cross sections indicated on the Drawings or as directed by the City Engineer or designated representative. When not otherwise included in the Contract Documents, this item shall include the work described in Specification Item Nos. 101S, "Preparing Right of Way", No. 104S, "Removing Portland Cement Concrete", No. 132S "Embankment" and No. 201S, "Subgrade Preparation".

### 111S.2 - Submittals

Not used.

### 111S.3 - Classification

All excavation shall be unclassified and shall include all materials encountered regardless of their nature or the manner in which they are removed.

### 111S.4 - Construction Methods

Prior to commencement of this work, all required erosion control and tree protection measures shall be in place in accordance with the City of Pflugerville Engineering Design Manual & Construction Standards, the City of Pflugerville Tree Technical Manual: Standards & Specifications, the City of Pflugerville Erosion and Sedimentation Control Notes and/or as indicated on the Drawings. The existing utilities shall be located and shall be protected as specified in the City of Pflugerville Engineering Design Manual & Construction Standards and/or indicated on the Drawings. A permit shall be required when utility adjustments are to be made in preparation for construction in the right-of-way.

Construction equipment shall not be operated, nor construction materials stockpiled under the canopies of trees, unless otherwise indicated on the Drawings. Excavation or embankment materials shall not be placed within the drip line of trees until tree wells are constructed, that conform to the City of Pflugerville Tree Technical Manual: Standards & Specifications.

All excavation shall be performed as specified herein and shall conform to the established alignment, grades and cross sections indicated on the Drawings. Suitable excavated materials shall be utilized, insofar as practical, in constructing required embankments. The construction of all embankments shall conform to Specification Item No. 132S, "Embankment". No material shall be stockpiled within the banks of a waterway.

Unsuitable excavated materials or excavation in excess of that needed for construction shall be known as "Waste" and shall become the property of the Contractor. Unsuitable material encountered below the subgrade elevation in roadway cuts, when declared "Waste" by the City Engineer or designated representative, shall be replaced with material from the roadway excavation or with other suitable material as approved by the City Engineer or designated representative. It shall become the Contractor's responsibility to dispose of this material off the limits of the right of way in an environmentally sound manner at a permitted disposal site.

Blasting is not permitted.

Adequate dewatering and drainage of excavation shall be maintained throughout the time required to complete the excavation work.

#### 111S.5 - Measurement

All accepted excavation will be measured by either Method A or B as follows:

1. Method A

Measurement of the volume of excavation in cubic yards by the average end area methods. Cross-sectional areas shall be computed from the existing ground surface to the established line of the subgrade, as shown on typical sections in the Drawings, over the limits of the right of way or other work limits, including parkway slopes and sidewalk areas.

2. Method B

Measurement of the volume of excavation in cubic yards based upon the average end area method taken from pre-construction cross sections and planned grades. The planned quantities for excavation will be used as the measurement for payment for this item.

#### 111S.6 - Payment

This item will be paid for at the contract unit bid price for "Excavation", as provided under measurement Method A or B as included in the bid. The bid price shall include full compensation for all work herein specified including dewatering, drainage, subgrade preparation, unless otherwise indicated, and the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the work. No separate payment will be made for work performed under this Specification for excavation of Trenches for utilities and storm drainage.

Payment will be made under one of the following:

<b>Pay Item No. 111S-A:</b>	Excavation (Field Measured)	Per Cubic Yard.
<b>Pay Item No. 111S-B:</b>	Excavation, Plan Quantity (Pre-Determined)	Per Cubic Yard.

**END**

## ITEM NO. 120S - CHANNEL EXCAVATION

### 120S.1 - Description

This item shall govern (1) excavation of channels within the limits indicated, regardless of the type of material encountered, (2) removal and proper utilization or otherwise satisfactory disposal of all excavated materials and (3) construction, shaping and finishing of all earthwork involved in conformity with the required line, grades and cross sections indicated.

When not otherwise indicated, this item shall include the work described in Specification Item Nos. 101S, "Preparing Right of Way", No. 104S, "Removing Portland Cement Concrete", No. 132S, "Embankment" and No. 236S, "Proof Rolling".

### 120S.2 - Submittals

The submittal requirements of this specification item may include:

- A. A plan for removal and deposition of all 'Waste' materials, and
- B. A Blasting Permit if blasting is required and allowed on the project.

### 120S.3 - Classification

All channel excavation will be unclassified and shall include all materials encountered regardless of their nature or the manner in which they are removed.

### 120S.4 - Construction Methods

Prior to commencing this work, all required erosion control and tree protection measures shall be in place and all existing utilities located and protected as specified in the City of Pflugerville Engineering Design Manual & Construction Standards and/or indicated on the Drawings. Construction equipment shall not be operated within the drip line of trees, unless otherwise indicated. Construction materials shall not be placed under the canopies of trees. Excavation or embankment materials shall not be placed within the drip line of trees until tree wells are constructed.

All channel excavation shall be performed as specified herein and shall conform to the established alignment, grades and cross sections. When fill sections are required, Specification Item No. 132S, "Embankments" shall govern the construction method. Suitable excavated materials shall be utilized, insofar as practicable, in constructing the required embankments. Precautions will be maintained at all times to protect all trees in the area of construction. Where removal of trees is necessary, they shall be marked as directed by the Engineer or designated representative.

Unsuitable excavated materials or excavation in excess of that needed for construction shall be known as "Waste" and shall become the property of the Contractor. It shall become the Contractor's sole responsibility to dispose of this material off the limits of the right of way in an environmentally sound manner at a permitted disposal site.

### 120S.5 - Measurement

Accepted channel excavation will be measured by either Method A or B as follows:

A. Method A

Measurement of the volume of excavation in cubic yard by the average end areas. Cross-sectional areas shall be computed from the existing ground surface to the established final section indicated.

B. Method B

Measurement of the volume of excavation in cubic yards, based upon average end areas taken from preconstruction cross sections and planned grades. The plan quantities for channel excavation will be used as the measurement for payment for this item.

120S.6 - Payment

This item will be paid for at the contract unit bid price for "Channel Excavation", as provided under measurement Method A, or B and included in the bid. The bid price shall include full compensation for furnishing all materials, equipment, tools, labor and incidentals necessary to complete the work.

Payment will be made under one of the following:

<b>Pay Item No. 120S-A:</b>	Channel Excavation	Per Cubic Yard.
<b>Pay Item No. 120S-B:</b>	Channel Excavation, Plan Quantity	Per Cubic Yard.

**END**

ITEM NO. 130S - BORROW

130S.1 - Description

This item shall govern required excavation, removal and proper utilization of materials secured from sources, selected by the Contractor and approved by the Engineer or designated representative. The compaction of embankments constructed from borrow as provided herein shall conform to the appropriate sections of Specification Item Nos. 132S, "Embankment" and 236S, "Proof Rolling".

Borrow will be used only when indicated on the Drawings or directed by the Engineer or designated representative and shall only be acquired from approved sources.

130S.2 - Submittals

The submittal requirements of this specification item may include:

- A. Identification of Class, source and characteristics (PI, linear shrinkage, etc.) of proposed borrow material, and
- B. A plan for managing and maintaining borrow sites.

130S.3 - Materials

All authorized borrow shall conform to one of the following classes:

- A. Class A (Select Borrow)

Class A Borrow material shall consist of suitable granular material, free from vegetation or other objectionable matter and reasonably free from lumps of earth. When tested by standard TxDOT laboratory methods Tex-105-E, Tex-106-E and Tex-107-E, the Class A Select Borrow, shall meet the following requirements:

The Liquid Limit shall not exceed	45
The Plasticity Index shall not exceed	15
The bar linear shrinkage shall not be less than	2

- B. Class B (Borrow)

Class B Borrow material shall consist of suitable non swelling [i.e. soils with a plasticity index (PI) less than 20] earth material such as loam, clay or other such materials that will form a stable embankment.

- C. Class C (Topsoil) See Standard Specification Item No. 601S.3(A)

Class C Borrow material shall consist of approved soils, which shall be clean, friable and capable of supporting plant life. This material shall also be free of stones and all other debris.

130S.4 - Construction Methods

Prior to commencing this work, all required erosion control and environmental measures shall be in place. All suitable materials removed from excavations shall be used, insofar as practicable in the formation of embankments conforming to Specification Item No. 132S, "Embankment", as otherwise indicated on the Drawings or as directed by the Engineer or designated representative. The completed work shall conform to the established alignment, grades and cross section as shown on the Drawings. The additional material necessary to complete the work described above shall be "Borrow" of the class specified.

The Contractor shall arrange for borrow from one of the following sources:

- 1. Existing borrow pit,
- 2. New borrow pit, or
- 3. Surplus excavated material from a site, with a site development permit.

The Contractor shall notify the Engineer 3 weeks prior to opening a pit or any other borrow source to allow necessary testing for approval of materials. All borrow sites shall comply with the requirements of the site development permit.

During construction, borrow sources shall be kept drained to permit final cross sections to be measured, when required.

Borrow sites shall be managed and maintained to minimize the impact of the appearance of the natural topographic features and at no time create a potential hazard to the public.

130S.5 - Measurement

Borrow will be measured by the cubic yard in its final position based upon the average end areas, calculated from pre-construction cross sections and plan grades. The plan quantities for Borrow or Topsoil will be used as the measurement for payment for this item.

130S.6 - Payment

All work performed as required herein and measured as provided under "Measurement" will be paid for at the unit bid price. The bid prices shall include full compensation for furnishing all labor; all materials; all royalty and freight involved; all hauling and delivering on the road; and all tools, equipment and incidentals necessary to complete the work. Payment will not be made for unauthorized work.

Payment will be made under one of the following:

<b>Pay Item No. 130S-A:</b>	Class A (Select Borrow), Plan Quantity	Per Cubic Yard.
<b>Pay Item No. 130S-B:</b>	Class B (Borrow), Plan Quantity	Per Cubic Yard.
<b>Pay Item No. 130S-T:</b>	Class C (Topsoil), Plan Quantity	Per Cubic Yard.

END

## ITEM NO. 132S - EMBANKMENT

### 132S.1 - Description

This item shall govern the placement and compaction of suitable materials obtained from approved sources for utilization in the construction of street or channel embankments, berms, levees, dikes and structures. When not otherwise included in the Contract Documents or indicated on the Drawings, this item shall include the work described in Specification Item Nos. 101S, "Preparing Right of Way", 104S, "Removing Portland Cement Concrete", 201S, "Subgrade Preparation" and No. 236S, "Proof Rolling."

### 132S.2 - Submittals

The submittal requirements of this specification item may include:

- A. A plan identifying source, material type, classification and characteristics (PI, optimum moisture-density, etc.) of the proposed embankment material,
- B. Type and size of equipment proposed to produce the required compaction, and
- C. Compaction (Density-moisture, etc.) test results for in-place embankment layers.

### 132S.3 - Construction Methods

#### A. General

Prior to the placement of any embankment, all tree protection and tree wells and erosion control devices shall be in place and all operations involving Standard Specification Item No. 101S, "Preparing Right of Way" shall have been completed for the areas over which the embankment is to be placed. Stump holes or other small excavations encountered within the limits of the embankments shall be backfilled with suitable material and thoroughly tamped by approved methods before commencement of the embankment construction.

The area of embankment placement shall be proof rolled (Specification Item No. 236S, "Proof Rolling") and any unstable or spongy areas shall be undercut and backfilled with suitable material or otherwise mechanically manipulated and compacted by approved methods. Where shown on the Drawings or required by the Engineer or designated representative, the ground surface thus prepared shall be compacted by sprinkling and rolling. The surface of the ground, including those plowed and loosened or roughened by small washes, shall be restored to approximately its original slope and the ground surface thus prepared shall be compacted by sprinkling and rolling.

Construction equipment shall not be operated within the drip line of trees, unless otherwise indicated. Construction materials shall not be stockpiled under the canopies of trees. Excavation or embankment materials shall not be placed within the drip line of trees until tree wells are constructed in accordance with the City of Pflugerville Engineering Design Manual & Construction Standards.

Unless otherwise indicated on the Drawings and with the exception of rock, the surface of the ground of all unpaved areas, which are to receive embankment, shall be loosened by scarifying or plowing to a depth of not less than 6 inches. The loosened material shall be re-compacted with the new embankment as hereinafter specified.

The surface of hillsides, which are to receive embankment, shall be loosened, by scarifying or plowing, to a depth of not less than 6 inches and benches constructed before the embankment materials are placed. The embankment shall then be placed in layers, as hereinafter specified,

beginning at the low side with partial width layers and increasing the widths of the layers as the embankment is raised. The material, which has been loosened during preparation of the original ground surface, shall be re-compacted simultaneously with the embankment material placed at the same elevation.

Where embankments are to be placed adjacent to or over existing roadbeds, the roadbed slopes shall be plowed or scarified to a depth of not less than 6 inches and the embankment along the roadbed slopes shall be built up in successive layers, as hereinafter specified, to the elevation of the old roadbed. Then, if specified, the top surface of the old roadbed shall be scarified to a minimum depth of 6 inches and re-compacted along with the next layer of the new embankment. The total depth of the scarified and added material shall not exceed the permissible layer depth, specified hereinafter.

Trees, stumps, roots, vegetation or other unsuitable materials shall not be placed in embankment.

All embankment shall be constructed in layers approximately parallel to the finished grade and unless otherwise indicated, each layer shall be so constructed as to provide a uniform slope of 1/4-inch per foot from the centerline of the roadbed to the outside. In the case of superelevated curves, each layer shall be constructed to conform to the specified superelevation or cross slope.

The embankment shall be continuously maintained at its finished section and grade until that portion of the work is accepted. After completion of the embankment to the finished section and grade, the Contractor shall proof roll the subgrade or finished grade in accordance with Specification Item No. 236S, "Proof Rolling". Any unstable or spongy areas shall be undercut and backfilled with suitable material or otherwise mechanically manipulated and compacted by approved methods. After acceptance of the embankment, re-vegetation activities shall commence immediately to minimize the soil loss and air pollution.

#### B. Earth Embankments

Earth embankments shall be defined as embankments composed of soil material other than rock and shall be constructed of acceptable material from approved sources.

Unless directed otherwise, earth embankments shall be constructed in successive layers, with a thickness of 8 inches or less in loose measure, for the full width of the individual cross section and in a length that is best suited to the sprinkling and compaction methods utilized.

Minor quantities of rocks with a maximum dimension of 4 inches may be incorporated in the earth embankment layers, provided that the rock is not placed immediately adjacent to structures.

Each layer of embankment shall be uniform as to material type and classification, density and moisture content before beginning compaction. Where layers of unlike materials abut each other, each layer shall be feathered on a slope of 1:20 or the materials shall be so mixed as to prevent abrupt changes in the soil. Any material placed in the embankment by dumping in a pile or windrows shall not be incorporated in a layer in that position. All such piles or windrows shall be incorporated in an embankment layer by blading and mixing or by similar methods. Clods or lumps of material shall be broken down into smaller sizes and the embankment material in a layer shall be mixed by blading, harrowing, discing or similar methods to ensure that a uniform material of uniform density is secured in each layer.



The water required in sprinkling the layers, to obtain the moisture content necessary for optimum compaction, shall be evenly applied. It shall be the responsibility of the Contractor to secure uniform moisture content throughout the layer by such methods as may be necessary.

All earth cuts, whether full width or partial width side hill cuts and which are not required to be excavated below the subgrade elevation, shall be scarified to a uniform depth of at least 6 inches below grade. The material shall be mixed and reshaped by blading, sprinkled and rolled in accordance with the requirements outlined above for earth embankments to the same density required for the adjacent embankment.

Compaction of embankments shall conform to Item No. 201S, "Subgrade Preparation". Each layer shall be compacted to the required density by any method, and/or type and size of equipment, which will produce the required compaction. Prior to and in conjunction with the rolling operation, each layer shall be brought to the moisture content necessary to obtain the required density and shall be kept leveled with suitable equipment to insure uniform compaction over the entire layer.

It is the intent of this specification to provide the required density and moisture control for each layer of earth embankment and select material based on the plasticity characteristics of the embankment soil. Each layer shall be sprinkled as required and compacted to the extent necessary to provide the density specified below, unless otherwise indicated.

Description	Density, Percent	Moisture
Non-swelling Soils (PI less than 20)	Not less than 95	
Swelling Soils (PI between 20 and 35)	Not less than 95 nor more than 102	Not less than optimum
Swelling Soils (PI greater than 35)	Not less than 95 nor more than 100	Not less than optimum

The Plasticity Index (PI) will be established in accordance with TxDOT Test Methods Tex-104-E, Tex-105-E and Tex-106-E and the density determination will be made in accordance with TxDOT Test Method Tex-114-E, "Laboratory Compaction Characteristics and Moisture-Density Relationship of Subgrade and Embankment Soil". Field density measurements will be made in accordance with TxDOT Test Method Tex-115-E, "Field Method for Determination of In-Place Density of Soils and Base Materials".

After each layer of earth embankment or select material is complete, tests, as necessary, will be conducted as directed by the Engineer or designated representative. If the material fails to meet the density specified, the course shall be reworked as necessary to obtain the specified compaction.

C. Rock Embankments

Rock embankments shall be defined as those composed principally of rock and shall be constructed of accepted material from approved sources. Rock embankments shall not be placed immediately adjacent to structures.

Except as otherwise indicated on the Drawings, rock embankments shall be constructed in successive layers of 18 inches or less in thickness for the full width of the cross section. When, in the opinion of the Engineer or designated representative, the rock sizes necessitate a greater thickness of layer than specified, the layer thickness may be increased as necessary, but in no case shall the thickness of layer exceed 2½ feet. Each layer shall be constructed by starting at one end and dumping the rock on top of the layer being constructed then pushing the material ahead with a bulldozer in such a manner that the larger rock will be placed on either the ground or the preceding embankment layer. Each layer shall be constructed in such a manner that the interstices between the larger stones are filled with small stones and spalls which have been created by this operation and from the placement of succeeding layers of material.

The maximum dimension of any rock used in embankment shall be less than the thickness of the embankment layer and in no case shall any rock over 2 feet in its greatest dimension be placed in the embankment, unless otherwise approved by the Engineer or designated representative. All oversized rocks, which are otherwise suitable for construction, shall be broken to the required dimension and utilized in embankment construction where indicated. When preferred by the Contractor and acceptable to the Engineer or designated representative, oversized rocks may be placed at other locations where the embankment layer is of greater depth, thus requiring less breakage.

Each layer shall be compacted to the required density as outlined for "Earth Embankments", above, except in those layers where rock will make density testing difficult, the Engineer or designated representative may accept the layer by visual inspection or proof rolling conforming to Specification Item No. 236S, "Proof Rolling".

Unless otherwise indicated, the upper 3 feet of the embankment shall not contain stones larger than 4 inches in their greatest dimension and shall be composed of material so graded that the density and uniformity of the surface layer may be secured in accordance with TxDOT Test Method Tex-114-E.

Exposed oversize material shall be broken up or removed.

#### D. At Culverts and Bridges

Embankment materials, which are to be placed adjacent to culverts and bridges and cannot be compacted by the blading and rolling equipment that was used in compacting the adjoining sections of embankment, shall be compacted in the manner prescribed under Item No. 401, "Structural Excavation and Backfill".

Embankment constructed around 'spill through' type abutments shall be constructed in 6-inch loose layers of a uniform suitable material and shall be placed so as to maintain approximately the same elevation on each side of the abutment. All materials shall be mixed, wetted and compacted as specified above. Embankment material placed adjacent to any portion of a structure or above the top of any culvert or similar structure shall be free of any appreciable amount of gravel or stone particles and shall be thoroughly compacted by mechanical compaction equipment.

#### E. Selection of Materials

In addition to the requirements in the excavation items of the specifications covering the general selections and utilization of materials to improve the roadbed, embankments shall be constructed

in proper sequence to receive the select material layers shown on the plans, with such modifications as may be directed by the Representative of the City. The layer of embankment immediately preceding the upper layer of select material shall be constructed to the proper section and grade within a tolerance of not more than 0.10 foot from the established section and grade when properly compacted and finished to receive the select material layer.

**Note: All underground utilities shall be installed prior to any lime treatment or flexible base placement.**

**Note: Bluetops will be set on the center, crown, and back of curb of the streets or roads every 50-foot station. These grade stakes will be to finished grade and visible for inspection before flexible base is applied.**

132S.4 - Measurement

All accepted embankment, when included in the contract as a separate pay item, will be measured in place and the volume computed in cubic yards by the method of average end areas. No allowance shall be made for shrinkage.

132S.5 - Payment

The work and materials presented herein will generally not be paid for directly but shall be included in the unit price bid for the item of construction in which this item is used. However, when specified in the contract bid form as a separate pay item, it shall be paid for at the contract unit bid price for "Embankment". The bid price shall include full compensation for all work herein specified, including the furnishing of all materials, (except "Borrow" when paid as a separate bid item) compaction, equipment, tools, labor, water for sprinkling, proof rolling and incidentals necessary to complete the work.

Payment, when included in the contract as a separate pay item, will be made under:

<b>Pay Item No. 132S-A:</b>	Embankment	Per Cubic Yard.
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**END**

## SERIES 200 - SUBGRADE AND BASE CONSTRUCTION

### ITEM NO. 201S - SUBGRADE PREPARATION

#### 201S.1 - Description

This item shall govern scarifying; blading and rolling the subgrade to obtain a uniform texture and provide as nearly as practicable a uniform density for the top 6 inches of the subgrade.

#### 201S.2 - Submittals

The submittal requirements of this specification item may include:

- A. A plan identifying classification and characteristics (PI, optimum moisture-density, etc.) of in situ subgrade soils, as well as the source, classification and characteristics of any proposed borrow material,
- B. Type and size of equipment proposed to produce the required compaction, and
- C. Compaction (moisture-density, etc.) test results for in situ subgrade soils and/or borrow materials.

#### 201S.3 - Construction Methods

Prior to initiation of subgrade preparation activities, all operations involving Standard Specification Item No. 101S, "Preparing Right of Way" shall be completed. The surface of the subgrade shall be scarified and shaped in conformity with the typical sections and the lines and grades indicated on the Drawings; by the removal of existing material or addition of approved material as established by the Engineer or designated representative. Any deviation in the subgrade cross section which exceeds  $\frac{1}{2}$  inch in a length of 10 feet, measured longitudinally, shall be corrected by loosening, adding or removing material, and then reshaping and compacting by sprinkling and rolling.

All unsuitable material shall be removed and replaced with approved material. All foundations, walls or other objectionable material shall be removed in accordance with Standard Specification Item No. 104S, "Removing Portland Cement Concrete" to a minimum depth of 18 inches under all structures and 12 inches under areas to be vegetated. All holes, ruts and depressions shall be filled with approved material and compacted by approved methods.

The subgrade shall be prepared sufficiently in advance to insure satisfactory prosecution of the Work. The Contractor will be required to set blue tops for the subgrade on the centerline, at the quarter points and along the curb lines or edge of pavement at maximum intervals of 50 feet. The subgrade shall be tested by proof rolling in conformity with Standard Specification Item No. 236S, "Proof Rolling" prior to placement of the first course of base material. Any unstable or spongy subgrade areas identified by proof rolling shall be corrected either by additional re-working, drying and compaction, or by removal and replacement of unsuitable materials. When specifically directed by the Engineer or designated representative, the Contractor shall re-work the subgrade\* as follows:

- A. Remove the unstable subgrade to the full depth of the unstable in situ material or to a minimum depth of 6 inches, whichever is greater;
- B. Spread the material over a sufficient area to allow reworking of the excavated material;

- C. Disc, scarify or otherwise breakup the excavated material and allow to dry (Note: If approved by the Engineer or designated representative, the addition of lime or other additive may be used to aid in the drying process or to stabilize the unstable material);
- D. Fill the excavated area with the re-worked material and compact to specified densities; and
- E. Proof roll the re-worked area.

\* The Rework process will not be allowed for unstable organic subgrade soils. These type soils will be permanently removed and replaced with materials approved by the Engineer or designated representative.

All suitable material removed in accordance with Standard Specification Item No. 111S, "Excavation", may be utilized in the subgrade with the approval of the Engineer or designated representative. All other material required for completion of the Subgrade, including those defined in accordance with Specification Item No. 130S, "Borrow", shall also be subject to approval by the Engineer or designated representative.

It is the intent of this specification to provide the required density and moisture control for the subgrade based on the plasticity characteristics of the approved materials. The subgrade materials shall be sprinkled as required and compacted to the extent necessary to provide the density specified below, unless otherwise indicated on the Drawings. The Plasticity Index (PI) will be established in accordance with TxDOT Test Methods Tex-104-E, Tex-105-E and Tex-106-E. The density determination will be made in accordance with TxDOT Test Method Tex-114-E and field density measurements will be made in accordance with TxDOT Test Method Tex-115-E.

Description	Density, Percent	Moisture
Non-swelling Soils (PI less than 20)	Not less than 95	
Swelling Soils (PI between 20 and 35)	Not less than 95 nor more than 102	Not less than optimum
Swelling Soils (PI greater than 35)	Not less than 95 nor more than 100	Not less than optimum

Subgrade materials on which planting or turf will be established shall be compacted to a minimum of 85 percent of the density as determined in accordance with TxDOT Test Method Tex-114-E. Field tests for density in accordance with TxDOT Test Method Tex-115-E will be made as soon as possible after compaction operations are completed. If the material fails to meet the density specified, it shall be reworked as necessary to obtain the density required.

Prior to placement of any base materials, the in-place density and moisture content of the top 6 inches of compacted subgrade shall be checked. If the tests indicate that the relative density and moisture do not meet the limits specified in the table above, the subgrade shall be reworked as necessary to obtain the specified compaction and moisture content. All initial testing will be paid for by the City of Pflugerville. All retesting shall be paid for by the Contractor.

201S.4 - Measurement

All acceptable subgrade preparation when included in the contract as a separate pay item, will be measured by the square yard. The measured area includes the entire width of the roadway for the entire length as indicated on the Drawings.

201S.5 - Payment

The work and materials presented herein will generally not be paid for directly, but shall be included in the unit price bid for the item of construction in which this item is used when specified as a separate pay item in the contract bid form, subgrade preparation shall be measured as specified above and paid for at the contract unit bid price for "Subgrade Preparation". The bid price shall include full compensation for all work herein specified, including the furnishing of all materials, equipment, tools and labor and incidentals necessary to complete the work.

Payment, when included as a contract pay item, will be made under:

<b>Pay Item No. 201S-A:</b>	Subgrade Preparation	Per Square Yard.
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**END**

ITEM NO. 202S - LIME

202S.1 - Description

This item establishes the requirements for quicklime pellets and commercial lime slurry of the type and grade considered suitable for use in the treatment of natural or processed materials or mixtures for stabilization of subgrade, subbase and base construction.

202S.2 - Submittals

The submittal requirements of this specification item may include:

- A. A plan identifying type, grade, chemical and physical composition of proposed lime application
- B. A plan for sampling and testing of lime slurry.
- C. Contractor to provide documentation on age of quicklime pellet material to verify the lime series will not need to be rerun to get results.

202S.3 - Materials

The various types and grades are defined and identified as follows:

A. Type B (Commercial Lime Slurry)

Type B Lime Slurry shall be a pumpable suspension of solids in water. The slurry shall be furnished at or above the minimum "Dry Solids" content as approved by the Engineer or designated representative and must be of a consistency that can be handled and uniformly applied without difficulty. The water of the liquid portion of the slurry shall not contain dissolved material in sufficient quantity and/or nature to make it injurious or objectionable for the purpose intended. The solids portion of the mixture, when considered on the basis of "solids content", shall consist principally of hydrated lime of a quality and fineness sufficient to meet the requirements as to chemical composition and residue identified below.

When sampled and tested according to prescribed TxDOT Standard Specification Item No. 264, hydrated lime shall conform to the following requirements as to chemical and physical composition:

- 1. Chemical Composition. The "solids content" of lime slurry shall have a hydrate alkalinity  $\text{Ca}(\text{OH})_2$  of not less than 87 percent by weight.
- 2. Residue (Wet Sieve)

The percent by weight of residue retained in the "solids content" of lime slurry shall conform to the following requirements:

Residue retained on No. 6 sieve	Maximum 0.2 %
Residue retained on No. 30 sieve	Maximum 4.0 %.

B. Type C: Quicklime Pellets

Quicklime pellets shall conform to TxDOT Grade DS (TxDOT Specification Item 264) and are only allowable when indicated on the Drawings or when approved by the Engineer or designated representative. Quicklime pellets shall be of a gradation suitable for either "Dry Placing" or for preparation of a slurry for "Wet Placing".

When sampled and tested according to prescribed TxDOT Standard Specification Item No. 264, the quicklime lime shall conform to the following requirements as to chemical and physical composition:

1. Chemical Composition. The "solids content" of lime slurry shall have a hydrate alkalinity CaO of not less than 87 percent by weight.
2. Residue (Wet and Dry Sieve)

The percent by weight retained in the "solids content" of quicklime shall conform to the following requirements:

Wet Sieve Requirements

Residue retained on No. 6 sieve	Maximum 8.0 %
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Dry Sieve Requirements

Retained on 1-inch sieve	0.0 %
Retained on ¾ inch sieve	Maximum of 10.0 %
Retained on No. 100 sieve	Minimum of 80.0 %

C. Water

Water shall be clean and free of industrial wastes and other objectionable substances harmful to the lime and the environment.

202S.4 - Sampling and Testing

The sampling and testing of lime slurry shall be conducted in accordance with TxDOT Test Methods: Tex-112-E, Tex-121-E and Tex-600-J.

202S.5 - Measurement and Payment

Lime will be measured and paid for in accordance with the governing specifications for the items of construction in which lime is used (e.g. Standard Specification Item 203S, " Lime Treatment for Materials



in Place"), except that lime treatment for small applications required to stabilize a problem area shall be paid per pound applied. The unit bid price for small applications shall include full compensation for all spreading, mixing and shaping required to stabilize the surface and for any other materials, manipulation, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under the following:

<b>Pay Item No. 202S-A:</b>	Small Area Application of Lime Slurry, Type B	Per Pound.
<b>Pay Item No. 202S-B:</b>	Small Area Application of QuickLime Pellets, Type C	Per Pound.

END

## ITEM NO. 203S - LIME TREATMENT FOR MATERIALS IN PLACE

### 203S.1 - Description

This item shall govern the preparation and treatment of the subgrade, existing subbase or existing base by pulverizing the existing materials; furnishing and applying lime; mixing; mellowing for a minimum of 12 hours and compacting the mixed material to the required depth and density. This item applies to treatment of natural ground, embankment or existing pavement structure and shall be constructed as specified herein and in conformity with the typical sections, lines and grades on the drawings or as directed by the Engineer or designated representative. If the type of lime to be placed is not indicated on the drawings, the Contractor shall use Type B, Commercial Lime Slurry or Type C quick lime pebbles for all applications on areas larger than 100 square feet.

### 203S.2 - Submittals

The submittal requirements of this specification item may include:

- A. Mix design information,
- B. Type of lime and rate of lime application, and
- C. Equipment proposed for use in proof rolling, pulverizing, mixing, placement and compaction operations.

### 203S.3 - Materials

#### A. Lime

The lime shall meet the requirements of Item No. 202S, "Lime" for the type of lime specified in the drawings or as directed by the Engineer or designated representative.

When Type B, Commercial Lime Slurry, is specified, the Contractor shall select the "Dry Solids" content to be used in the slurry prior to construction and shall notify the Engineer in writing 5 working days before changing the "Dry Solids" content.

When dry placement of Type C quicklime pebbles are indicated on the Drawings or approved by the Engineer or designated representative, the pebbles shall conform to TxDOT Grade DS (TxDOT Specification Item 264) and shall have a gradation suitable for dry placement.

If lime is furnished in bags, each bag shall bear the manufacturer's certified weight. Bags varying more than 5 percent from that weight may be rejected and the average weight of bags in any shipment, as shown by weighing 10 bags selected at random, shall not be less than the manufacturer's certified weight.

#### B. Water.

The water shall meet the material requirements of Standard Specification Item No. 220S, "Sprinkling for Dust Control"

#### C. Asphalt.

The asphalt shall conform to the requirements of Standard Specification Item No. 301S, "Asphalts, Oils and Emulsions"

#### 203S.4 - Equipment

The pulverizing, mixing and proof rolling machinery, tools and equipment, which are necessary for the proper execution of the work, shall be approved by the Engineer or designated representative. The equipment shall be located on the project site prior to the initiation of construction operations.

During the conduct of the Work all in-use machinery, tools and equipment shall be maintained in a satisfactory manner.

Lime shall be stored and handled in closed, weatherproof containers up to the time that mixing is initiated to form a slurry for distribution on the areas to be treated. If storage bins are used, they shall be completely enclosed. Hydrated lime in bags shall be stored in weatherproof buildings with adequate protection from ground dampness.

If lime is furnished in trucks, each truck shall have the weight of lime certified on public scales or the Contractor shall place a set of standard platform truck scales or hopper scales at a location approved by the Engineer or designated representative.

#### 203S.5 - Construction Methods

##### A. General

Prior to commencement of the work, all required erosion control and tree protection measures shall be in place and the utilities located and protected as specified in the City of Pflugerville Engineering Design Manual & Construction Standards. Construction equipment shall not be operated within the drip line of trees unless otherwise indicated on the drawings or directed by the Engineer or designated representative. Construction materials shall not be stockpiled under the canopies of trees. Excavation or embankment materials shall not be placed within the drip line of trees until appropriate tree wells are constructed.

The placement of lime shall not be allowed to adversely impact vegetation, drainageways or waterways, storm water inlets or overflow channels. Structures shall be screened, blocked or protected to prevent lime from entering any structure or waterway.

It is the primary requirement of this specification to secure a completed course of treated material, which contains a uniform lime mixture at the rate specified on the drawings or directed by the Engineer or designated representative, is free from loose or segregated areas, exhibits uniform density and moisture content, is well bound for its full depth and displays a smooth surface suitable for placement of subsequent courses. It shall be the responsibility of the Contractor to regulate the sequence of his work, use the proper amount of lime, maintain the work and rework the courses as necessary to meet the above requirements.

##### B. Preparation of Subgrade or Existing Base.

Unless indicated otherwise on the drawings or directed otherwise by the Engineer or designated representative, the Contractor shall proof roll the roadbed/subgrade in accordance with Standard Specification Item No. 236S, "Proof Rolling" prior to pulverization or scarification of the existing material and/or subgrade. Any unstable or spongy subgrade areas identified by proof rolling shall be corrected either by additional re-working, drying and compaction, or by removal and replacement of unsuitable materials. When specifically directed by the Engineer or designated

representative, the Contractor shall re-work the subgrade in accordance with Section 201S.3, "Construction Methods" of Standard Specification Item No. 201S, "Subgrade Preparation."

Prior to treatment of existing material and/or subgrade the layer to be treated shall be constructed shaped to conform to the typical sections, lines and grades as indicated on the Drawings or as established by the Engineer or designated representative. This work shall be done in accordance with the provisions of applicable bid items. When shown on the Drawings, any existing asphaltic concrete pavement shall be removed, and the work will be paid for in accordance with the applicable bid items.

When the Contractor elects to use a cutting and pulverizing machine that will process the material to the specified depth, the Contractor will not be required to excavate to the secondary grade or windrow the material. This method will be permitted only if a machine is provided, which will ensure that the material is cut uniformly to the proper depth and which has cutters that will plane the secondary grade to a uniform surface over the entire width of the cut. The machine shall provide a visible indication of the depth of cut at all times.

The material, either before or after lime is applied, shall be excavated to the secondary grade (i.e. proposed depth of lime treatment) and removed or windrowed to expose the secondary grade. The secondary grade shall be blue topped at the edge, 1/4 points and along the centerline at not more than 50-foot centers. Any wet or unstable materials, located below the secondary grade, shall be corrected, as directed by the Engineer or designated representative, by removing the unstable material or by scarifying, adding lime and compacting until uniform stability is attained.

The Contractor shall instruct their crews in the proper handling of lime to ensure that the workers and the public are adequately protected during lime handling and application operations.

#### C. Premixing Surface

When any material is uncovered during the premixing operation that exhibits properties different from the anticipated material, the Engineer or designated representative shall secure a sample of the material for appropriate testing to establish a suitable rate of lime application for the material.

#### D. Lime Application

The percentage of lime to be added by weight in pounds per square yard shall be as directed in this document or in accordance with the Lime mix design indicated on the Drawings and may be varied by the Engineer or designated representative if conditions warrant.

Unless otherwise approved by the Engineer or designated representative, the lime operation shall not be started when the air temperature is below 41°F and falling, but may be started when the air temperature is above 35°F and rising. The temperature will be taken in the shade and away from artificial heat.

Lime shall not be placed when weather conditions in the opinion of the Engineer or designated representative are unsuitable.

Lime shall only be applied to those areas that can be properly processed during the same working day.

The application and mixing of lime with the existing material shall be accomplished by the methods hereinafter described as "Dry Placement" or "Slurry Placement." Dry placement will only

be permitted for small isolated areas as indicated on the drawings or as directed by the Engineer or designated representative. The minimum rate of lime solids application shall be seven (7) percent by weight, unless indicated otherwise on the Drawings or as directed by the Engineer or designated representative.

Any lime exposed to the air for more than six (6) hours and any lime lost or damaged before application due to rain, wind or other cause will be rejected and replaced by the Contractor at its own expense.

1. Dry Placement

The lime shall be spread by a spreader approved by the Engineer or designated representative or by bag distribution at the rates shown on the Drawings or as directed by the Engineer or designated representative.

The lime shall be distributed at a uniform rate and in such manner as to reduce the scattering of lime by wind. Lime shall not be applied when the wind conditions, in the opinion of the Engineer or designated representative, are such that blowing lime becomes objectionable to adjacent property owners or dangerous to traffic. A motor grader may be used to spread Type C Quicklime Grade "DS" pebbles.

The material shall be sprinkled, as approved by the Engineer or designated representative, until the proper moisture content has been secured.

2. Slurry Placement

The lime shall be mixed with water in a mixer or trucks with approved distributors to form a slurry with a solids content approved by the Engineer or designated representative. Application of the slurry shall be attained by successive passes over a measured section of roadway until the proper moisture and lime content has been secured. The distributor truck shall be equipped with an agitator, which will keep the lime and water in a uniform mixture.

E. Mixing

The mixing procedure shall be the same for "Dry Placement" or "Slurry Placement" as herein described.

During the interval of time between application and mixing, hydrated lime that has been exposed to the open air for a period of 6 hours or more or to excessive loss due to washing or blowing will not be accepted and the area shall be retreated.

In addition to the above, when Type C Quicklime, Grade "DS", is used under "Dry Placing", the material and lime shall be mixed as thoroughly as possible at the time of the lime application. Sufficient moisture shall be added during the mixing to hydrate the quicklime. After mixing, and prior to compaction, the mixture of material, quicklime and water, shall be moist cured for two (2) to seven (7) days, as approved by the Engineer or designated representative. After curing, mixing shall continue until the material and lime are thoroughly blended to the satisfaction of the Engineer or designated representative.

The material and lime shall be thoroughly mixed by road pulverizer equipment approved by the Engineer or designated representative. The material and lime shall be brought to the proper

moisture content and the mixing shall be continued until a homogeneous, friable mixture of material and lime is obtained. The lime-material mixture shall be free from all clods or lumps so that, when all nonslaking aggregates retained on the #4 sieve are removed, the remainder of the material shall meet the following pulverization requirements, when tested in accordance with TxDOT Test Method Tex-101-E, Part III:

	Percent
Minimum Passing the 1¾ inch Sieve	100
Minimum Passing the ¾ inch Sieve	85
Minimum Passing the No. 4 Sieve	60

When the lime-material mixture satisfies the requirements above, the mixture shall be allowed to "mellow" for a minimum of 12 hours prior to the initiation of compaction.

F. Compaction

Prior to initiation of compaction, the material shall be aerated or sprinkled as necessary to provide the optimum moisture. The lime-conditioned materials shall then be shaped and uniformly compacted to the sections; lines and grades indicated on the drawings or as directed by the Engineer or designated representative. Compaction shall continue until the entire depth of mixture is uniformly compacted as shown on the Drawings, as specified herein, or as directed by the Engineer or designated representative.

When shown on the Drawings or approved by the Engineer or designated representative, multiple lifts will be permitted; however, the 12-hour "mellowing" procedure is required for each lift. Individual lift thickness should not exceed 8 inches.

The course shall be sprinkled as required and compacted to the extent necessary to provide the density specified below:

Description	Density, Percent
For lime-conditioned subgrade, existing subbase or existing base that will receive subsequent subbase or base courses.	Not less than 95% of 'optimum density' or as otherwise indicated on the drawings.
For lime-conditioned existing base that will receive surface courses	Not less than 98% of 'optimum density' or as otherwise indicated on the drawings.

Testing for the 'optimum density' used for compaction control shall conform to TxDOT Test Method Tex-113-E. In addition to the requirements specified for density, the full depth of the material indicated shall be compacted to the extent necessary to remain firm and stable under

construction equipment. After each section is completed and proof rolled in accordance with Specification Section No. 236S "Proof Rolling", in place compaction tests will be conducted, as necessary, by the Engineer or designated representative in accordance with TxDOT Test Method, Tex 115-E. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. Throughout the entire operation the shape of the course shall be maintained by blading and the surface upon completion shall be smooth and in conformity with the typical sections, lines and grades as shown on the Drawings or as established by the Engineer or designated representative.

If the lime-conditioned material, due to any reason or cause, loses the required stability, density and finish before the next course is placed, it shall be re-compacted and refinished at the sole expense of the Contractor.

#### G. Reworking a Section

When a section is reworked within 72 hours after completion of compaction, the Contractor shall rework the section to provide the required compaction. When a section is reworked more than 72 hours after completion of compaction, the Contractor shall add 25 percent of the original specified rate of lime application during the reworking operation.

Reworking shall include loosening, road mixing as approved by the Engineer or designated representative, compacting and finishing. When a section is reworked, a new optimum density will be determined from the reworked material in accordance with TxDOT Test Method Tex-113-E.

#### 203S.6 - Finishing, Curing and Preparation for Surfacing

After the final layer or course of the lime conditioned subgrade, subbase or base has been compacted; it shall be brought to the required lines and grades in accordance with the typical sections indicated on the drawings. The completed section shall then be "finished off" by rolling with a pneumatic tire or other suitable roller, approved by the Engineer or designated representative, that is sufficiently light in loading to prevent hair cracking.

The Contractor shall set blue tops at edges, 1/4 point, and along the centerline at not more than 50 foot spacing. The completed section shall be maintained in a moist cured condition for a minimum of 3 days either by maintenance of moist conditions by water sprinkling or by the prevention of moisture loss due to drying by the addition of an asphalt prime coat as indicated on the drawings or as directed by the Engineer or designated representative at the rate of 0.05 to 0.20 gallons per square yard before further courses are added or any through traffic is permitted, unless otherwise directed by the Engineer or designated representative. Curing shall continue for a minimum of seven (7) days before further courses are added or traffic is permitted access, unless a shorter curing period is approved by the Engineer or designated representative.

If the drawings require the lime-conditioned material to be sealed or covered by other courses of material, the seal or other course shall be applied within 14 days after final mixing is completed, unless otherwise directed by the Engineer or designated representative. If the 14 day limit cannot be achieved because of insufficient strength gain or other problem with the lime-treated layer, the Contractor shall rework the section in accordance with Section 203S.5 (G) above.

### 203S.7 - Sampling and Testing

The lime-conditioned mixture shall be tested daily at the Project site for conformance to specification requirements. The Engineer or designated representative shall determine sample locations based on the Contractor's anticipated production.

When, in the opinion of the Engineer or designated representative, test results appear unrepresentative, additional testing may be authorized. Retesting due to failures or to resolve unrepresentative results will be at the expense of the Contractor and the results of the retesting shall be averaged with the results of the original testing. If the results of retesting indicate that the original testing was erroneous, the original test results will be discarded.

The Engineer will obtain samples of completed work to conduct the following tests:

Testing Requirement	TxDOT Test Procedure
Optimum Moisture Density	Test Method Tex-113E
In-Place Density of Lime Conditioning	Test Method Tex 115-E
Thickness of Lime Conditioning	Test Method Tex-140-E & Tex-600-J
PI Reduction	Test Method Tex-106-E

The contractor shall repair areas disturbed while obtaining samples.

### 203S.8 - Tolerances

#### A. In-Place Density

The Work must pass all density tests performed.

#### B. Dimensional

Areas of lime conditioning which do not meet the tolerances specified below will be delineated and shall be corrected to drawing dimensions by scarifying, remanipulating and recompacting the deficient areas at the Contractor's sole expense.

##### 1. Thickness Requirements:

Under thickness shall not exceed 3/4 inch. Overthickness will be waived at no additional cost to the City.

##### 2. Widths Requirements:

Roadway under width shall not exceed 6 inches. Shoulder underwidth shall not exceed 3 inches. If lime conditioning for both roadway and shoulder is constructed at the same time, the 6-inch underwidth tolerance shall apply. Overwidth will be waived at no additional cost to the City.



203S.9 - Measurement

Lime-conditioning of the type, grade and rate of application on the subgrade, existing subbase and existing base shall be measured by the square yard to neat lines as shown on the typical sections.

Reworking a section to provide the proper compaction shall be measured by the square yard.

203S.10 - Payment

Work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for as follows:

"Lime Treated Subgrade," "Lime Treated Existing Subbase" and "Lime Treated Existing Base" will be paid for at the unit bid price per square yard.

The unit bid prices shall include full compensation for: preparing the roadbed; furnishing all materials; all freight involved; public scales weighing charges or furnishing scales and labor involved in weighing the material; loosening, mixing, pulverizing, spreading, drying, furnishing and application of lime, sprinkling, rolling, shaping, proof rolling, maintenance and all manipulations, reworking, labor, equipment, fuels, tools and incidentals necessary to complete the work.

Reworking a section shall include full compensation for: loosening lime treated layer, furnishing and application of additional lime, road mixing, sprinkling, rolling, shaping, proof rolling, maintenance and all manipulations, labor, equipment, fuels, tools and incidentals necessary to complete reworking.

Payment will be made under one of the following:

<b>Pay Item No. 203S-A:</b>	Lime Treated Subgrade, ( _____ in. Thick)	Per Square Yard.
<b>Pay Item No. 203S-B:</b>	Lime Treated Existing Subbase, ( _____ in. Thick)	Per Square Yard.
<b>Pay Item No. 203S-C:</b>	Lime Treated Existing Base, ( _____ in. Thick)	Per Square Yard.
<b>Pay Item No. 203S-R:</b>	Reworking Lime Treated Layer, ( _____ in. Thick)	Per Square Yard.

END

## ITEM NO. 204S - PORTLAND CEMENT TREATMENT FOR MATERIALS IN PLACE

### 204S.1 - Description

This item shall govern the treatment of materials in place by pulverizing soil or aggregate materials, adding Portland Cement (PC), mixing, wetting and then compacting the treated material to the required density, as herein specified and in conformity with the typical sections, lines, grades and thickness as shown on the Drawings or as established by the Engineer or designated representative. This item applies to natural subgrade soils, embankment materials, new base or existing base (with or without asphaltic concrete pavement layers) or combinations as shown on the Drawings.

### 204S.2 - Submittals

The submittal requirements of this specification item may include:

- A. A mix design identifying classification of in-place materials, type of cement, source of water and quantities of cement and water required in the proposed application to yield the specified compressive strength requirements, and
- B. An update in the mix design, if source of material changes during construction,
- C. A plan describing the construction equipment proposed for the work and identifying the type and condition of each equipment item.

### 204S.3 - Materials

#### A. Soil

Soil shall consist of approved material, free from vegetation or other objectionable matter, encountered in the existing roadway and/or other acceptable embankment or borrow material selected for use in preparation of the roadway in accordance with this specification.

#### B. Portland Cement

PC shall be either Type 1, 1P or II and shall conform to TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges Item No. 524.

The Contractor may use bag or bulk cement.

#### C. Water

Water shall be free from oils, acids, organic matter or other substances deleterious to the cement treatment of materials. The water shall not contain more than 1000 parts per million of chlorides as Cl nor more than 1000 parts per million of sulfates as SO<sub>4</sub>. Water from municipal supplies approved by the State Health Department will not require testing, but water from other sources will be sampled and tested in accordance with AASHTO T-26. The water source shall be approved by the Engineer or designated representative.

### 204S.4 - Equipment

The equipment utilized for materials, which are specified to be measured or proportioned by weight shall be approved by the Engineer or designated representative. Prior to the start of construction operations, the equipment necessary for the proper construction of the work shall be on the project site, in first class

working condition and approved by the Engineer or designated representative, both as to type and condition. The Contractor shall at all times provide sufficient equipment to enable continuous prosecution of the work and to insure completion in the required number of working days.

"Portland Cement Treatment for Materials in Place" may be constructed with any machine or combination of machines and auxiliary equipment that will produce results as outlined in this specification.

Mixing may be accomplished by (1) a multiple-pass traveling mixing plant or (2) a single-pass traveling mixing plant.

The equipment provided by the Contractor shall be operated by experienced and capable workers and shall be that necessary to provide a cement treatment meeting the requirements herein specified.

#### 204S.5 - Mix Design

Cement content will be selected by the Engineer or designated representative, based on compressive strength test results from a testing laboratory approved by the City of Pflugerville. The mix design shall meet the strength requirements as shown on the Drawings or indicated in the Specifications.

Unless otherwise indicated in the Drawings or established by the Engineer or designated representative, the mix will be designed with the intention of producing a minimum average 7 day compressive strength of 400 psi using the unconfined compression testing procedures described in TxDOT Test Method Tex-120-E.

When material properties or sources change, Contractor shall provide additional mix design tests and adjust the cement content as necessary to meet the compressive strength requirements.

#### 204S.6 - Construction Methods

##### A. General

Prior to commencement of this work, all required erosion control and tree protection measures shall be in place and the utilities located and protected as specified in the City of Pflugerville Engineering Design Manual & Construction Standards.

Construction equipment shall not be operated within the drip line of trees unless otherwise indicated on the Drawings. Construction materials shall not be stockpiled under the canopies of trees. Excavation or embankment materials shall not be placed within the drip line of trees until tree wells are constructed.

It is the primary requirement of this specification to secure a uniformly treated course of cement treated material, free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth and with a smooth surface suitable for placing subsequent courses.

##### B. Preparation of Subgrade or existing surface

Prior to scarifying or pulverizing the existing material, the subgrade or existing surface shall be graded and shaped as required to construct the "Portland Cement Treatment for Materials in Place" in conformance with the lines, grades, thickness and cross section indicated on the Drawings or as approved by the Engineer or designated representative. Unsuitable material shall be removed and replaced with acceptable material.

The Contractor shall proof roll the subgrade or existing surface in accordance with Standard Specification Item No. 236S "Proof Rolling". The subgrade or existing surface shall be firm and able to support without displacement the construction equipment and the compaction hereinafter specified. Soft or yielding subgrade shall be corrected and made stable before construction proceeds.

When the Contractor elects to use a cutting and pulverizing machine that will process the material to the specified depth, the Contractor will not be required to excavate to the secondary grade or windrow the material. This method will be permitted only if a machine is provided which will insure that the material is cut uniformly to the proper depth and which has cutters that will plane the secondary grade to a smooth surface over the entire width of the cut. The machine shall be of such design that a visible indication is provided at all times that the machine is cutting to the proper depth. If the machine fails to achieve the proper cutting depth, it shall be removed from the project or adjusted to the satisfaction of the Engineer or designated representative to accomplish the work as specified.

In lieu of using the cutting and pulverizing machine, the Contractor shall excavate and windrow the material to expose the secondary grade to the typical sections, lines and grades as shown on the Drawings or as established by the Engineer or designated representative. The windrowed material shall be uniformly replaced before the cement is applied.

#### C. Pulverization

The existing subgrade material to be stabilized shall be so pulverized that, a minimum of 80 percent passes a No. 4 sieve, exclusive of gravel or stone retained on this sieve. When shown on the Drawings or approved by the Engineer or designated representative, this pulverization requirement may be waived if the material contains a substantial amount of aggregate.

Existing asphaltic concrete wearing surfaces, subbases and bases shall be pulverized so that 100 percent will pass a 2-inch sieve.

#### D. Application of Cement (Roadmix)

It shall be the responsibility of the Contractor to (1) regulate the sequence of his work, (2) process a sufficient quantity of material to provide full depth as indicated on the Drawings, (3) use the proper amount of PC, that is established by the approved job mix design or approved by the Engineer or designated representative and (4) maintain the work and rework the courses as necessary to meet the design strength requirements.

The cement shall be spread by an approved spreader or by bag distribution. It shall be distributed at a uniform rate and in such a manner as to reduce to a minimum the scattering of cement by wind. Cement treatment shall not be mixed or placed when the wind velocity exceeds 15 miles per hour or when the air temperature is below 40°F and falling but may be mixed or placed when the air temperature is above 35°F and rising. The temperature shall be taken in the shade and away from artificial heat. In any event cement treatment shall be mixed or placed only when weather conditions, in the opinion of the Engineer or designated representative, are suitable. If a bulk cement spreader is used, it shall be positioned with string lines or other approved method during spreading to insure a uniform distribution of cement.

Cement shall be applied only in that area where the mixing, compacting and finishing operations can be continuous and completed in daylight within 6 hours of such application.

The percentage of moisture in the soil at the time of cement application shall not exceed the quantity that will permit uniform and intimate mixture of material and cement during dry mixing operations. The percentage of moisture in the soil at the time of cement application shall not exceed the optimum moisture content for the cement-stabilized mixture.

No equipment, except that used in spreading and mixing, will be allowed to pass over the freshly spread cement until it is mixed.

#### E. Mixing and Processing

Either single or multiple soil stabilizer mixers shall be used.

After any required mixing of the material(s), the cement shall be dry mixed with the material(s) prior to the addition of water. Immediately after dry mixing, water shall be uniformly applied. After mixing, the mixture shall be in a loose, evenly spread state ready for compaction. The mixture shall be mixed and compacted in one (1) lift.

The mixer shall be provided with means for the visible and accurate gauging of the water application. The water shall be uniformly applied through a pressure spray bar.

After the cement is spread, the mixing operation shall proceed as follows:

1. The mixer shall in one continuous operation: mix the air-dry material and cement to the full depth indicated on the Drawings, provide for the addition of water uniformly, thoroughly moist-mix the material, cement and water, spread the completed cement mixture evenly over the machine processed width of the subgrade, and leave it in a loose condition ready for immediate compaction.
2. The stabilized cement mixture shall not remain undisturbed after mixing and before compacting for more than 30 minutes.

#### F. Compaction

Unless otherwise shown on the Drawings or established by the Engineer or designated representative, the cement treated course shall be sprinkled as required herein and compacted to the extent necessary to provide not less than 95 percent of the density as determined by TxDOT Test Method Tex-120-E, Part II. The in-place roadway density will be determined by TxDOT Test Method Tex-115-E.

At the start of compaction, the percentage of moisture in the mixture shall be within 2 percentage points either side of the specified optimum moisture content as determined by TxDOT Test Method Tex-120-E, unless otherwise approved by the Engineer or designated representative. The percent of moisture will be determined in accordance with TxDOT Test Method Tex-103-E.

If the percent of moisture is outside the allowable tolerance, the Contractor shall adjust operations to meet this requirement. When the uncompacted cement stabilized mixture is wetted by rain so that the average moisture content exceeds the specified tolerance at the time of final compaction, the entire section shall be reconstructed in accordance with this specification at the sole expense of the Contractor.

When the material fails to meet the density requirements or should the material lose the required stability, density or finish before the next course is placed or the project is accepted, the treated

material shall be removed and replaced, unless otherwise approved by the Engineer or designated representative. Removal and replacement with acceptable treated material will be at the Contractor's expense. All initial density testing will be paid for by the City of Pflugerville. All retesting shall be paid for by the Contractor.

#### G. Finishing

The resulting surface shall be "clipped", "skinned" or "tight bladed" by a maintainer or subgrade trimmer to a depth of approximately 1/4 inch, removing all loosened materials. The loosened materials will be disposed of at the Contractor's expense and at a location approved by the Engineer or designated representative. The surface shall then be rolled with the pneumatic roller in accordance with Standard Specification Item No. 232S "Rolling (Pneumatic Tire)", adding small increments of moisture as needed during rolling. Throughout this operation, the shape of the course shall be maintained and the surface upon completion shall be smooth and in conformity with the typical sections, lines and grades as shown on the Drawings or as established by the Engineer or designated representative.

If plus No. 4 aggregate is present in the mixture, one complete coverage of the section with the flat wheel roller in accordance with Standard Specification Item No. 230S "Rolling (Flat Tire)" shall be made immediately after the "clipping" operation. When directed by the Engineer or designated representative, surface finishing methods may be varied from this procedure, provided a dense, uniform surface, free of surface compaction planes, is produced.

The moisture content of the surface material must be maintained within two (2) percentage points of optimum during all finishing operations. Surface compaction and finishing shall proceed in such a manner as to produce, in not more than 2 hours, a smooth, closely knit surface conforming to the crown, grade and line indicated which is free of cracks, ridges or loose material.

#### 204S.7 - Curing

##### A. Protection and Cover

After the cement treated course has been finished as specified herein, the surface shall be protected against rapid drying by either one of the following curing methods. The protection measures shall be continued: (a) for the specified period, but in no case less than 3 days, or (b) until the surface or subsequent courses are placed:

1. Maintain in a thorough and continuously moist condition by sprinkling.
2. Apply a 2-inch layer of earth on the completed course and maintain in a moist condition.
3. Apply an asphaltic material to the treated course at the rate of 0.05 to 0.20 gallon per square yard, as determined by the Engineer or designated representative. The asphalt used shall be the type and grade shown on the Drawings or as approved by the Engineer or designated representative, in accordance with Standard Specification Item No. 301 "Asphalts, Oils and Emulsions". The asphalt shall completely cover and seal the total surface of the base and fill all voids.

If this method is used, it shall be the Contractor's responsibility to protect the asphalt membrane from being picked up by traffic by either sanding or dusting the membrane

surface. The asphalt membrane may remain in place when the proposed surface or other base courses are placed.

#### B. Surface

The surface or other base courses may be applied on the finished base as soon after completion as operations will permit.

##### 204S.8 - Construction Joints

At the end of each day's construction, a straight transverse construction joint shall be formed by cutting back into the total width of completed work to form a vertical face free of loose and shattered material.

Cement treatment for large, wide areas shall be built in a series of parallel lanes of convenient length and width meeting the approval of the Engineer or designated representative.

##### 204S.9 - Traffic

Completed sections of cement treated material in place may be opened immediately to local traffic, construction equipment and all traffic after the curing period, provided the cement treated course has hardened sufficiently to prevent marring or distorting of the surface by equipment or traffic.

##### 204S.10 - Maintenance

The Contractor shall be required, within the limits of the contract, to maintain the cement treated course in good condition until all work has been completed and accepted. Maintenance shall include immediate repairs of any defects that may occur. This work shall be done by the Contractor at the Contractor's own expense and shall be repeated as often as needed to keep the area continuously intact. Any improper, insufficient or faulty work shall be replaced to the full depth of treatment.

It is the intent of this specification that the Contractor construct the plan depth of cement treatment in one homogeneous mass. The addition of thin stabilized layers will not be permitted to provide the minimum specified depth.

##### 204S.11 - Measurement

"Portland Cement Treatment for Materials in Place" will be measured as follows:

Cement treatment for materials in place will be measured by the square yard of surface area of completed and accepted work.

PC, specified by the Engineer or designated representative for incorporation in the cement treatment, will be measured by the barrel of 376 pounds of cement.

##### 204S.12 - Payment

This item will be paid for at the contract unit bid price for "Portland Cement" and "Portland Cement Treatment of Materials in Place".

The unit bid prices shall each include full compensation for: (a) mix designs, (b) preparing the roadbed; (c) furnishing all material; (d) all freight charges involved; (e) furnishing scales and labor involved in weighing the material; (f) pulverizing; applying cement and water, (g) all processing, mixing, spreading,

sprinkling, compacting, finishing and curing the cement treated soil; and (h) all manipulations, labor, equipment, fuels, tools and incidentals necessary to complete the work.

Payment will be made under one of the following:

<b>Pay Item No. 204S-A:</b>	Portland Cement Treatment of Materials in Place _____ inch thickness	Per Square Yard.
<b>Pay Item No. 204S-B:</b>	Portland Cement	Per Barrel.

END



ITEM NO. 210S - FLEXIBLE BASE

210S.1 - Description

This item governs furnishing and placing a crushed stone base course for surfacing, pavement, or other base courses. "Flexible Base" shall be constructed on an approved, prepared surface in one or more courses conforming to the typical sections and to the lines and grades, indicated on the Drawings or established by the Engineer or designated representative.

210S.2 - Submittals

The submittal requirements of this specification item may include:

- A. Source, gradation and test results for the crushed limestone material,
- B. Field density test results for in-place compacted flexible base

210S.3 - Material

- A. Mineral Aggregate

The material shall be crushed argillaceous limestone meeting the requirements specified herein. The material shall be from sources approved by the City and shall consist of durable crushed stone that has been screened to the required gradation.

Flexible base materials shall be tested according to the following TxDOT standard test methods:

a) Preparation for Soil Constants and Sieve Analysis	Tex-101-E
b) Liquid Limit	Tex-104-E
c) Plastic Limit	Tex-105-E
d) Plasticity Index	Tex-106-E
e) Sieve Analysis	Tex-110-E
f) Wet Ball Mill	Tex-116-E
g) Triaxial Test	Tex-117-E, Part II

1. Plasticity Index shall be determined in accordance with Tex-107-E (Linear Shrinkage) when liquid limit is unattainable as defined in Tex-104-E.
2. When a soundness value is required on the drawings, the material shall be tested in accordance with Tex-411-A.

The material shall be well graded and shall meet the following requirements:

Sieve Designation	Other Requirements	% Retained	
US			
1 <sup>3</sup> / <sub>4</sub> "		0	
7/8"		10—35	
3/8"		30—50	
#4		45—65	
#40		70—85	
	Maximum Plasticity Index		10
	Maximum Wet Ball Mill		42
Maximum Increase in passing #40 sieve from Wet Ball Mill Test		20	

Minimum compressive strength when subjected to the triaxial test shall be 35 psi at 0 psi lateral pressure and 175 psi at 15 psi lateral pressure.

C. Tolerances

The limits establishing reasonably close conformity with the specified gradation and plasticity index are defined by the following:

The City may accept the material, providing not more than two (2) out of 10 consecutive gradation tests performed are outside the specified limit on any individual or combination of sieves by no more than five (5) percent and where no two (2) consecutive tests are outside the specified limit.

The City may accept the material providing not more than 2 out of 10 consecutive plasticity index samples tested are outside the specified limit by no more than two (2) points and where no two (2) consecutive tests are outside the specified limit.

210S.4 - Stockpiling, Storage and Management

A. Managing Material:

The stockpile shall be constructed on a relatively smooth area that has been cleared of debris, weeds, brush, trees and grass. Stockpiles shall contain between 25,000 and 50,000 cubic yards. The stockpile shall be constructed using scrapers, bottom dumps or other similar equipment that allows dumping and spreading without rehandling. The stockpile shall be constructed to allow

dumping and spreading in one direction only. The height of the stockpile shall not exceed the capabilities of available equipment to make a full cut (bottom to top) on any of the four sides.

A stockpile shall be completed before being tested by the City. The Contractor's supplier shall notify the City when a stockpile has been completed and is ready to be tested. The stockpile shall not be added to after it has been tested.

The Contractor shall provide material only from stockpiles that have been inspected, tested and accepted by the City. A ticket showing the date, source, stockpile number, and net weight shall be provided to the Inspector with each load of material delivered to the Project.

Material shall be loaded from the stockpile by making successive vertical cuts through its entire depth.

**B. Test Sampling:**

The Contractor's supplier may choose the method of sample gathering for testing by the City's laboratory as follows:

1. The supplier shall make a full-height cut a sufficient distance into each side of the stockpile to obtain a uniform sample. The four samples (one from each side of the stockpile) shall then be combined and mixed into a single "test" specimen from which the City's laboratory can obtain a sample.
2. As the stockpile is constructed, a perpendicular cut will be made across the spreading direction at every two feet to four feet of height and the sample used to start a "mini" stockpile. The process shall be repeated in two feet to four feet increments of height, until the stockpile and the "mini" stockpile are completed. Samples shall be obtained from the "mini" stockpile in the same manner described in (1) above.

**C. Testing and Acceptance:**

When initial tests indicate that the material is unacceptable, the City may, if requested by the Contractor's supplier, sample and test the material one more time. The additional sampling and testing shall be paid for by the supplier.

**210S.5 - Construction Methods**

**A. Preparation of Subgrade:**

Flexible base shall not be placed until the Contractor has verified by proof rolling that the subgrade has been prepared and compacted in conformity with Standard Specification Item 201S, "Subgrade Preparation," to the typical sections, lines and grades indicated on the Drawings. Any deviation shall be corrected and proof rolled prior to placement of the flexible base material.

The Contractor shall not place flexible base until the subgrade has cured to the satisfaction of the Engineer or designated representative, regardless of whether or not the subgrade has been successfully proof rolled. As a minimum, this will be after the surface displays no damp spots and there is no evidence of "sponginess" in the subgrade.

**B. First Lift:**

Immediately before placing the flexible base material, the subgrade shall be checked for conformity with grade and section. The thickness of each lift of flexible base shall be equal increments of the total base depth. No single lift shall be more than six inches or less than three inches compacted thickness.

The material shall be delivered in approved vehicles. It shall be the responsibility of the Contractor to deliver the required amount of material. If it becomes evident that insufficient material was placed, additional material as necessary shall be delivered and the entire course scarified, mixed and compacted.

Material deposited upon the subgrade shall be spread and shaped the same day unless otherwise approved by the Engineer or designated representative. In the event inclement weather or other unforeseen circumstances render spreading of the material impractical, the material shall be spread as soon as conditions allow.

Additionally, if the material cannot be spread and worked the same day it is deposited, the Contractor shall "close up" the dump piles before leaving the job site. "Closed up" shall be defined as the use of a motor grader to blade all dump piles together, leaving no open space between piles.

The material shall be spread, sprinkled, if required, then thoroughly mixed; bladed, dragged and shaped to conform to the typical sections indicated on the Drawings.

All areas and "nests" of segregated coarse or fine material shall be corrected or removed and replaced with well-graded material.

Each lift shall be sprinkled as required to bring the material to optimum moisture content, then compacted to the extent necessary to provide not less than the percent density specified in Section 210S.5.D, "Density." In addition to the requirements specified for density, the full depth of flexible base material shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section of flexible base material is completed, tests, as necessary, will be made by the Engineer or designated representative. As a minimum, three in-place density tests per section per day will be taken (testing shall be taken every 750 square yards or 300 linear feet whichever is less). If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. All initial testing will be paid for by the City. All retesting shall be paid for by the Contractor.

Throughout the entire operation, the surface of the material shall be maintained by blading and, upon completion, shall be smooth and shall conform to the typical section indicated on the Drawings and to the established lines and grades.

In that area on which pavement is to be placed, any deviation in excess of 1/4 inch in cross section or 1/4 inch in a length of 16 feet measured longitudinally shall be corrected by loosening, adding or removing material, and by reshaping and recompacting. All irregularities, depressions or weak spots shall be corrected immediately by scarifying the areas affected, adding suitable material as required, and by reshaping and recompacting. Should the lift, due to any reason or cause, lose the required stability, density and/or finish before the surfacing is complete, it shall be recompacted and refinished at the Contractor's expense.

C. Succeeding Lifts:

Construction methods for succeeding lifts shall be the same as prescribed for the first lift. For that lift of the flexible base upon which the curb and gutter will be constructed, as well as the last flexible base lift (i.e. top of the flexible base), the Contractor shall check the surface of the lift for conformity to the lines and grades by setting "blue tops" at intervals not exceeding 50 feet on the centerline, at 1/4 points, at curb lines or edge of pavement, and at other points that may be indicated on the Drawings.

When the thickness of a particular lift of the flexible base is in question, the Contractor shall check the surface of the lift for conformity to the lines and grades by setting "blue tops" at intervals not exceeding 50 feet on the centerline, at 1/4 points, at curb lines or edge of pavement, and at other points that may be indicated on the Drawings.

D. Density:

The flexible base shall be compacted to not less than 100 percent density as determined by TxDOT Test Method Tex-113-E.

Field density determination shall be made in accordance with TxDOT Test Method Tex-115-E unless otherwise approved by the Engineer or designated representative. Each lift of the flexible base shall also be tested by proof rolling in conformity with Standard Specification Item 236S "Proof Rolling."

E. Priming:

After the flexible base material has been compacted to not less than 100 percent density, and tested by proof rolling, a prime coat will be applied in accordance with Standard Specification Item 306S, "Prime Coat."

F. Curing:

Pavement materials, such as a tack coat or surface course, shall not be placed on the primed surface until the prime coat has been absorbed into the base course. At least 24 hours, or longer if designated by the Engineer or designated representative, shall be allowed when cutback asphalt is used as the prime coat.

210S.6 - Measurement

"Flexible Base" will be measured by the cubic yard, complete in place, as indicated in the Contract Documents.

210S.7 - Payment

This item will be paid for at the contract unit bid price for "Flexible Base". The unit bid price shall include full compensation for all work specified herein, including the furnishing, hauling, placing and compacting of all materials; for rolling, proof rolling, recompacting and refinishing; for all water required; for retesting as necessary; for priming; and for all equipment, tools, labor and incidentals necessary to complete the Work.

Prime coat will not be measured nor paid for directly but shall be included in the unit price bid for Standard Specification Item 210S, "Flexible Base."

Payment will be made under one of the following:

<b>Pay Item No. 210S-A:</b>	Flexible Base	Per Cubic Yard.
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**END**

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## ITEM NO. 211S - RECYCLING EXISTING AGGREGATE

### 211S.1 - Description

This item governs: (1) breaking up existing asphalt pavement surfaces, (2) salvaging and placing existing broken up asphalt surface and flexible base materials on an existing subgrade and (3) compacting the courses in conformity with typical sections indicated in the Drawings, directions of the Engineer or designated representative and requirements herein specified.

### 211S.2 - Submittals

The submittal requirements of this specification item may include:

- A. Source, gradation and test results for the recycled existing material, and
- B. Field density test results for in-place compacted recycled aggregate layers.

### 211S.3 - Materials

Materials required for use under this specification item shall conform to the following specification items as applicable:

Description of Activity	Item No.
Street Excavation	110S
Lime	202S
Lime Treatment for Materials in Place	203S
Portland Cement Treatment for Materials in Place	204S
Flexible Base	210S
Asphalts, Oils and Emulsions	301S
Emulsified Asphalt Treatment	310S
Two Course Surface Treatment	320S
Hot Mix Asphaltic Concrete Pavement	340S

### 211S.4 - Construction Methods

The existing roadway right of way shall be cleared of any vegetation or contaminants that would be in the path of the recycling equipment. The existing asphaltic concrete surface shall be scarified, loosened and broken up and pulverized in place into 1-inch maximum size pieces. The salvaged asphaltic concrete

surface materials will be removed prior to scarifying the underlying existing base material. The Contractor shall make any necessary provision to prevent contamination of the asphaltic material during and after removal. When the existing pavement consists only of a surface treatment, it will not be necessary to remove the surface treatment before scarifying the underlying existing base material.

The existing base, with or without an existing asphaltic concrete pavement, shall be cleaned of all objectionable materials by blading, brooming or other approved methods, prior to scarifying. After cleaning, the existing material shall be scarified for its full width and depth, unless otherwise shown on the Drawings. In no case shall the underlying subgrade be disturbed. Unless otherwise shown on the Drawings, the materials shall be broken into particles of no more than 2½ inches in largest dimension.

All salvaging operations, including temporary stockpiling or windrowing, shall be conducted in such a manner as not to interfere with traffic, proper drainage or the general requirements of the Work. All material shown on the Drawings to be salvaged shall be kept reasonably free of soil from the subgrade or roadbed during the salvaging operation. The scarified material shall be removed from the roadbed using equipment approved by the Engineer or designated representative. The salvaged material may be placed in temporary stockpiles or windrows until sufficient subgrade has been prepared to receive the material.

Prior to replacing the salvaged material, the subgrade shall be constructed and shaped to conform to the typical sections as shown on the Drawings or as established by the Engineer or designated representative. This work shall be done in accordance with the provisions of Standard Specification Item 201S, "Subgrade Preparation".

Prior to replacing the salvaged material, when shown on the Drawings and when directed by the Engineer or designated representative, the Contractor shall proof roll the roadbed in accordance with Standard Specification Item 236S, "Proof Rolling". Soft spots, unstable or spongy areas shall be undercut, backfilled with suitable material and compacted by approved methods.

The salvaged base material shall be mixed, spread and shaped to conform to the typical sections shown on the Drawings. However, in no case, shall the underlying subgrade be disturbed. New base material and/or salvaged asphaltic materials, when shown on the Drawings to be mixed with the scarified base materials, shall be placed on the existing scarified material, and uniformly incorporated.

Unless shown otherwise on the Drawings, each lift of salvaged material shall be sprinkled as required and compacted to the extent necessary to provide not less than 98 percent density as determined by TxDOT Test Method Tex-113-E. Field density determination shall be made in accordance with TxDOT Test Method Tex-115-E

If the reworked base material, due to any reason or cause, loses the required stability, density or finish before placement of the next lift of the reworked base material, placement of the next course of material or prior to acceptance of the project, it shall be recompacted and refinished at the Contractor's expense. All initial testing will be paid for by the City of Pflugerville. All retesting shall be paid for by the Contractor.

#### 211S.5 - Measurement

Recycled aggregate will be measured by the cubic yard, or by the square yard of the thickness indicated on the Drawings, complete in place.



211S.6 - Payment

This item will be paid for at the contract unit bid price for "Recycling Existing Aggregate". The unit bid price shall include full compensation for all work herein specified, including: scarifying, loosening and breaking up the existing asphaltic surface and base materials; removing, saving, loading, hauling and stockpiling materials; placing of salvaged materials with or without additional base materials; all water required and all equipment, tools, labor and incidentals necessary to complete the work. Any new materials required shall be paid under their respective items listed above, but the pulverizing of new and old materials shall be incidental to complete the work.

Payment will be made under:

<b>Pay Item No. 211S-A:</b>	Recycling Existing Aggregate -	Per Cubic Yard.
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**END**

## ITEM NO. 212S - RECYCLED CONCRETE FLEXIBLE BASE

### 212S.1 - Description

This item governs furnishing and placing a crushed recycled concrete base course. "Recycled Concrete Flexible Base" shall be constructed on an approved, prepared surface in one or more courses conforming to the typical sections and to the lines and grades, indicated on the Drawings or established by the Engineer or designated representative.

### 212S.2 - Submittals

The submittal requirements of this specification item may include:

- A. Source, gradation and test results for the crushed recycled concrete material,
- B. Notification that the crushed recycled concrete stockpile is completed and ready for testing,
- C. Certification of compliance with TxDOT DMS 11000, "Evaluating and Using Non-hazardous Recyclable Material Guidelines", and
- D. Field density test results for in-place compacted flexible base

### 212S.3 - Material

#### A. Mineral Aggregate

The material shall be crushed recycled concrete meeting the requirements specified herein. The material shall be from sources approved by the City and shall consist of durable crushed recycled concrete that has been screened to the required gradation.

The recycled concrete material shall be free of reinforcing steel and other objectionable materials and shall have no more than 1.5% deleterious material (when tested in conformance with Tex-413-A) and 3000 ppm of soluble sulfates ASTM C1580.

Recycled concrete flexible base materials shall be tested according to the following TxDOT standard test methods:

a) Preparation for Soil Constants and Sieve Analysis	Tex-101-E
b) Liquid Limit <sup>1</sup>	Tex-104-E
c) Plastic Limit	Tex-105-E
d) Plasticity Index	Tex-106-E
e) Sieve Analysis	Tex-110-E
f) Wet Ball Mill <sup>2</sup>	Tex-116-E

g) Triaxial Test	Tex-117-E, Part II
h) Deleterious Materials	Tex-413-A

1. Plasticity Index shall be determined in accordance with Tex-107-E (Linear Shrinkage) when liquid limit is unattainable as defined in Tex-104-E.
2. When a soundness value is required on the drawings, the material shall be tested in accordance with Tex-411-A.

The recycled concrete base material shall be stockpiled after crushing, then tested by the City's designated laboratory and approved by the Engineer or designated representative prior to being hauled to the Project.

The recycled concrete material shall be well graded and shall meet the following requirements. Additives such as but not limited to lime, cement or fly ash shall not be used to modify the aggregates to meet the requirements unless specified otherwise on the drawings.

Sieve Designation	Other Requirements	% Retained	
US			
1 3/4"		0	
7/8"		10—35	
3/8"		30—50	
#4		45—65	
#40		70—85	
	Maximum Plasticity Index		10
	Maximum Wet Ball Mill		42
Maximum Increase in passing #40 sieve from Wet Ball Mill Test		20	

Minimum compressive strength when subjected to the triaxial test shall be 35 psi at 0 psi lateral pressure and 175 psi at 15 psi lateral pressure.

212S.4 - Stockpiling, Storage and Management

A. Managing Material:

The stockpile shall be constructed on a relatively smooth area that has been cleared of debris, weeds, brush, trees and grass. Stockpiles shall contain between 25,000 and 50,000 cubic yards. The stockpile shall be constructed using scrapers, bottom dumps or other similar equipment that allows dumping and spreading without rehandling. The stockpile shall be constructed to allow dumping and spreading in one direction only. The height of the stockpile shall not exceed the capabilities of available equipment to make a full cut (bottom to top) on any of the four sides.

A stockpile shall be completed before being tested by the City. The Contractor's supplier shall notify the City when a stockpile has been completed and is ready to be tested. The stockpile shall not be added to after it has been tested.

The Contractor shall provide material only from stockpiles that have been inspected, tested and accepted by the City. A ticket showing the date, source, stockpile number, and net weight shall be provided to the Inspector with each load of material delivered to the Project.

Because of its high absorptive properties, the recycled concrete material contained in a stockpile can potentially lose strength with subsequent moisture addition. As a consequence, the City may require additional testing if an unprotected stockpile is exposed to significant extended rainfall or a stockpile remains open for an extended period of time.

Material shall be loaded from the stockpile by making successive vertical cuts through its entire depth.

B. Test Sampling:

The Contractor's supplier may choose the method of sample gathering for testing by the City's laboratory as follows:

1. The supplier shall make a full-height cut a sufficient distance into each side of the stockpile to obtain a uniform sample. The four samples (one from each side of the stockpile) shall then be combined and mixed into a single "test" specimen from which the City's laboratory can obtain a sample.
2. As the stockpile is constructed, a perpendicular cut will be made across the spreading direction at every two feet to four feet of height and the sample used to start a "mini" stockpile. The process shall be repeated in two feet to four feet increments of height, until the stockpile and the "mini" stockpile are completed. Samples shall be obtained from the "mini" stockpile in the same manner described in (1) above.

C. Testing and Acceptance:

When initial tests indicate that the material is unacceptable, the City may, if requested by the Contractor's supplier, sample and test the material one more time. The additional sampling and testing shall be paid for by the supplier.

## 212S.5 - Construction Methods

A. Preparation of Subgrade:

Recycled concrete flexible base shall not be placed until the Contractor has verified by proof rolling that the subgrade has been prepared and compacted in conformity with Standard Specification Item 201S, "Subgrade Preparation," to the typical sections, lines and grades

indicated on the Drawings. Any deviation shall be corrected, and proof rolled prior to placement of the flexible base material.

The Contractor shall not place recycled concrete flexible base until the subgrade has cured to the satisfaction of the Engineer or designated representative, regardless of whether or not the subgrade has been successfully proof rolled. As a minimum, this will be after the surface displays no damp spots and there is no evidence of "sponginess" in the subgrade.

B. First Lift:

Immediately before placing the recycled concrete flexible base material, the subgrade shall be checked for conformity with grade and section. The thickness of each lift of flexible base shall be equal increments of the total base depth. No single lift shall be more than six inches or less than three inches compacted thickness.

The material shall be delivered in approved vehicles. It shall be the responsibility of the Contractor to deliver the required amount of material. If it becomes evident that insufficient material was placed, additional material as necessary shall be delivered and the entire course scarified, mixed and compacted.

Material deposited upon the subgrade shall be spread and shaped the same day unless otherwise approved by the Engineer or designated representative. In the event inclement weather or other unforeseen circumstances render spreading of the material impractical, the material shall be spread as soon as conditions allow.

Additionally, if the material cannot be spread and worked the same day it is deposited, the Contractor shall "close up" the dump piles before leaving the job site. "Closed up" shall be defined as the use of a motor grader to blade all dump piles together, leaving no open space between piles.

The material shall be spread, sprinkled, if required, then thoroughly mixed; bladed, dragged and shaped to conform to the typical sections indicated on the Drawings.

All areas and "nests" of segregated coarse or fine material shall be corrected or removed and replaced with well-graded material.

Each lift shall be sprinkled as required to bring the material to optimum moisture content, and then compacted to the extent necessary to provide not less than the percent density specified in Section 212S.5.D, "Density." In addition to the requirements specified for density, the full depth of recycled concrete flexible base material shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section of recycled concrete flexible base material is completed, tests, as necessary, will be made by the Engineer or designated representative. As a minimum, three in-place density tests per section per day will be taken at 300 linear foot intervals and every 750 square yards of placement. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. All initial density testing will be paid for by the City. All retesting shall be paid for by the Contractor.

Throughout the entire operation, the surface of the material shall be maintained by blading and, upon completion, shall be smooth and shall conform to the typical section indicated on the Drawings and to the established lines and grades.

In that area on which pavement is to be placed, any deviation in excess of 1/4 inch in cross section or 1/4 inch in a length of 16 feet measured longitudinally shall be corrected by loosening, adding or removing material, and by reshaping and recompacting. All irregularities, depressions or weak spots shall be corrected immediately by scarifying the areas affected, adding suitable material as required, and by reshaping and recompacting. Should the lift, due to any reason or cause, lose the required stability, density and/or finish before the surfacing is complete, it shall be recompacted and refinished at the Contractor's expense.

C. Succeeding Lifts:

Construction methods for succeeding lifts shall be the same as prescribed for the first lift. For that lift of the recycled concrete flexible base upon which the curb and gutter will be constructed, as well as the last recycled concrete flexible base lift (i.e. top of the recycled concrete flexible base), the Contractor shall check the surface of the lift for conformity to the lines and grades by setting "blue tops" at intervals not exceeding 50 feet on the centerline, at 1/4 points, at curb lines or edge of pavement, and at other points that may be indicated on the Drawings.

When the thickness of a particular lift of the flexible base is in question, the Contractor shall check the surface of the lift for conformity to the lines and grades by setting "blue tops" at intervals not exceeding 50 feet on the centerline, at 1/4 points, at curb lines or edge of pavement, and at other points that may be indicated on the Drawings

D. Density:

The recycled concrete flexible base shall be compacted to not less than 100 percent density as determined by TxDOT Test Method Tex-113-E.

Field density determination shall be made in accordance with TxDOT Test Method Tex-115-E unless otherwise approved by the Engineer or designated representative. Each lift of the recycled concrete flexible base shall also be tested by proof rolling in conformity with Standard Specification Item 236S "Proof Rolling."

E. Priming:

Because of its high absorptive properties, the recycled concrete material can potentially lose strength if not protected from subsequent moisture addition. Consequently, after the recycled concrete flexible base material has been compacted to not less than 100 percent density, and tested by proof rolling, a prime coat will be applied in accordance with Standard Specification Item 306S, "Prime Coat."

F. Curing:

Pavement materials, such as a tack coat or surface course, shall not be placed on the primed surface until the prime coat has been absorbed into the recycled concrete base course. At least 24 hours, or longer if designated by the Engineer or designated representative, shall be allowed when cutback asphalt is used as the prime coat.

## 212S.6 - Measurement

"Recycled Concrete Flexible Base" will be measured by the cubic yard complete in place, as indicated in the Contract Documents.

212S.7 - Payment

This item will be paid for at the contract unit bid price for "Recycled Concrete Flexible Base". The unit bid price shall include full compensation for all work specified herein, including the furnishing, hauling, placing and compacting of all materials; for rolling, proof rolling, recompacting and refinishing; for all water required; for retesting as necessary; for priming; and for all equipment, tools, labor and incidentals necessary to complete the Work.

Prime coat will not be measured or paid for directly but shall be included in the unit price bid for Standard Specification Item 212S, "Recycled Concrete Flexible Base."

Payment will be made under one of the following:

<b>Pay Item No. 212S-A:</b>	Recycled Concrete Flexible Base	Per Cubic Yard.
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END

## ITEM NO. 220S - SPRINKLING FOR DUST CONTROL

### 220S.1 - Description

This item shall govern the authorized application of water for dust control on specified streets, detours, haul routes or construction sites, as shown on the Drawings or directed by the Engineer or designated representative, for the purpose of maintaining these areas relatively free of dust.

### 220S.2 - Submittals

The submittal requirements of this specification item include

- A. The manufacturer, model and description of the proposed dust control equipment,
- B. The sprinkling plan including application rate, pattern of sprinkling and scheduled times of application.

### 220S.3 - Materials

Water shall be furnished by the Contractor and shall be clean and free from industrial wastes and other objectionable matter.

### 220S.4 - Construction Methods

Dust control shall only be conducted when directed by the Engineer or designated representative. The Contractor shall furnish and operate an approved sprinkler, equipped with positive and rapidly working cut-off valves and approved spray bars to ensure the distribution of water in a uniform and controllable rate of application over the entire width sprinkled. The Contractor shall apply the water in the quantity specified on the Drawings or as directed by the Engineer or designated representative.

It shall be the Contractor's continuous responsibility at all times, including nights, holidays and weekends until acceptance of the project by the City, to maintain the specified areas relatively free of dust in a manner that will cause the least inconvenience to the public.

### 220S.5 - Measurement

Sprinkling for dust control will be included in the unit price bid for other items of the contract unless included as a separate pay item in the contract. When included for payment in the contract as a separate contract pay item, it will be measured in units of 1,000 gallons actually placed as authorized by the Engineer or designated representative.

### 220S.6 - Payment

When this item is specified on the Drawings as a separate pay item, the water furnished and the work performed as prescribed by this item and measured as provided under Section 220S.5, "Measurement" will be paid for in accordance with the contract unit bid price for 'Sprinkling for Dust Control'. The unit bid price shall include total compensation for all labor, materials, tools, machinery, equipment and incidentals necessary to complete the work as indicated on the Drawings.



Payment, when specified in the contract, will be made under the following:

<b>Pay Item No. 220S-A:</b>	Sprinkling for Dust Control (Water) -	Per 1000 gallon Unit.
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**END**

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## ITEM NO. 230S - ROLLING (FLAT WHEEL)

### 230S.1 - Description

This item shall govern compaction of subgrade, embankment, flexible base, surface treatments and asphalt surfaces by the operation of approved power rollers as herein specified and as directed by the Engineer or designated representative.

### 230S.2 - Submittals

The submittal requirements of this specification item may include:

- A. A plan describing the condition of each roller proposed for the work, as well as the type, size, weight, configuration (three wheel, tandem, etc) for each individual roller, and
- B. The operating speed proposed for each individual roller.

### 230S.3 - Equipment

#### A. Embankments and Flexible Bases

Power rollers shall be of the 3-wheel, self-propelled type, weighing not less than 10 tons and shall provide compression on the rear wheels of not less than 325 pounds per linear inch of wheel width. All wheels shall be flat. The rear wheels shall have a diameter of not less than 48 inches and each shall have a wheel width of not less than 20 inches.

#### B. Surface Treatments and Pavements

Power rollers shall be the 3-wheel or tandem, self-propelled type, weighing not less than 3 tons nor more than 6 tons. All wheels shall be flat. Rollers shall be equipped with an adequate scraping or cleaning device on each wheel. Rollers used to compact asphalt mixture shall be equipped with a water system, which will keep all tires uniformly wet.

In lieu of the rolling equipment specified, the Contractor may, upon written permission from the Engineer or designated representative, operate other compacting equipment that will produce equivalent relative compaction in the same period of time as the specified equipment. If the substituted compaction equipment fails to produce the desired compaction within the same period of time as would be expected of the specified equipment, as determined by the Engineer or designated representative, its use shall be discontinued and the Contractor will be required to furnish the specified equipment.

Rollers shall be maintained in good repair and operating condition and shall be approved by the Engineer or designated representative.

### 230S.4 - Construction Methods

This work shall only be conducted at the direction of the Engineer or designated representative. A sufficient number of rollers shall be provided to compact the material in a satisfactory manner. When operations are isolated and a single roller unit cannot produce the required compaction satisfactorily, additional roller units shall be provided.

#### A. Subgrades, Embankments and Flexible Base

The subgrade, embankment layer or base course shall be sprinkled, if required by Standard Specification Item Nos. 201S, "Subgrade Preparation" and 210S, "Flexible Base". Rolling with a power roller shall start longitudinally at the sides of the designated area and proceed towards the center, overlapping on successive trips by at least 1/2 the width of the rear wheel of the power roller. On superelevated curves, rolling shall begin at the low sides and progress toward the high sides. Alternate trips of the roller shall be slightly different in length. Rolling shall be conducted in accordance with Standard Specification Item Nos. 201S, "Subgrade Preparation" and 210S, "Flexible Base". The rollers, unless otherwise directed by the Engineer or designated representative, shall be operated at a speed between 2 and 3 miles per hour.

**B. Surface Treatments and Pavements**

Rolling shall be done as called for in the surface treatment (Items 310S "Emulsified Asphalt Treatment" and 320S "Two Course Surface Treatment") and asphalt pavement (Item 340S "Hot Mix Asphaltic Concrete Pavement") Standard Specification Items. The sequence of work shall be as specified above for embankment layer or base course. The operating speed shall be determined by the Contractor and approved by the Engineer or designated representative.

**230S.5 - Measurement and Payment**

Compensation will not be allowed for materials, equipment or labor required by this item, but shall be included in the unit price bid for the item of construction in which this item is used.

**END**

## ITEM NO. 232S - ROLLING (PNEUMATIC TIRE)

### 232S.1 - Description

This item shall govern compaction of embankment, flexible base, surface treatments or pavements by the operation of approved pneumatic tire rollers as herein specified and as directed by the Engineer or designated representative.

### 232S.2 - Submittals

The submittal requirements of this specification item may include:

- A. A plan describing the condition of each roller proposed for the work, as well as the type of traction (self-propelled or drawn), Type, size, weight, tire pressure and configuration for each individual roller, and
- B. The operating speed proposed for each individual roller.

### 232S.3 - Equipment

#### A. General Requirements

When used on seal coats, asphaltic surface treatments and bituminous mixture pavements, the roller shall be self-propelled and equipped with smooth tread tires whether "Rolling (Light Pneumatic Tire)" or "Rolling (Medium Pneumatic Tire)" is specified on the Drawings. The roller shall be so constructed as to be capable of being operated in both a forward and a reverse direction. When used on bituminous mixture pavements, the roller shall have suitable provisions for moistening the surface of the tires while operating.

When turning is impractical or detrimental to the work and when specifically directed by the Engineer or designated representative, the roller shall be capable of being operated in a forward or backward motion.

In lieu of the rolling equipment specified, the Contractor may, upon written permission of the Engineer or designated representative, operate other compacting equipment that will produce equivalent relative compaction in the same period of time as the specified equipment. If the substituted compaction equipment fails to produce the desired compaction within the same period of time as would be expected of the specified equipment, as determined by the Engineer or designated representative, its use shall be discontinued and the Contractor will be required to furnish the specified equipment.

Rollers shall be maintained in good repair and operating condition and shall be approved by the Engineer or designated representative.

Tire pressure is critical to successful operation of the roller. The Contractor shall have equipment on the construction site to inflate tires as required.

#### B. Light Pneumatic Tire Roller

The light pneumatic tire roller shall consist of not less than 9 pneumatic tired wheels, running on axles in such manner that the rear group of tires will cover the entire gap between adjacent tires of the forward group and mounted in a rigid frame and provided with a loading platform or body

suitable for ballast loading. The front axle shall be attached to the frame in such a manner that the roller may be turned within a minimum circle. The pneumatic tire roller, under working conditions, shall have an effective rolling width of approximately 60 inches and shall be so designed that by ballast loading, the total load may be varied uniformly from 9,000 pounds or less to 18,000 pounds or more. The roller shall be equipped with tires that will afford ground contact pressures to 45 pounds per square inch or more. The operating load and tire air pressure shall be within the range of the manufacturer's chart or tabulations showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loadings for the particular tires furnished. The roller under working conditions shall provide a uniform compression under all wheels. Individual tire inflation pressures shall be within + 5 psi of each other. The pneumatic tire roller shall be drawn by a suitable crawler type tractor, a pneumatic tired tractor, a truck of adequate tractive effort or may be of the self-propelled type. The roller, when drawn or propelled by either type of equipment, shall be considered a light pneumatic tire roller unit.

C. Medium Pneumatic Tire Roller (Type A)

The medium pneumatic tire roller (Type A) shall consist of not less than 7 pneumatic tired wheels, running on axles in such manner that the rear group of tires will cover the entire gap between adjacent tires of the forward group and mounted in a rigid frame and provided with a loading platform or body suitable for ballast loading. The front axle shall be attached to the frame in such a manner that the roller may be turned within a minimum circle. The pneumatic tire roller, under working conditions, shall have an effective rolling width of approximately 84 inches and shall be so designed that, by ballast loading, the total load may be varied uniformly from 23,500 pounds or less to 50,000 pounds or more. The roller shall be equipped with tires that will afford ground contact pressures of 80 pounds per square inch or more. The operating load and tire air pressure shall be within the range of the manufacturer's chart. The roller under working conditions shall provide a uniform compression under all wheels. Individual tire inflation pressures shall be within + 5 psi of each other.

The pneumatic tire roller shall be drawn by a suitable crawler type tractor, a pneumatic tired tractor, a truck of adequate tractive effort or may be of the self-propelled type. The roller, when drawn or propelled by any type of equipment, shall be considered a medium pneumatic tire roller unit. The power unit shall have adequate tractive effort to properly move the operating roller at variable uniform speeds up to approximately 5 miles per hour.

D. Medium Pneumatic Tire Roller (Type B)

The medium pneumatic tire roller (Type B) shall conform to the requirements for Medium Pneumatic Tire Roller (Type A) as specified above, except that the roller shall be equipped with tires that will afford ground contact pressures to 90 psi or more.

#### 232S.4 - Construction Methods

The embankment layer or the base course shall be sprinkled in accordance with Standard Specification Item Nos. 201S, "Subgrade Preparation" and 210S, "Flexible Base". Rolling with a pneumatic tire roller shall start longitudinally at the sides of the designated area and shall proceed towards the center, overlapping on successive trips by at least 1/2 of the width of the pneumatic tire roller. On superelevated curves, rolling shall begin at the low sides and progress toward the high sides. Alternate trips of the roller shall be slightly different in length.

The light pneumatic tire roller shall be operated at speeds, which shall be between 3 and 11 miles per hour for asphalt surfacing work and between 2 and 6 miles per hour for all other work.

The medium pneumatic tire roller shall be operated at speeds as directed by the Engineer or designated representative, which produce a satisfactory product.

Sufficient rollers shall be provided to compact the material in a satisfactory manner. When operations are so isolated from one another that 1 roller unit cannot produce the required compaction satisfactorily, additional roller units shall be provided.

#### 232S.5 - Measurement and Payment

Compensation will not be allowed for materials, equipment or labor required by this item. These items shall be included in the unit price bid for the item of construction in which this item is used.

**END**

## ITEM NO. 234S - ROLLING (TAMPING)

### 234S.1 - Description

This item shall govern compaction of embankment, lime-treated subgrade or other courses by the operation of approved tamping rollers as herein specified and as directed by the Engineer or designated representative.

### 234S.2 - Submittals

The submittal requirements of this specification item may include:

- A. A plan describing the condition of each roller proposed for the work, as well as the type of traction (self-propelled or drawn), Type of roller, size, weight, and configuration of each individual tamping roller, and
- B. The operating speed proposed for each individual tamping roller.

### 234S.3 - Equipment

The tamping rollers shall consist of 2 metal rollers, drums or shells of 40 inches minimum diameter; each not less than 42 inches in length. The drums shall be unit mounted in a rigid frame in such a manner that each roller may oscillate independently of the other.

Each roller, drum or shell shall be surmounted by metal studs with tamping feet projecting not less than 7 inches from the surface and spaced not less than 6 inches nor more than 10 inches, measured diagonally center to center and the cross-sectional area of each tamping foot, measured perpendicularly to the axis of the stud, shall not be less than 5 nor more than 8 square inches. The roller shall be supplemented with cleaning teeth to provide self-cleaning.

The roller shall be so designed that, by ballast loading, the load on each tamping foot may be varied uniformly from 125 to 550 psi of cross-sectional area. The load per tamping foot will be determined by dividing the total weight of the roller by the number of tamping feet in 1 row parallel to or approximately parallel to the axis of the roller. The compression to be provided at any time shall be as directed by the Engineer or designated representative.

The tamping roller shall be drawn by suitable power equipment of adequate tractive effort. Two tamping rollers, consisting of 4 cylinders, conforming to the above prescribed requirements, drawn by approved power equipment, shall be considered a roller unit.

Where turning is impractical or detrimental to the work and when specifically directed by the Engineer or designated representative, the roller shall be capable of being operated in a forward and backward direction. When operations are confined to narrow widths and when specifically directed in writing by the Engineer or designated representative, 1 tamping roller consisting of 2 cylinders, fastened to the front end of approved power equipment shall be considered a roller unit.

In lieu of the rolling equipment specified, the Contractor may, upon written permission from the Engineer or designated representative, operate other compacting equipment that will produce equivalent relative compaction in the same period of time as the specified equipment. If the substituted compaction equipment fails to produce the desired compaction within the same period of time as would be expected of the specified equipment, as determined by the Engineer or designated representative, its use shall be discontinued and the Contractor will be required to furnish the specified equipment.

Rollers shall be maintained in good repair and operating condition and shall be approved by the Engineer or designated representative.

#### 234S.4 - Construction Methods

The embankment layer, subbase or the base course shall be sprinkled in accordance with Standard Specification Item Nos. 201S, "Subgrade Preparation" and 203, "Lime Treatment for Materials In Place". Rolling with a tamping roller unit shall start longitudinally at the sides of the designated area and proceed toward the center, overlapping on successive trips by at least 1/2 of the width of the tamping roller unit. On superelevated curves, rolling shall begin at the low sides and progress toward the high sides. Alternate trips of the unit shall be slightly different in length. The tamping roller unit, unless otherwise directed by the Engineer or designated representative, shall be operated at a speed between 2 and 3 miles per hour.

Sufficient rollers shall be provided to compact the material in a satisfactory manner. When operations are so isolated from one another that one roller cannot perform the required compaction satisfactorily, additional rollers shall be provided and operated as directed by the Engineer.

#### 234S.5 - Measurement and Payment

No additional payment will be made for the materials, equipment or labor required by this item, but shall be included in the unit price bid for the item of construction in which this item is used.

**END**



## ITEM NO. 236S - PROOF ROLLING

### 236S.1 - Description

This item shall govern furnishing and operating heavy pneumatic tired compaction equipment for locating unstable areas of embankment, subgrade and flexible base courses.

### 236S.2 - Submittals

The submittal requirements of this specification item may include:

- A. A plan describing the condition of each roller proposed for the work, as well as the type of traction (self-propelled or drawn), Type of roller, size, weight, tire pressure (if appropriate) and configuration of each individual roller, and
- B. The operating speed proposed for each individual roller.

### 236S.3 - Equipment

#### A. Standard Proof Roller:

The proof rolling equipment shall have a loading platform or body suitable for ballast loading that is supported on a minimum of two (2) axles with not more than two (2) pneumatic tired wheels per axle. All wheels shall be arranged so that they will carry approximately equal loads when operating on uneven surfaces. Pneumatic proof rolling equipment with multiple pivotal axles and more than two tires along the front or rear axle axis shall have articulating axle supports to equally distribute the load to all tires over uneven surfaces.

The proof roller unit, under working conditions, shall have a minimum contact width of 7½ feet and shall be so designed that the gross roller weight may be varied uniformly from 25 tons to 50 tons by ballast loading. The tires shall be capable of operating under various loads with variable air pressures up to 145 psi. The tires shall be smooth tread and shall impart a minimum ground contact pressure of 75 pounds per square inch. Tires shall be practically full of liquid (i.e. when liquid will flow from the valve stem of a fully inflated tire with the stem in the uppermost position). The operating load and tire pressure shall be within the range of the manufacturer's chart as directed by the Engineer or designated representative.

The proof roller shall be drawn by a power train of adequate tractive effort or may be of a self-propelled type. The proof rolling equipment shall be equipped with a reverse mode transmission or be capable of turning 180 degrees in the street width. When a separate power train is used to draw the proof roller, the power train weight shall not be considered in the weight of the proof roller. The power train shall be rubber-tired when rolling subgrade and base materials. A cleated or track-type power train may be used on earth and rock embankments.

#### B. Alternate Equipment:

With the written approval of the Engineer or designated representative, the Contractor may utilize alternate equipment on embankment courses, subgrade and base courses subject to the requirements of the standard proof roller except with respect to minimum contact width, axle/tire arrangement and tire tread.

Alternate equipment for stability testing of embankments shall be restricted to equipment that can be shown to impart a stress distribution on the embankment structure equivalent to or greater than the stress induced by the concentrated weight of a standard proof roller.

C. Equipment Submittals:

All standard proof rollers and proposed alternate equipment must be approved by the Engineer or designated representative prior to their use. The Contractor shall furnish the Engineer or designated representative with charts or tabulations showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loadings for the particular tires furnished.

Alternate equipment submittals for proof rolling of embankments shall be signed and sealed by a registered Professional Engineer licensed in the State of Texas.

236S.4 - Construction Methods

A. General:

Within the ranges set forth in Section 236S.3, the load and tire inflation pressures shall be adjusted as directed by the Engineer or designated representative. It is proposed to use a contact pressure corresponding as nearly as practical to the maximum supporting value of the earthwork or base. The entirety of prepared surfaces to be tested by this method shall be proof rolled by a minimum of two passes of the proof roller tires. Each succeeding trip of the proof roller shall be offset by not greater than one tire width.

When alternate equipment is proposed and only one axle meets minimum requirements, only the qualifying axle shall be used to proof roll. If the operation of the proof roller shows an area to be unstable, the substandard area shall be brought to satisfactory stability and uniformity by additional curing, compaction, or by removal and replacement of unsuitable materials. The re-worked area shall then be proof rolled.

Proof rollers shall be operated at speeds between 2 and 6 miles per hour or as directed by the Engineer or designated representative.

Acceptable limits of elastic and plastic deformation of prepared subgrade courses shall be established by proof rolling Test Sections of representative soil conditions, previously tested and approved for density and moisture requirements of the governing subgrade and earth embankment items. Proof rolling of first course base over a plastic subgrade may be waived by the Engineer or designated representative if it is determined that the prepared first course base will be damaged by the proof roller.

B. Roadway Construction:

The subgrade and all lifts of base material shall be proof rolled in new roadway construction and in the reconstruction of existing streets. Proof rolling of the curb course base may be substituted for proof rolling of final course base at the direction of the Engineer or designated representative. Proof rolling may be waived by the Engineer or designated representative where construction is limited to turn lanes, street widening less than 7½ feet in width, or where the site is otherwise congested.

C. Trenches:

Trenches shall be proof rolled where no limitations to the operation of the proof roller exist as may be determined by the Engineer subject to the provisions hereunder.

All trenches shall be proof rolled in new roadways or in existing roadways under reconstruction. Trenches shall be proof rolled at the street subgrade elevation by longitudinal and perpendicular passes of the roller as may be dictated by the width of the trench.

Proof rolling of trenches in existing paved streets shall be limited to pavement cross-sections capable of sustaining the weight of the proof rolling equipment without imparting damage to the remaining pavement structure as determined by the Engineer. Trenches less than 4 feet in width shall be exempted of all proof rolling requirements. Only the final course base shall be proof rolled in trenches 4 feet or wider but narrower than the proof roller contact width. The subgrade, the first course and the final course base shall be proof rolled in trenches 7½ feet or wider.

D. Embankment Construction:

All embankment courses shall be proof rolled, unless otherwise directed by the Engineer or designated representative.

If required by the Engineer or designated representative, stability testing of embankments constructed to the finished cross-section and elevation or to interim elevations shall either be conducted with a standard proof roller or alternate equipment, which can be proven to impart a horizontal and vertical pressure distributions equivalent to or greater than those induced by a standard proof roller.

236S.5 - Measurement and Payment

No direct payment will be made for the materials, equipment or labor required by this item, but shall be included in the unit price bid for the item of construction in which this item is used.

**END**

## ITEM NO. 281S - TERMITE CONTROL

### 281S.1 - Description

This item shall govern soil treatment below slabs-on-grade and at foundation perimeter for subterranean insects. The lines and grades shall not be disturbed without approval of the Engineer or designated representative.

### 281S.2 - Submittals

The submittal requirements shall include:

- A. A listing of each proposed application (i.e. slab on grade, foundation walls, utilities, etc.) of a toxicant chemical.
- B. Specific information for each chemical toxicant in the listing including:
  1. Manufacturer, product name and description of chemical composition,
  2. Handling, storage and mixing requirements,
  3. Application recommendations, retreatment procedures, and
  4. MSDS Sheets.
- C. Warning sign information including Description, legend and areas of application.

### 281S.3 - Materials

#### A. Toxicant Chemical

The toxicant chemical shall be a water-based emulsion of uniform composition with a synthetic dye to permit visual identification of the treated soil.

#### B. Acceptable Products

1. Pryfon 6
2. Dursban TC
3. Tribute
4. Dragnet
5. Demon

The toxicant chemical shall be diluted with water to yield the manufacturer's recommended concentration.

## 281S.4 - Construction Methods

### A. Inspection

The inspection shall verify that the soil surfaces are not frozen, surface dry sufficiently to absorb toxicant and ready to receive the treatment.

### B. Application

The user shall acquire and review the current Material Safety Data Sheet (MSDS), for warnings and precautions, and shall follow the directions in the use of the product and disposal of all containers after use. The user shall apply the toxicant chemical with a low-pressure spray (less than 50 psi) consistent with the manufacturer's recommendations. The diluted toxicant solution shall be applied using a metered applicator to the soil in the following locations at the rates recommended by the manufacturer:

1. Under floor slabs-on-grade
2. Both sides of foundation wall.
3. Soil within 10 feet of building perimeter for a depth of 1 foot.
4. Expansion joints.
5. Utility entrances.
6. Critical locations such as where utilities pass through exterior walls and through floor slabs.

The diluted toxicant solution shall be applied immediately prior to installation of vapor barrier under slabs-on-grade or finish grading outside foundation walls.

Extra treatment shall be applied in a coarse spray to ensure uniform distribution to structure penetrations, pipe ducts and other soil penetrations. Any treated soil that is disturbed shall be retreated.

### C. Directions For Use

The user shall become fully informed of the recommended precautions in the handling and storage of the chemical toxicant, as well as the directions for use of the toxicant chemical as listed on the current MSDS and in conformance with the Uniform Fire Code, Article 86, Pesticide Storage and Display. Signs warning workers that soil poisoning has been applied shall be posted in areas of application. The signs shall be removed once the areas are covered by other construction.

### D. Retreatment

If inspection identifies the presence of termites, the soil shall be retreated and subsequently retested. The retreatment toxicant shall be the same as the original toxicant treatment.

## 281S.5 - Measurement

Accepted work performed as prescribed by this item will be measured by the square foot of treated area for "Termite Control".

281S.6 - Payment

The work performed as prescribed by this item will be paid for at the unit bid price per square foot of treated area for "Termite Control". The unit bid price shall include full compensation for furnishing chemicals and application of solution on the prepared subgrade.

Payment, when included as a pay item, will be made under:

<b>Pay Item No. 281S-A:</b>	Termite Control	Per Square Foot
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**END**

SERIES 300 - STREET SURFACE COURSES

ITEM NO. 301S - ASPHALTS, OILS, AND EMULSIONS

301S.1 - Description

This item includes the requirements for cutback asphalts, emulsified asphalts, polymer modified asphalt cements, performance graded asphalt binders and other miscellaneous asphaltic materials and latex additives.

301S.2 - Submittals

Submittals shall include test results for each the materials described herein when specifically identified on the drawings and/or referenced in associated standard specification items and standard details.

Submittals may include samples of the base asphalt cement and polymer additives.

301S.3 - Materials

When tested in accordance with designated TxDOT, AASHTO and/or ASTM test methods, the various materials shall meet the applicable requirements of this specification.

A. Acronyms

The acronyms used in this specification are defined in the following table.

**Table 1: Acronyms**

Acronym	Definition	Acronym	Definition
Test Method Prefix		Polymer Modifier	
Tex	TxDOT	SBR or L	Styrene-Butadiene Rubber (Latex)
T	AASHTO	SBS	Styrene-Butadiene-Styrene Block Copolymer
D	ASTM	TR	Tire Rubber, from ambient temperature grinding of truck and passenger tires
		P	Polymer Modified
AC	Asphalt Cement	SS	Slow Setting
RC	Rapid Curing	H-suffix	Harder Residue (Lower Penetration)
MC	Medium Curing	AE	Asphalt Emulsion

Acronym	Definition	Acronym	Definition
SCM	Special Cutback Material	S-suffix	Stockpile Usage
HF	High Float	AE-P	Asphalt Emulsion Prime
C	Cationic	EAP&T	Emulsified Asphalt Prime and Tack
RS	Rapid Setting	PCE	Prime, Cure, and Erosion Control
MS	Medium Setting	PG	Performance Grade

#### B. Asphalt Cement

The material shall be homogeneous, free from water, shall not foam when heated to 350°F and shall meet the requirements in Table 2.

**Table 2: Asphalt Cement Requirements**

Viscosity Grade		AC-10		AC-20		AC-30	
Property	Test Method	Min	Max	Min	Max	Min	Max
Viscosity: 140°F, poises	T 202	800	1200	1600	2400	2400	3600
Viscosity: 275°F, stokes	T 202	1.9	-	2.5	-	3.0	-
Penetration: 77°F, 100g, 5 sec.	T 49	85	-	55	-	45	-
Flash Point, C.O.C. °F	T 48	450	-	450	-	450	-
% Solubility trichloroethylene	T44	99.0	-	99.0	-	99.0	-
Spot test	Tex 509-C						
Viscosity: 140°F stokes	T 202	-	3000	-	6000	-	9000
Ductility 77°F, 5 cm/min, cm	T 202	100	-	70	-	50	-



C. Polymer Modified Asphalt Cement

Polymer modified asphalt cement must be smooth, homogeneous, and shall comply with the requirements listed in Table 3.

**Table 3: Polymer Modified Asphalt Cement Requirements**

Polymer Modified Viscosity Grade		AC-5		AC-10		AC-15P		AC-45P*	
Polymer Type		SBR		SBR		SBS		SBS	
Property	Test Method	Min	Max	Min	Max	Min	Max	Min	Max
Polymer in % (solids basis)	Tex-533-C	2.0	-	2.0	-	3.0	-	3.0	-
Viscosity									
140°F, poise	T 202	700	-	1300	-	1500	-	4500	-
275°F, poise	T 202	-	7.0	-	8.0	-	8.0	14.0	
Penetration, 77°F, 100 g, 5 sec.	T 49	120	-	80	-	100	150	50	74
Ductility, 5cm/min., 39.2°F, cm	T 51	70	-	60	-	-	-	15	-
Elastic Recovery, 50°F, %	Tex-539-C	-	-	-	-	55	-	-	-
Polymer Separation, 48 hrs**.	Tex-540-C	None		None		None		None	
Flash Point, C.O.C., °F,	T 48	425	-	425	-	425	-	425	-
Tests on Residue from Thin Film Oven Test: (T179)									
Retained Penetration Ratio, 77°F, % original	T 49	-	-	-	-	0.60	1.00	0.60	0.90

\* The SBS block copolymer may be pre-blended with a polymer processing oil (up to a 1:1 ratio of polymer to oil) to aid the solution of the polymer in the asphalt.

\*\* A 0.77 pound sample of the asphalt-SBS blend is stored for 48 hours at 325°F. Upon completion of the storage time, the sample is visually examined for separation of the SBS from the asphalt (smoothness and homogeneity). If a question still exists about the separation of the SBS, samples shall be taken from the top and bottom of the sample for Infrared Spectroscopy

analysis. A difference of 0.4% or more in the concentration of the SBS between the top and bottom samples shall constitute separation.

D. Cutback Asphalt

Cutback asphalt shall meet the requirements presented in Tables 4 and 5 for the specified type and grade.

**Table 4: Rapid Curing Type Cutback Asphalt Requirements**

Type-Grade		RC-250		RC-800		RC-3000	
Properties	Test Method	Min	Max	Min	Max	Min	Max
Water, percent	T55	-	0.2	-	0.2	-	0.2
Flash Point, T.O.C., °F	T79	80	-	80	-	80	-
Kinematic viscosity @ 140°F, cSt	T201	250	400	800	1600	3000	6000
Distillation Test:	T78						
Distillate, % by volume of total distillate to 680°F:							
to 437°F:		40	75	35	70	20	55
to 500°F:		65	90	55	85	45	75
to 600°F:		85	-	80	-	70	-
Residue from Distillation, Volume %		70	-	75	-	82	-
Tests of Distillation Residue:							
Penetration, 100g, 5 sec., 77°F, cm	T49	80	120	80	120	80	120
Ductility, 5 cm/min., 77°F, 5 cm/min., cm	T51	100	-	100	-	100	-
Solubility in trichloroethylene, %	T44	99.0	-	99.0	-	99.0	-
Spot Test	Tex 509-C	ALL NEGATIVE					

**Table 5: Medium Curing Type Cutback Asphalt Requirements**

Type		MC-30		MC-70		MC-250		MC-800		MC-3000	
Properties	Test Method	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Water, %	T55	-	0.2	-	0.2	-	0.2	-	0.2	-	0.2
Flash Point, T.O.C., °F	T79	100	-	100	-	150	-	150	-	150	-
Kinematic viscosity. @ 140°F. cst	T201	30	60	70	140	250	500	800	1600	3000	6000
Distillation Test:	T78										
Distillate, as % by volume to total distillate to 680°F shall be as follows:											
to 437°F:		-	25	-	20	-	10	-	-	-	-
to 500°F:		40	70	20	60	15	55	-	35	-	15
to 600°F:		75	93	65	90	60	87	45	80	15	≥75
Residue from 80°F distillation											
Volume Percent		50	-	55	-	67	-	75	-	80	-
Tests on Distillation Residue:											
Penetration	T49	120	250	120	250	120	250	120	250	120	250
@77°F, 100g, sec., 01 mm:											
Ductility	T51										
@ 77°F, 5 cm/min, cms		100*	-	100*	-	100*	-	100*	-	100*	-
% Solubility in trichloroethylene	T44	99.0	-	99.0	-	99.0	-	99.0	-	99.0	-
Spot Test	Tex 509-C	ALL NEGATIVE									

\* If penetration of residue is more than 200 and the ductility at 77°F is less than 100 cm, the material will be acceptable if its ductility at 60°F is more than 100cm.

E. Emulsified Asphalt

The material shall be homogenous. It shall show no separation of asphalt after thorough mixing and shall meet the requirements for the specified type and grade presented in Tables 6, 7 and 8.

**Table 6: Anionic Emulsion Requirements**

	Type	Medium Setting		Slow Setting			
	Grade	MS-2		SS-1		SS-1h	
Property	Test Method	Min	Max	Min	Max	Min	Max
Furol Viscosity @ 77°F, sec.	T72	-	-	20	100	30	100
@ 122°F, sec		100	300	-	-	-	-
Sieve Test, %.	T59	-	0.1	-	0.1	-	0.1
Miscibility (Standard Test)	T59	-	-	Passing		Passing	
Cement Mixing, %	T59	-	-	-	2.0	-	2.0
% Demulsibility: 35 cc 0.02N CaCl <sub>2</sub>	T59	-	30	-	-	-	-
Storage Stability 1 day, %	T59	-	1	-	1	-	1
Freezing Test, 3 Cycles*	T59	Passing		Passing	Passing		
Distillation Test	T59						
Distillation Residue, %		65	-	60	-	60	-
Distillate Oil Portion, %		-	½	-	½	-	½
Tests of Residue from Distillation:							
Penetration @ 77°F, 100g, 5 sec.	T49	120	160	120	160	70	100
Solubility in Trichloroethylene, %	T44	97.5	-	97.5	-	97.5	-
Ductility @ 77F, 5 cm/min., cm	T51	100	-	100	-	80	-

\* Applies only when Engineer or designated representative specifies the material for winter use.

**Table 7: High Float anionic Emulsion Requirements**

	Type	Rapid Setting		Medium Setting	
	Grade	HFRS-2		AES-300	
Property	Test Method	Min	Max	Min	Max
Viscosity, Saybolt Furol	T72				
@ 77°F, sec.		-	-	75	400
@ 122°F, sec.		150	400	-	-
Oil Portion of Distillate, %	T59	-	2	-	7
Sieve Test, %	T59	-	0.1	-	0.1
Particle Charge	T59	positive		positive	
Coating Ability and Water Resistance:	T59				
Coating, dry aggregate		-	-	good	
Coating, after spraying		-	-	fair	
Coating, wet aggregate				fair	
Coating, after spraying				fair	
% Demulsibility: 35 ml 0.02 N CaCl <sub>2</sub>	T59	50	-	-	-
Storage Stability Test, 1 day, %	T59	-	1	-	1
Distillation Test	T59				
Residue by Distillation, % by weight		65	-	65	-
Oil Distillate, by volume of emulsion, %		-	1/2	-	5
Tests on Residue from Distillation:					
Penetration at 77°F, 100g, 5 sec.	T49	100	140	300	-

Solubility in Trichloroethylene, %	T44	97.5	-	97.5	-
Ductility @ 77°F., 5 cm/min, cms	T51	100	-	-	-
Float Test at 140°F, sec.	Tex 509-C	1200	-	1200	-

**Table 8: Cationic Emulsion Requirements**

Property	Type	Rapid Setting				Medium Setting				Slow Setting			
	Grade	CRS-2		CRS-2h		CMS-2		CMS-2s		CSS-1		CSS-1h	
Property	Test Method	Min	Max	Min	Max	Min.	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T72												
@ 77°F, sec.		-	-	-	-	-	-	-	-	20	100	20	100
@ 122°F, sec.		150	400	150	400	100	300	100	300	-	-	-	-
Storage stability test, 1 day %	T59	-	1	-	1	-	1	-	1	-	1	-	1
% Demulsibility: *, **	T59	40	-	40	-	-	-	-	-	-	-	-	-
Coating, ability & water resistance	T59												
Coating, dry aggregate		-	-	-	-	good	good	-	-	-	-	-	-
Coating, after spraying		-	-	-	-	fair	fair	-	-	-	-	-	-
Coating, wet aggregate		-	-	-	-	fair	fair	-	-	-	-	-	-
Coating, after spraying		-	-	-	-	fair	fair	-	-	-	-	-	-
Particle charge test	T59	Positive		Positive		Positive		Positive		Positive		Positive	
Sieve test, %	T59	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10

	Type	Rapid Setting				Medium Setting				Slow Setting			
	Grade	CRS-2		CRS-2h		CMS-2		CMS-2s		CSS-1		CSS-1h	
Property	Test Method	Min	Max	Min	Max	Min.	Max	Min	Max	Min	Max	Min	Max
Cement Mixing test, %	T59	-	-	-	-	-	-	-	-	-	2.0	-	2.0
Distillation Test:	T59												
% Oil distillate, vol. of emulsion		-	1/2	-	1/2	-	7	-	5	-	1/2	-	1/2
Residue by Distillation,% by wt.		65	-	65	-	65	-	65	-	60	-	60	-
Tests on Residue from Distillation:													
Penetration, 77°F	T49	120	160	80	110	120	200	300	-	120	160	80	110
Ductility,	T51												
77°F, 5 cm/min, cm		100	-	80	-	100	-	-	-	100	-	80	-
% Solubility in trichloroethylene	T44	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-

\* At a level of 35 ml 0.8% sodium dioctyl sulfosuccinate.

\*\* The demulsibility test shall be made within 30 days from date of shipment.

#### F. Polymer Modified Emulsions

The material shall be homogenous. It shall show no separation of asphalt after thorough mixing and shall meet the requirements for the specified type and grade presented in Tables 9 and 10.

#### G. Specialty Emulsions

Specialty emulsions may be either asphaltic-based or resin-based and must meet the requirements included in Table 11.

#### H. Recycling Agent

Recycling agent and emulsified recycling agent must meet the requirements of Table 12. Additionally, recycling agent and residue from emulsified recycling agent, when added in the specified proportions to the recycled asphalt, must meet the properties specified on the drawings.

**Table 9: Polymer Modified Emulsified Asphalt Requirements**

Type-Grade	Test Method	Rapid Setting				Medium Setting						Slow Setting	
		RS-1P		HFRS-2P		AES-150P		AES-300P		AES-300S		SS-1P	
Property	Test Method	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72												
77°F, sec.		-	-	-	-	75	400	75	400	75	400	30	100
122°F, sec.		50	200	150	400	-	-	-	-	-	-	-	-
Sieve Test, %	T 59	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1
Miscibility	T 59	-	-	-	-	-	-	-	-	-	-	-	pass
Coating Ability and Water Resistance:	T 59												
dry aggregate/after spray		-	-	-	-	good/fair	good/fair	good/fair	good/fair	good/fair	good/fair	-	-
wet aggregate/after spray		-	-	-	-	fair/fair	fair/fair	fair/fair	fair/fair	fair/fair	fair/fair	-	-
Demulsibility, 35 ml of 0.02 N CaCl <sub>2</sub> , %	T 59	60	-	50	-	-	-	-	-	-	-	-	-
Storage Stability, 1 day, %	T 59	-	1	-	1	-	1	-	1	-	1	-	1
Breaking Index, g	Tex-542-C	-	80	-	-	-	-	-	-	-	-	-	-
Distillation Test: <sup>1</sup>	T 59												
Residue by Distillation, % by wt.		65	-	65	-	65	-	65	-	65	-	60	-
Oil Distillate, % by vol of emulsion		-	3	-	0.5	-	3	-	5	-	7	-	0.5



Type-Grade		Rapid Setting				Medium Setting				Slow Setting			
		RS-1P		HFRS-2P		AES-150P		AES-300P		AES-300S		SS-1P	
Property	Test Method	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Tests: Residue from Distillation:													
Polymer Content, wt. % (solids basis)	Tex-533-C	-	-	3.0	-	-	-	-	-	-	-	3.0	-
Penetration, 77°F, 100 g, 5 sec. ±±	T 49	225	300	90	140	150	300	300	-	300	-	100	140
Solubility in Trichloroethylene, %	T 44	97.0	-	97.0	-	97.0	-	97.0	-	97.0	-	97.0	-
Viscosity, 140&degF, poise 60°C, Pa-s	T 202	-	-	1500	-	-	-	-	-	-	-	1300	-
Float Test, 140°F, sec.	T 50	-	-	1200	-	1200	-	1200	-	1200	-	-	-
Ductility <sup>2</sup> ,													
39.2°F, 5 cm/min., cm	T 51	-	-	50	-	-	-	-	-	-	-	50	-
Elastic Recovery <sup>2</sup> , 50°F,(10°C), %	Tex-539-C	55	-	55	-	-	-	-	-	-	-	-	-
Tests on RTFO Curing of Distillation Residue:													
Elastic Recovery, 50°F,( 10°C), %	Tex-539-C	-	-	-	-	50	-	50	-	30	-	-	-

<sup>1</sup> Exception to AASHTO T 59: Bring the temperature on the lower thermometer slowly to 350°F +/- 10°F. Maintain at this temperature for 20 min. Complete total distillation in 60 +/- 5 min. from the first application of heat.

<sup>2</sup> HFRS-2P must meet one of either the Ductility or Elastic Recovery.

**Table 10: Polymer Modified Cationic Emulsified Asphalt Requirements**

Type-Grade		Rapid Setting				Slow Setting	
		CRS-1P		CRS-2P		CSS-1P	
Property	Test Method	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72	-	-	-	-	20	100
77°F, sec.		50	150	150	400	-	-
122°F, sec.		-	0.1	-	0.1	-	0.1
Sieve Test, %	T 59	60	-	70	-	-	-
Demulsibility, 35 ml of 0.8% sodium dioctyl sulfosuccinate, %	T 59	-	1				
Storage Stability, 1 day, %	T 59	-	1	-	1	-	1
Breaking Index, g	Tex-542-C		80	-	-	-	-
Particle Charge	T 59	positive		positive		positive	
Distillation Test: <sup>1</sup>	T 59	65	-	65	-	62	-
Residue by Distillation, % by wt.							
Oil Distillate, % by volume of emulsion		-	3	-	0.5	-	0.5
Tests on Residue from Distillation:							
Polymer Content, wt. % (solids basis)	Tex-533-C	-	-	3.0	-	3.0	-
Penetration, 77°F, 100 g, 5 sec.	T 49	225	300	90	150	55	90
Viscosity, 140°F, poise	T 202	-	-	1300	-	-	-
Solubility in Trichloroethylene, %	T 44	97.0	-	97.0	-	97.0	-
Softening Point, °F	T 53	-	-	-	-	135	-
Ductility, 77°F, 5 cm/min., cm	T 51	-	-	-	-	70	-
Ductility <sup>2</sup> , 39.2°F, 5 cm/min., cm	T 51	-	-	50	-	-	-
Elastic Recovery <sup>2</sup> , 50°F, %	Tex-539-C	45	-	55	-	-	-

<sup>1</sup> Exception to AASHTO T 59: Bring the temperature on the lower thermometer slowly to 350°F +/- 10°F. Maintain at this temperature for 20 min. Complete total distillation in 60 +/- 5 min. from the first application of heat.

<sup>2</sup> CRS-2P must meet one of either the Ductility or Elastic Recovery.

**Table 11: Specialty Emulsion Requirements**

Type-Grade		Medium Setting				Slow Setting	
		AE-P		EAP&T		PCE <sup>1</sup>	
Property	Test Method	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72						
77°F, sec.		-	-	-	-	10	100
122°F, sec.		15	150	-	-	-	-
Sieve Test, %	T 59	-	0.1	-	0.1	-	0.1
Miscibility <sup>2</sup>	T 59	-		pass		pass	
Demulsibility, 35 ml of 0.10 N CaCl <sub>2</sub> , %	T 59	-	70	-	-	-	-
Storage Stability, 1 day, %	T 59	-	1	-	1	-	-
Particle Size <sup>3</sup> , % by volume ≤ 2.5 m	Tex-238-F	-	-	90	-	-	-
Asphalt Emulsion Distillation to 500°F followed by Cutback Asphalt Distillation of Residue to 680°F:	T 59 & T 78						
Residue after both Distillations, % by wt.		40	-	-	-	-	-
Total Oil Distillate from both distillations, % by volume of emulsion		25	40	-	-	-	-
Distillation:	T 59						
Residue by Distillation, % by wt.		-	-	60	-	-	-
Evaporation:4	T 59						
Residue by Evaporation, % by wt.		-	-	-	-	60	-
Tests on Residue after all Distillation(s):							
Viscosity, 140°F, poise	T 202	-	-	800	-	-	-

Type-Grade		Medium Setting				Slow Setting	
		AE-P		EAP&T		PCE <sup>1</sup>	
Property	Test Method	Min	Max	Min	Max	Min	Max
Kinematic Viscosity, 140°F, cSt	T 201	-	-	-	-	100	350
Flash Point, C.O.C., °F	T 48	-	-	-	-	400	-
Solubility in Trichloroethylene, %	T 44	97.5	-	-	-	-	-
Float Test, 122°F, sec.	T 50	50	200	-	-	-	-

<sup>1</sup> Supply with each shipment of PCE:

- a) a copy of a lab report from an approved analytical lab, signed by a lab official, indicating the PCE formulation does not meet any characteristics of a Resource Conservation Recovery Act (RCRA) hazardous waste;
- b) a certification from the producer that the formulation supplied does not differ from the one tested and that no listed RCRA hazardous wastes or PCB's have been mixed with the product; and
- c) a Materials Safety Data Sheet.

<sup>2</sup> Exception to AASHTO T 59: In dilution, use 350 ml of distilled or deionized water and a 1000-ml beaker.

<sup>3</sup> Tex-238-F, beginning at "Particle Size Analysis by Laser Diffraction," "Procedure" (using - medium: distilled or deionized water and dispersant: none), or other approved method.

<sup>4</sup> Exception to AASHTO T 59: Leave sample in the oven until foaming ceases, then cool and weigh.

**Table 12: Recycling Agent and Emulsified Recycling Agent Requirements**

Property	Test Method	Recycling Agent		Emulsified Recycling Agent	
		Min	Max	Min	Max
Viscosity, Saybolt Furol, 77°F, sec.	T 72	-	-	15	100
Sieve Test, %	T 59	-	-	-	0.1
Miscibility <sup>1</sup>	T 59	-		No Coagulation	

Property	Test Method	Recycling Agent		Emulsified Recycling Agent	
		Min	Max	Min	Max
Evaporation Test: <sup>2</sup>	T 59				
Residue by Evaporation, % by wt.		-	-	60	-
Tests on Recycling Agent or Residue from Evaporation:					
Flash Point, C.O.C., °F	T 48	400	-	400	-
Kinematic Viscosity,	T 201				
140°F, cSt		75	200	75	200
275°F, cSt		-	10.0	-	10.0

<sup>1</sup> Exception to AASHTO T 59: Use 0.02 N CaCl<sub>2</sub> solution in place of water.

<sup>2</sup> Exception to AASHTO T 59: Maintain sample at 300°F until foaming ceases, then cool and weigh.

#### I. Crack Sealer

This section sets forth the requirements for a polymer modified emulsion suitable for sealing fine cracks, and a rubber asphalt compound suitable for sealing cracks of 1/8 inch or greater width.

##### 1. Polymer Modified Asphalt Emulsion Crack Sealer

For cracks on the order of 1/8 inch width, HFRS-2P polymer modified emulsion as described in the table included in Section F, Polymer Modified Emulsions of this item may be used. Requirements for the polymer modified emulsion and rubber-asphalt crack-sealing compound are presented in Table 13.

**Table 13: Polymer Modified Asphalt Emulsion Crack Sealer Requirements**

Property	Test Methods	Min	Max
Rotational Viscosity, 77°F, cP	ASTM D 2196, Method A	10,000	25,000
Sieve Test, %	T 59	-	0.1
Storage Stability, 1 day, %	T 59	-	1
Evaporation	Tex-543-C		

Residue by Evaporation, % by wt.		65	-
<b>Property</b>	<b>Test Methods</b>	<b>Min</b>	<b>Max</b>
Tests on Residue from Evaporation:			
Penetration, 77°F, 100 g, 5 sec.	T 49	35	75
Softening Point, °F	T 53	140	-
Ductility, 39.2°F, 5 cm/min., cm	T 51	100	-

## 2. Rubber-Asphalt Crack Sealing Compound

This specification item may be a proprietary product. The compound shall be capable of being melted and applied at a temperature of 400°F (200°C) or less by a suitable oil jacketed kettle equipped with a pressure pump, a hose and a nozzle. It shall contain no water or highly-volatile matter. It shall not be tracked by vehicular traffic once it cools to road pavement temperature.

The rubber-asphalt crack sealing compound shall meet requirements in Table 14.

**Table 14: Rubber-Asphalt Crack Sealer Requirements**

Property	Test Methods	Class A		Class B	
		Min	Max	Min	Max
CRM Content, Grade A or B, % by wt.	Tex-544-C	22	26	-	-
CRM Content, Grade B, % by wt.	Tex-544-C	-	-	13	17
Virgin Rubber Content <sup>1</sup> , % by wt.		-	-	2	-
Flash Point <sup>2</sup> , COC, °F	T 48	400	-	400	-
Penetration <sup>3</sup> , 77°F, 150g, 5 sec.	T 49	30	50	30	50
Penetration <sup>3</sup> , 32°F, 200g, 60 sec.	T 49	12	-	12	-
Softening Point, °F	T 53	-	-	170	-
Bond <sup>4</sup> , 3 cycles, 20°F	Tex-525-C	-	Pass		

<sup>1</sup> Provide certification that the min. % virgin-rubber was added.

<sup>2</sup> Before passing the test flame over the cup, agitate the sealing compound with a 3/8 to 1/2 in. wide, square-end metal spatula in a manner so as to bring the material on the bottom of the cup

to the surface, i.e., turn the material over. Start at one side of the thermometer, move around to the other, and then return to the starting point using 8 to 10 rapid circular strokes. Accomplish agitation in 3 to 4 sec. Pass the test flame over the cup immediately after stirring is completed.

<sup>3</sup> Exception to AASHTO T 49: Substitute the cone specified in ASTM D 217 for the penetration needle.

<sup>4</sup> No crack in the crack sealing materials or break in the bond between the sealer and the mortar blocks over 1/4 in. deep for any specimen after completion of the test.

a. Properties of Rubber Used in Sealer. The rubber shall be one of the following types;

1) Type I - Ground tire rubber.

2) Type II - A mixture of ground tire rubber and high natural reclaimed scrap rubber. The natural rubber content, determined by ASTM D 297, shall be a minimum of 25 percent.

b. Ground Rubber. The ground rubber shall comply with the following gradation requirements when tested by TxDOT Test Method Tex-200-F, Part I.

**Table 15: Ground Rubber Gradation Requirements**

Sieve Size	Percent Retained	
	Type I	Type II
U.S. No. 8	0	-
No. 10	0-5	0
No. 30	90-100	50-70
No. 50	95-100	70-95
No. 100	-	95-100

The ground rubber shall be free from fabric, wire, cord or other contaminating materials.

c. Packaging. The rubber-asphalt crack sealing compound shall be packaged in boxes, which contain two 30-35 pound blocks that are individually packaged in a liner made of polyethylene, or other packaging approved by the Engineer or designated representative.

J. Performance Graded Binders

Performance graded binders must be smooth, homogeneous, show no separation when tested in accordance with Test Method Tex-540-C, and must meet the requirements in the following table.

Separation testing is not required if:

- a modifier is introduced separately at the mix plant either by injection in the asphalt line or mixer, or
- the binder is blended on site in continuously agitated tanks, or
- binder acceptance is based on field samples taken from an in-line sampling port at the hot mix plant after the addition of modifiers.

**Table 16: Performance Graded Binder Requirements (Printer-friendly version in PDF)**

Performance Grade	PG 58			PG 64			PG 70			PG 76			PG 82					
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
	22	28	34	16	22	28	34	16	22	28	34	16	22	28	34			
Average 7-day Max Pavement Design Temperature, °C <sup>1</sup>	58			64			70			76			82					
Min Pavement Design Temperature, °C <sup>1</sup>	≥-	≥-	≥-	≥-	≥-	≥-	≥-	≥-	≥-	≥-	≥-	≥-	≥-	≥-	≥-			
	22	28	34	16	22	28	34	16	22	28	34	16	22	28	34			
ORIGINAL BINDER																		
Flash Point, AASHTO T 48: Min,	230°C (also note Fahrenheit temperatures)																	
Viscosity, AASHTO TP 48: <sup>2,3</sup> Max, 3.0 Pas, Test Temperature,	135°C																	
Dynamic Shear, AASHTO TP 5: <sup>4</sup> G*/sin (δ), Min, 1.00 kPa Test Temperature @ 10 rad/sec.,	58°C			64°C			70°C			76°C			82°C					
Elastic Recovery, ASTM D 6084, 50°F, % Min	-	-	30	-	-	30	50	-	30	50	60	30	50	60	70	50	60	70
ROLLING THIN FILM OVEN (Tex-541-C)																		
Mass Loss, Max, %	1.0																	
Dynamic Shear, AASHTO TP 5: G*/sin (δ) in, 2.20 kPa Test Temperature @10 rad/sec.,	58°C			64°C			70°C			76°C			82°C					



Performance Grade	PG 58			PG 64			PG 70			PG 76			PG 82					
PRESSURE AGING VESSEL (PAV) RESIDUE (AASHTO PP 1)																		
PAV Aging Temperature	100°C																	
Dynamic Shear, AASHTO TP 5: $G^*/\sin(\delta)$ Max, 5000 kPa Test Temperature 10 rad/sec., °C	25	22	19	28	25	22	19	28	25	22	19	28	25	22	19	28	25	22
Creep Stiffness, AASHTO TP 1: <sup>5,6</sup> S, Max, 300 mPa, M - value, Min, 0.300 Test Temperature @ 60 sec., °C	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18
Direct Tension, AASHTO TP 3: <sup>6</sup> Failure Strain, Min, 1.0% Test Temperature @ 1.0 mm/min., °C	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18

<sup>1</sup> Pavement temperatures are estimated from air temperatures using an algorithm contained in the PGEXCEL3.xls software program, may be provided by the Department or by following the procedures as outlined in AASHTO MP 2 and PP 28.

<sup>2</sup> This requirement may be waived at the Department's discretion if the supplier warrants that the asphalt binder can be adequately pumped, mixed and compacted at temperatures that meet all applicable safety, environmental, and constructability requirements. At test temperatures where the binder is a Newtonian fluid, any suitable standard means of viscosity measurement may be used, including capillary (AASHTO T 201 or T 202) or rotational viscometry (AASHTO TP 48).

<sup>3</sup> Viscosity at 135°C is an indicator of mixing and compaction temperatures that can be expected in the lab and field. High values may indicate high mixing and compaction temperatures. Additionally, significant variation can occur from batch to batch. Contractors should be aware that variation could significantly impact their mixing and compaction operations. Contractors are therefore responsible for addressing any constructability issues that may arise.

<sup>4</sup> For quality control of unmodified asphalt binder production, measurement of the viscosity of the original asphalt binder may be substituted for dynamic shear measurements of  $G^*/\sin(\delta)$  at test temperatures where the asphalt is a Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary (AASHTO T 201 or T 202) or rotational viscometry (AASHTO TP 48).

<sup>5</sup> Silicone beam molds, as described in AASHTO TP 1-93, are acceptable for use.

<sup>6</sup> If creep stiffness is below 300 mPa, direct tension test is not required. If creep stiffness is between 300 and 600 mPa, the direct tension failure strain requirement can be used instead of the creep stiffness requirement. The m-value requirement must be satisfied in both cases.

301S.4 - Equipment.

All equipment necessary to transport, store, sample, heat, apply, and incorporate asphalts, oils and emulsions shall be provided.

301S.5 - Construction

Typical materials used for specific applications are identified in Table 17. These are typical uses only and circumstances may require use of other material.

**Table 17: Typical Material Use**

<b>Material Application</b>	<b>Typically Used Materials</b>
Hot-Mixed, Hot-Laid Asphalt Mixtures	PG Binders, Modified PG Binders
Surface Treatment	AC-5, AC-10, AC-5 w/2% SBR, AC-10 w/2% SBR, AC-15P, AC-15-5TR, HFRS-2, MS-2, CRS-2, CRS-2H, HFRS-2P, CRS-2P, Surface Treatment
(Cool Weather)	RS-1P, CRS-1P, RC-250, RC-800, RC-3000, MC-250, MC-800, MC-3000, MC-2400L
Precoating	AC-5, AC-10, PG 64-22, SS-1, SS-1H, CSS-1, CSS-1H
Tack Coat	RC-250, SS-1, SS-1H, CSS-1, CSS-1H, EAP&T
Fog Seal	SS-1, SS-1H, CSS-1, CSS-1H
Hot-Mixed, Cold-Laid Asphalt Mixtures	AC-0.6, AC-1.5, AC-3, AES-300, AES-300P, CMS-2, CMS-2S
Patching Mix	MC-800, SCM I, SCM II, AES-300S
Recycling	AC-3, AES-150P, AES-300P, Recycling Agent, Emulsified Recycling Agent
Crack Sealing	SS-1P, Polymer Mod AE Crack Sealant, Rubber Asphalt Crack Sealers (Class A, Class B)
Prime	MC-30, AE-P, EAP&T, PCE
Curing Membrane	SS-1, SS-1H, CSS-1, CSS-1H, PCE
Erosion Control	SS-1, SS-1H, CSS-1, CSS-1H, PCE

301S.6 - Storage, Heating and Application Temperatures

Asphaltic materials should be applied at the temperature, which provides proper and uniform distribution. Within practical limits higher temperatures than necessary to produce the desired results shall be avoided. Satisfactory application usually should be obtained within the recommended ranges shown below.

No material shall be heated above the following maximum temperatures:

**Table:18 Recommended Temperature Ranges**

	<b>Recommended Range; °F</b>	<b>Maximum Temperature; °F for</b>	
<b>Type-Grade</b>	<b>Application/Mixing</b>	<b>Allowable Application</b>	<b>Storage</b>
AC-5, 10,20,30	275—350	375	400
AC-5 or AC-10 + 2% SBR	300—375	390*	375
AC-10 + 3% SBR, AC-45P	300—350	350	360
RC-250	125—180	200	200
RC-800	170—230	260	260
RC-3000	215—275	285	285
MC-30, AEP	70—150	175	175
MC-70	125—175	200	200
MC-250	125—210	240	240
MC-800, SCM I, SCM II	175—260	275	275
MC-3000 & MC-2400 Latex	225—275	290	290
HFRS-2, MS-2, CRS-2, CRS-2H, HFRS-2P, CRS-2P, CMS-2, CMS-2S, AES-300, AES-300S, AES-150P, AES-300P	120—160	180	180
SS-1, SS-1h, SS-1P, CSS-1, CSS-1h, PCE, EAP & T, SS-1P, RS-1P, CRS-1P, CSS-1P, recycling	50—130	140	140

	Recommended Range; °F	Maximum Temperature; °F for	
Type-Grade	Application/Mixing	Allowable Application	Storage
agent, emulsified recycling agent, polymer modified AE crack sealant.			
RS-2, RS-2h, MS-2, CRS-2, CRS-2h, CRS-2p, CMS-2, CMS-2S, HFRS-2, HFRS-2p, AES-300	110—160	170	170
Special Precoat Material	125—250	275	275
PG Binders, Modified PG Binders	275—350	350	350
Rubber Asphalt Crack Sealers (Class A, Class B)	350—375	400	-
Rubber-Asphalt Crack Sealer	350—375	400	-

\* AC-5 + 2% SBR and AC-10 + 2% SBR, which is designated for surface treatment work, may be heated to a maximum temperature of 390°F by the supplier loading through an in-line heater, or with the permission of the Engineer or designated representative, these materials may be heated to maximum of 390°F by the Contractor just prior to application. When any of the SBR-modified asphalt cements are used in asphaltic concrete, the storage temperature at the mix plant should not exceed 350°F.

Attention is called to the fact that asphaltic materials (except emulsions) are very flammable and constitute fire hazards. Proper precautions should be used in all cases, especially with RC cutbacks.

Utmost care shall be taken to prevent open flames from coming in contact with the asphaltic material or the gases of it. The Contractor shall be responsible for any fires or accidents, which may result from heating the asphaltic materials.

#### 301S.7 - Measurement and Payment

All asphaltic materials included in this specification will not be paid for directly but shall be included in the unit price bid for the item of construction in which this item is used.

**END**

## ITEM NO. 302S - AGGREGATES FOR SURFACE TREATMENTS

### 302S.1 - Description

This item shall govern aggregate and precoated aggregate to be used in the construction of surface treatments.

### 302S.2 - Submittals

The submittal requirements of this specification item include:

- A. Aggregate types, gradations and physical characteristics (i.e. flakiness index, % wear, soundness, polish value, etc.)
- B. Proposed proportioning of materials.
- C. Aggregate precoat and fluxing material.
- D. Type of mixing plant and associated equipment including chart indicating the calibration of each cold bin.
- E. Aggregate storage/stockpiling plans.

### 302S.3 - Materials

#### A. Aggregates

Aggregates shall be composed of clean, tough and durable particles of gravel, crushed gravel, crushed stone, crushed slag or natural limestone rock asphalt. These materials shall not contain more than 2 percent by weight of soft particles and other deleterious materials as determined by TxDOT Test Method Tex-217-F, Part I. The natural limestone rock asphalt aggregate furnished shall have an average bitumen content from 4 to 7 percent by weight of naturally impregnated asphalt, as determined by TxDOT Test Method Tex-215-F and shall contain no more than 2 percent by weight of any one of or combination of iron pyrites or other objectionable matter, as determined by TxDOT Test Method Tex-217-F, Part I. No aggregate shall contain a total of more than 2 percent by weight of impurities or objectionable matter listed above.

The aggregate shall be either dark in color or be precoated. If not precoated, it shall be sufficiently washed as to produce a clean, dust free surface.

The aggregate shall not contain more than 1 percent loss from fine dust, clay-like particles and/or silt when tested in accordance with TxDOT Test Method Tex-217-F, Part II. The flakiness index for the aggregate, as determined by TxDOT Test Method Tex-224-F, shall not exceed 17 unless otherwise shown on the Drawings.

The percent of wear, as determined by TxDOT Test Method Tex-410-A (Los Angeles Abrasion Test), for each of the materials, except natural limestone rock asphalt (LRA), shall not exceed 35 percent. The percent of wear on natural limestone rock asphalt aggregate (LRA) shall not exceed 40 percent as determined by TxDOT Test Method Tex-410-A on that portion of the material retained on the No. 4 sieve, having a impregnated asphalt content of less than 1 percent.

Unless indicated otherwise on the drawings crushed gravel shall have a minimum of 85 percent of the particles retained on the No. 4 sieve with two or more mechanically induced crushed faces, as determined by TxDOT Test Method Tex-460-A, Part I.

The aggregate will be subjected to five (5) cycles of magnesium sulfate soundness testing in accordance with Test Method Tex-411-A. The loss shall not exceed 25 percent, unless indicated otherwise on the Drawings.

The polish value for the aggregate used in the surface or finish course shall be the value shown on the Drawings, when tested in accordance with TxDOT Test Method Tex-438-A. Unless otherwise shown on the Drawings, a minimum polish-value requirement of 30 will apply only to aggregate used in the travel lanes.

When aggregates requiring polish value are supplied from a source rated for a previous City of Pflugerville roadway project or rated by TxDOT Materials and Tests Division, the Rated Source Polish Value (RSPV) for that source will be used to meet this requirement. When aggregates are supplied from a source that is not rated, the aggregate will be sampled and tested prior to use. The procedures will be in accordance with TxDOT Test Methods Tex-400-A and Tex-438-A, Part I. Blending of aggregates to achieve polish value will not be permitted, unless otherwise shown on the Drawings. If blending is allowed, TxDOT Test Method Tex-438-A, Part II, Method B will be used to determine the required blend percentages. However, a minimum of 50 percent by volume of non-polishing aggregate is required.

**B. Precoat Material and Fluxing Material**

1. The precoat material shall meet requirements for "Precoat Materials" as specified in Standard Specification Item No. 301S, "Asphalts, Oils and Emulsions".
2. The fluxing material shall meet the requirements for "Fluxing Material " as specified in Standard Specification Item No. 301S, "Asphalts, Oils and Emulsions".
3. Water in an amount not to exceed 3 percent by weight (mass) of the mixture may be used in preparing the mixture. The water shall be added as directed by the Engineer or designated representative during the mixing. In the event water is used in the mixing operation, adequate measuring devices shall be used and the water shall be administered to the mix through an approved spray bar. Potable water from City of Pflugerville supplies is preferred, but the Contractor may submit test results of other water sources for approval by the Engineer or designated representative before use.

**302S.4 - Types of Aggregates**

The various types of aggregates are identified as follows:

**A. Uncoated Aggregate Types.**

**Uncoated Aggregate Types**

Type	Description
A	gravel, crushed slag, crushed stone or natural limestone rock asphalt (LRA)

Type	Description
B	crushed gravel, crushed slag, crushed stone or natural limestone rock asphalt (LRA)
C	gravel, crushed slag or crushed stone
D	crushed gravel, crushed slag or crushed stone
E	Aggregate as shown on drawings
F	Trap Rock

#### B. Precoated Aggregate

Precoated aggregate shall be aggregate of the type and grade specified above, coated with 0.5 to 1.5 percent, by mass, of residual bitumen from a precoating material. When indicated on the drawings, specific aggregates may be prohibited from being precoated.

Where limestone rock asphalt (LRA) is used, it shall be fluxed with 0.5 to 1.5 percent by mass of fluxing material. Limestone rock asphalt (LRA) that contains visual surface moisture or excessive quantities of fines shall not be precoated.

The grade of aggregate specified shall meet all requirements of sections 302S.3 "Materials" and 302S.4 "Types of Aggregates" prior to the application of the precoat or fluxing material.

The materials may be mixed on the job or at a central mixing plant and shipped ready for use. Mixes that do not maintain flow qualities such that the precoated aggregate may be satisfactorily spread by approved mechanical spreading devices will not be acceptable.

Materials that are not uniformly and/or properly coated, in the opinion of the Engineer or designated representative, will not be accepted for use.

The various types of precoated aggregates are identified as follows:

#### Precoated Aggregate Types

Type	Description
PA	gravel, crushed slag, crushed stone or natural limestone rock asphalt (LRA)
PB	crushed gravel, crushed slag, crushed stone or natural limestone rock asphalt (LRA)
PC	gravel, crushed slag or crushed stone
PD	crushed gravel, crushed slag or crushed stone

Type	Description
PE	Aggregate as shown on drawings

### 302S.5 - Grades

When tested by TxDOT Test Method Tex-200-F, Part I, the gradation requirements for the several grades of aggregate shall be as follows:

Sieve Designation	Percent Retained By Weight for				
	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
US					
1 inch	0				
7/8 inch	0—2	0			
3/4 inch	20—35	0—2	0		
5/8 inch	85—100	20—40	0—2	0	
1/2 inch		80—100	20—40	0—5	0
3/8 inch	95—100	95—100	80—100	20—40	0—5
1/4 inch			95—100		
No. 4				95—100	50—80
No. 20	99—100	99—100	99—100	98—100	98—100

### 302S.6 - Equipment For Precoating Aggregate

Mixing plants that will not continually meet all the requirements of this specification shall be rejected.

Mixing plants may be either the weigh batching type, the continuous mixing type or the drum mix type. Each type of plant shall be equipped with satisfactory conveyors, power units, aggregate handling equipment, aggregate screens and bins and shall consist of the essential pieces of equipment listed below:

If the Engineer or designated representative approves the use of emulsion as a precoat material, the Engineer or designated representative may also waive the requirement for a dryer, as specified below, if it is demonstrated that a satisfactory coating can be obtained without drying or heating the aggregate.



When using a low grade fuel oil or waste oil, the plant shall meet the requirements of article 340.4.2 of TxDOT Specification Item 340, "Dense-Graded Hot-Mix Asphalt (Small Quantity)".

A. Weigh Batching Type

1. Cold Aggregate Bin and Proportioning Device

The cold aggregate bins or aggregate stockpiles shall be of sufficient number and size to supply the amount of aggregate required to keep the plant in continuous operation. The proportioning device shall be such as will provide a uniform and continuous flow of aggregate to the plant in the desired proportions.

2. Dryer

The dryer shall be of the type that continually agitates the aggregate during heating and in which the temperature can be so controlled that aggregate will not be damaged in the necessary drying and heating operations, which are required to obtain a mixture of the specified temperature.

3. Burner

The burner or combination of burners and type of fuel used shall be such that in the process of heating the aggregate to the desired or specified temperatures, no residue from the fuel shall adhere to the heated aggregate. A recording thermometer shall be provided which will record the temperature of the aggregate when it leaves the dryer. The dryer shall be of sufficient size to keep the plant in continuous operation. The dryer will not be required for precoating natural limestone rock asphalt.

4. Screening and Proportioning

The screening capacity and size of the bins shall be sufficient to screen and store the amount of aggregate required to properly operate the plant and keep the plant in continuous operation at full capacity. Proper provisions shall be made to enable inspection forces to have easy and safe access to the proper location on the mixing plant where accurate representative samples of aggregate may be taken from the bins for testing.

5. Weighing and Measuring Equipment

The weighing and measuring equipment shall be of sufficient capacity and of adequate design for proper batching. The following equipment, conforming to the requirements of the TxDOT Standard Specification, Item No. 520, "Weighing and Measuring Equipment", shall be furnished:

- (a) Aggregate weigh box and batching scales.
- (b) Bucket and scales for precoat material for flux oil.

A pressure type flow meter may be used to measure the precoat material or fluxing material for each batch.

If a pressure type flow meter is used to measure the asphaltic material, the requirements of TxDOT Specification Item No. 520, "Weighing and Measuring Equipment", shall apply.

Provisions of a permanent nature shall be made for checking the accuracy of the asphaltic material measuring device. The line to the measuring device shall be protected with a jacket of hot oil or other means approved by the Engineer to maintain the temperature of the line near the temperature specified for the precoat material.

6. Mixer

The mixer shall be of the pug mill type and shall have a capacity of not less than 3000 pounds in a single batch. The number of blades and the position of same shall be such as to give a uniform and complete circulation of the batch in the mixer. The mixer shall be equipped with an approved spray bar that will distribute the precoat material or fluxing material quickly and uniformly throughout the mixer. Any mixer that has a tendency to segregate the mineral aggregate or fails to secure a thorough and uniform mixing with the precoat material or fluxing material shall not be used. All mixers shall be provided with an automatic time lock that will lock the discharge doors of the mixer for the required mixing period. The dump door or doors and the shaft seals of the mixer shall be tight enough to prevent the spilling of aggregate or mixture from the pug mill.

B. Continuous Mixing Type

1. Cold Aggregate Bin and Proportioning Device.

Same as for weigh batching type of plant.

2. Dryer.

Same as for weigh batching type of plant.

3. Screening and Proportioning.

Same as for weigh batching type of plant. These requirements shall also apply to materials that are stockpiled and that are proposed for direct use by a continuous mixing plant without the use of plant bins.

4. Aggregate Proportioning Device.

The aggregate proportioning device shall be so designed, that when properly operated, a uniform and continuous flow of aggregate into the mixer will be maintained.

5. Spray Bar for Precoat Material and Fluxing Material.

The spray bar for the precoat material or fluxing material shall be so designed that the material will spray uniformly and continuously into the mixer.

6. Meter for Precoat Material or Fluxing Material.

An accurate recording meter for precoat material or fluxing material shall be placed in the line leading to the spray bar so that the accumulative amount of precoat material or fluxing material being used can be accurately determined. Provisions of a permanent nature shall be made for checking the accuracy of the meter output.

## 7. Mixer

The mixer shall be of the pug mill continuous type and shall have a capacity of not less than 40 tons of mixture per hour. Any mixer that has a tendency to segregate the aggregate or fails to secure a thorough and uniform mixing of the aggregate with the precoat material or fluxing material shall not be used.

### C. Drum Mix Plant

Unless otherwise indicated on the Drawings or if natural limestone rock asphalt is to be used, the Contractor may elect to use the drum-mixing process. The plant shall be adequately designed and constructed for the process of mixing aggregates and precoat material in the dryer-drum without preheating the aggregates. The plant shall be equipped with satisfactory conveyors, power units, aggregate-handling equipment and feed controls and shall consist of the following essential pieces of equipment.

#### 1. Cold Aggregate Bin and Feed System

The number of compartments in the cold aggregate bin shall be equal to or greater than the number of stockpiles of individual materials to be used.

The bin shall be of sufficient size to store the amount of aggregate required to keep the plant in continuous operation and of proper design to prevent overflow of material from one compartment to another. There shall be vertical partitions meeting the requirements of article 340.4.2 of TxDOT Specification Item 340, "Dense-Graded Hot-Mix Asphalt (Small Quantity)". The feed system shall provide a uniform and continuous flow of aggregate in the desired proportion to the dryer. The Contractor shall furnish a chart indicating the calibration of each cold bin in accordance with the manufacturer's recommendations or in a method acceptable to the Engineer or designated representative.

The system shall provide positive weight (mass) measurement of the combined cold aggregate feed by use of belt scales or other approved devices. Provisions of a permanent nature shall be made for checking the accuracy of the measuring device, as required by TxDOT Specification Item No. 520, "Weighing and Measuring Equipment". When a belt scale is used, mixture production shall be maintained so that the scale normally operates between 50 percent and 100 percent of its rated capacity. Belt scale operation below 50 percent of the rated capacity may be allowed by the Engineer or designated representative if accuracy checks show the scale to meet the requirements of TxDOT Specification Item No. 520, "Weighing and Measuring Equipment", at the selected rate and it can be satisfactorily demonstrated to the Engineer or designated representative that mixture uniformity and quality have not been adversely affected.

#### 2. Scalping Screen

A scalping screen shall be required, unless otherwise indicated on the Drawings and shall be located ahead of the combined aggregate belt scale.

#### 3. Precoat Material Measuring System

An asphaltic material measuring device meeting the requirements of the TxDOT Item No. 520, "Weighing and Measuring Equipment", shall be placed in the line leading to the drum

mixer so that the accumulative amount of precoat material used can be accurately determined. Provisions of a permanent nature shall be made for checking the accuracy of the measuring device output. The measuring device and line to the measuring device shall be protected with a jacket of hot oil or other approved means to maintain the temperature of the line and measuring device near the temperature specified for the precoat material. The measuring system shall include an automatic temperature compensation device to maintain a constant percent by mass of precoating material in the mixture. Unless otherwise indicated, the temperature of the precoat material entering the measuring device shall be maintained at +100°F of the temperature at which the measuring set was calibrated and set.

#### 4. Synchronization Equipment for Feed-Control Systems

The precoat material feed-control shall be coupled with the total aggregate weight measuring device in such a manner as to automatically vary the precoat material feed rate as required to maintain the required proportion.

#### 5. Drum Mix System

The drum mix system shall be of the type that continually agitates the aggregate and precoat mixture during heating, and in which the temperature can be so controlled that aggregate and asphalt will not be damaged in the necessary drying and heating operations that are required to obtain a mixture at the specified temperature. A continuously-recording thermometer shall be provided which will indicate the temperature of the mixture as it leaves the drum mixer.

#### 6. Surge-Storage System

A surge-storage system will be required. It shall be adequate to minimize the production interruptions during the normal day's operations and shall be constructed to minimize segregation. A device such as a gob hopper or other similar devices approved by the Engineer or designated representative to prevent segregation in the surge-storage bin will be required.

#### 7. Heating Equipment for Precoat Material and Fluxing Material

Heating equipment for precoat material and fluxing material shall be adequate to heat the amount of material required to the desired temperature. The material may be heated by steam coils which shall be absolutely tight. Direct fire heating will be permitted, provided the heater used is manufactured by a reputable concern and there is positive circulation of the liquid throughout the heater. Agitation with steam or air will not be permitted. The heating apparatus shall be equipped with a recording thermometer with a 24-hour chart that will record the temperature of the precoat material or fluxing material where it is at the point of highest temperature.

## 302S.7 - Storage, Proportioning and Mixing

### A. Aggregate Storage

If the mineral aggregates are stored or stockpiled, they shall be handled in such a manner as to prevent segregation, mixing of the various materials or sizes and contamination with foreign materials. The grading of aggregates proposed for use and as supplied to the mixing plant shall be uniform. When directed by the Engineer or designated representative, aggregate materials shall not be added to stockpiles that have already been sampled for approval.

When asphalt cement is the precoating material, stockpile height shall be limited to approximately three (3) feet (one meter) immediately after production to limit the buildup of heat. These stockpiles may be consolidated after cooling adequately, in the opinion of the Engineer or designated representative.

The use of limestone rock asphalt aggregate containing moisture in excess of the saturated surface-dry condition will not be permitted. Excess moisture will be evidenced by visual surface moisture on the aggregate or any unusual quantities of fines clinging to the aggregate.

### B. Storage and Heating of Precoating Material or Fluxing Material

The precoating or fluxing material storage shall be ample to meet the requirements of the plant. The precoating materials shall not be heated in storage to a temperature in excess of 2500F or the maximum temperature established in Standard Specification Item Number 301S, "Asphalts, Oils and Emulsions". All equipment used in the storage and handling of precoat material or fluxing material shall be kept in a clean condition at all times and shall be operated in such manner that there will be no contamination with foreign matter.

### C. Feeding and Drying of Aggregate

The feeding of various sizes of aggregate, other than natural limestone rock asphalt, to the dryer shall be done through the cold aggregate bin and proportioning device in such a manner that a uniform and constant flow of material in the required proportions will be maintained. The aggregate shall be heated to the temperature necessary to produce a mixture meeting the requirements of Article 302S.3.A and 302S.7.

### D. Proportioning

The proportioning of the various materials entering into the mixture shall be as directed by the Engineer or designated representative and in accordance with these specifications. Aggregate shall be proportioned by weight using the weigh box and batching scales herein specified when the weigh-batch type of plant is used and by volume using the aggregate proportioning device when the continuous mixer type of plant is used. The precoat material or fluxing material shall be proportioned by weight or by volume based on weight using the specified equipment.

### E. Mixing

#### 1. Batch Type Mixer

In the charging of the weigh box and the charging of the mixer from the weigh box, such methods or devices shall be used as are necessary to secure a uniform mixture. In introducing the batch into the mixer, the mineral aggregate shall be introduced first; shall be

mixed thoroughly, as directed, to uniformly distribute the various sizes throughout the batch before the precoat material or fluxing material is added; the precoat material or fluxing material shall then be added and the mixing continued until such time that the aggregate is properly coated. This mixing period may be varied, if in the opinion of the Engineer or designated representative the mixture is not uniform.

2. Continuous Type Mixer and Drum Mixer

The amount of aggregate and precoat material or fluxing material entering the mixer and the rate of travel through the mixer shall be so coordinated that a uniform mixture of the specified grading and percent by weight (mass) of precoat material or fluxing material will be produced.

302S.8 - Physical Properties of the Mixture

The materials shall be mixed at a central mixing plant and shipped ready for use. Mixes that do not remain workable over a sufficient period of time or do not maintain flow qualities such that the precoated aggregate may be satisfactorily spread by normal approved mechanical spreading devices will not be acceptable. Materials that are not uniformly and/or properly coated or fluxed, in the opinion of the Engineer or designated representative will not be accepted for use.

302S.9 - Measurement and Payment

Aggregates and precoated aggregates provided in accordance with this specification will not be paid for directly but shall be included in the unit price bid for the item of construction in which this item is used.

**END**

## ITEM NO. 306S - PRIME COAT

### 306S.1 - Description

This item shall govern the application of asphaltic material on the completed base course and/or other approved areas in accordance with the Drawings, these specifications or as directed by the Engineer or designated representative.

### 306S.2 - Submittals

The submittal requirements of this specification item include:

- A. List of recommended materials (i.e. prime material, dispersal agent, etc.).
- B. Temperature Viscosity data and proposed temperature of application.
- C. Characteristics (i.e. manufacturer, rate of application, speed, etc.) of the proposed pressure distributor including calibration documentation.
- D. List of facilities and equipment proposed for temperature measurements.
- E. List of facilities and equipment proposed for storage and handling of asphaltic materials.

### 306S.3 - Materials

#### A. Asphalt Materials

The asphalt material for Prime Coat shall meet the requirements of Cutback Asphalt, MC-30, Emulsion, SS-1, Emulsion CSS-1 or AE-P, Standard Specification Item No. 301S, "Asphalts, Oils and Emulsions".

#### B. Water

Water shall be furnished by the Contractor and shall be clean and free from industrial wastes and other objectionable matter.

#### C. Dispersal Agent

Agent shall be added to water and sprayed on surfaces to be primed in accordance with asphalt manufacturer's recommendations.

### 306S.3 - Construction Methods

When, in the opinion of the Engineer or designated representative, the base course or other surface is satisfactory to receive the prime coat, the surface shall be prepared by sweeping or other approved methods as directed by the Engineer or designated representative. The surface shall be lightly sprinkled with water just prior to application of the asphaltic material unless this requirement is waived by the Engineer or designated representative. The Contractor shall submit a list of prime material(s) recommended for application on the work to the Engineer or designated representative for approval. When emulsions are approved, a dispersal agent shall be added to the water before sprinkling.

The asphaltic material shall be applied on the clean surface by an approved type of self-propelled pressure distributor operated so as to distribute the prime coat at a rate ranging from 0.1 to 0.3 gallons

per square yard of surface area. The material shall be evenly and smoothly distributed under pressure sufficient to assure proper distribution. During the application of prime coat, care shall be taken to prevent splattering of adjacent pavement, curb and gutters or structures. The Contractor shall be responsible for cleaning all splattered areas.

Prime Coat may be applied when the temperature of the surface on which the prime coat is to be placed is 60°F or above and the air temperature is above 50°F and rising; the air temperature being taken in the shade and away from artificial heat. Asphaltic material shall not be placed when general weather conditions, in the opinion of the Engineer or designated representative, are not suitable.

The Contractor shall provide all necessary facilities and equipment for determining the temperature of the asphaltic material in all of the heating equipment and in the distributor, for determining the rate at which it is applied, and for securing uniformity at the junction of two (2) distributor loads.

The distributor shall have been calibrated within three (3) years from the date it is first used on this project. The Engineer or designated representative shall be furnished an accurate and satisfactory record of such calibration. After beginning the work, if the yield on the asphaltic material applied appears in error, the distributor shall be calibrated in a manner satisfactory to the Engineer or designated representative before proceeding with the work.

The Contractor shall be responsible for the maintenance of the surface until the work is accepted by the Engineer or designated representative. No traffic, hauling or placement of any subsequent courses shall be permitted over the freshly applied prime coat for a minimum of 48 hours or until the prime coat is accepted as dry and cured completely by the Engineer or designated representative.

All storage tanks, piping, retorts, booster tanks and distributors used in storing or handling asphaltic material shall be kept clean and in good operating condition at all times and they shall be operated in such a manner that there will be no contamination of the asphaltic material with foreign material. It shall be the responsibility of the Contractor to provide and maintain in good working order a recording thermometer at the storage heating unit at all times.

The Engineer or designated representative will approve the temperature of application based on the temperature-viscosity relationship that will permit application of the asphalt within the limits recommended in Standard Specification Item No. 301S, "Asphalts, Oils and Emulsions". The Contractor shall apply the asphalt at a temperature within 150F of the temperature specified in Standard Specification Item No. 301S, "Asphalt, Oils and Emulsions".

#### 306S.5 - Measurement

The prime coat will be included in the unit price bid for Standard Specification Item No. 340S, "Hot Mix Asphaltic Concrete Pavement" unless included as a separate pay item in the contract. When included for payment, it shall be measured at point of delivery on the project in gallons at the applied temperature. The quantity to be paid for shall be the number of gallons used in the accepted prime coat.

#### 306S.6 - Payment

The work performed and materials furnished as prescribed by this item, when included as a contract pay item, will be paid for at the unit bid price per gallon for "Prime Coat". The price shall include full compensation for cleaning the base course or other surface, for furnishing, heating, hauling and distributing the prime coat specified; for all freight involved and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work.



Payment, when included as a contract pay item, will be made under:

<b>Pay Item No. 306S-A:</b>	Prime Coat	Per Gallon.
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**END**

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ITEM NO. 307S - TACK COAT

307S.1 - Description

This item shall govern the application of asphaltic material on completed base courses, existing pavement, bituminous surface, bridge deck, slab or prepared surface as indicated on the Drawings and as directed by the Engineer or designated representative. The application of asphaltic material on completed base courses shall only be applied after the prime coat has completely cured in accordance with Standard Specification Item No. 306S, "Prime Coat"

307S.2 - Submittals

The submittal requirements of this specification item include:

- A. List of recommended materials (i.e. tack coat material, sand type, etc.).
- B. Temperature Viscosity data and proposed temperature of application.
- C. Characteristics (i.e. manufacturer, rate of application, speed, etc.) of the proposed pressure distributor including calibration documentation.
- D. List of facilities and equipment proposed for temperature measurements.
- E. List of facilities and equipment proposed for storage and handling of asphaltic materials.

307S.3 - Materials

A. Asphalt Materials

The asphalt material for "Tack Coat" shall meet the requirements for Cutback Asphalt or Emulsified Asphalt, Standard Specification Item No. 301S, "Asphalts, Oils and Emulsions" as listed below. Cutback asphalt shall be made by combining 50 to 70 percent by volume of the asphaltic material as specified for the type of paving mixture with 30 to 50 percent by volume of gasoline and/or kerosene. The type of material shall be selected from the following table:

Temperature of Surface, °F	40—70°F	Over 70°F
	RS-2	SS-1
	RS-2H	
	RC-250	MC-70
	CRS-2	CSS-1
	CRS-2H	CSS-1h

B. Water

Water shall be furnished by the Contractor and shall be clean and free from industrial wastes and other objectionable matter.

C. Sand

Sand may be Grade 1 conforming to Standard Specification Item No. 403S, "Concrete Structures" or washed sand, largely siliceous, with the following gradation:

Sieve Designation	Percent Retained by Weight (Mass) Natural Sand	SI
US		SI
No. 8	2.36 mm	0
No. 16	1.18 mm	0—40
No. 30	600mm	25—65
No. 50	300mm	65—85
No. 100	150mm	85—98
No. 200	75mm	98—100

There shall not be more than 50 percent of the aggregate retained between any 2 sieves listed above and not more than 25 percent of the aggregate retained between the No. 50 (300 μm) and the No. 100 (150 μm) sieves.

307S.4 - Construction Methods

Tack coat shall be applied when the surface on which the tack coat is to be placed is 60°F or above and the air temperature is above 50°F and rising, where the air temperature is measured in the shade and away from any artificial heat. Asphaltic material shall not be placed when general weather conditions, in the opinion of the Engineer or designated representative, are not suitable.

Before the tack coat is applied, the surface shall be cleaned thoroughly to the satisfaction of the Engineer or designated representative. The asphaltic material shall be applied on the clean surface by an approved type of self-propelled pressure distributor, so operated as to distribute the tack coat at a rate not to exceed 0.10 gallon per square yard of surface, evenly and smoothly with sufficient pressure to provide proper distribution.

In those instances where the pavement mixture will adhere to the surface on which it is to be placed without the use of a tack coat, the tack coat may be eliminated by the Engineer or designated representative. All contact surfaces of curbs and structures and all joints shall be cleaned thoroughly and

painted with a thin uniform coat of the asphaltic material used for tack coat. The tack coat shall be rolled with a pneumatic tire roller to distribute the asphaltic material uniformly over the tacked area. During the application of tack coat, care shall be taken to prevent splattering of adjacent pavement, curb and gutters or structures. The Contractor shall clean splattered areas.

The distributor shall have been calibrated within three (3) years from the date it is first used on this project. The Engineer or designated representative shall be furnished an accurate and satisfactory record of such calibration. After beginning of the work, if the yield on the asphaltic material applied appears in error, the distributor shall be calibrated in a manner satisfactory to the Engineer or designated representative before proceeding with the work.

The Contractor shall provide all necessary facilities and equipment for determining the temperature of the asphaltic material in all of the heating equipment and in the distributor, for determining the rate at which it is applied, and for securing uniformity at the junction of two (2) distributor loads.

The Contractor shall be responsible for the maintenance of the surface until the HMAC is placed over the tack coat or the work is accepted by the Engineer or designated representative. No traffic, hauling or placement of any subsequent courses shall be permitted over the freshly applied tack coat unless it is blotted by the application of sand as directed by the Engineer or designated representative.

All storage tanks, piping, retorts, booster tanks and distributors used in storing or handling asphaltic material shall be kept clean and in good operating condition at all times and they shall be operated in such a manner that there will be no contamination of the asphaltic material with foreign material. It shall be the responsibility of the Contractor to provide and maintain in good working order a recording thermometer at the storage heating unit at all times.

The Contractor shall apply the asphalt at a temperature that will permit application of the asphalt within the limits recommended in Standard Specification Item No 301S, "Asphalts, Oils and Emulsions". The application temperature shall be within 150°F of 1600°F.

#### 307S.5 - Measurement

The asphaltic material for "Tack Coat" will be included in the unit price bid for Standard Specification Item 340S, "Hot Mix Asphaltic Concrete Pavement" unless included as a separate pay item in the contract. When included for payment, "Tack Coat" shall be measured at point of delivery on the project in gallons at the applied temperature. The quantity to be paid for shall be the number of gallons used.

#### 307S.6 - Payment

The work performed and materials furnished as prescribed by this item, when included as a contract pay item, will be paid for at the unit bid price per gallon for "Tack Coat". The price shall include full compensation for cleaning the area to receive the "Tack Coat"; for furnishing, heating, hauling and distributing the tack coat specified; for all freight involved and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment, when included as a contract pay item, will be made under:

<b>Pay Item No. 307S-A:</b>	Tack Coat	Per Gallon.
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**END**

## ITEM NO. 310S - EMULSIFIED ASPHALT TREATMENT

### 310S.1 - Description

This item shall govern one or more applications of a mixture of emulsified asphalt and water to be used as a base or subgrade treatment, earthwork seal for erosion control, prime coat or dust palliative, which is constructed in accordance with the Drawings and these specifications. This mixture may be applied to the base course, subgrade, shoulders or detours at the locations and to the extent indicated on the Drawings or as directed by the Engineer or designated representative.

### 310S.2 - Submittals

The submittal requirements of this specification item include:

- A. List of recommended materials (i.e. emulsified asphalt, dispersal agent, etc.).
- B. Recommended use, rate of application and percent emulsified asphalt in the mixture.
- C. Characteristics (i.e. manufacturer, rate of application, speed, etc.) of the proposed sprinkler including calibration documentation.

### 310S.3 - Materials

The emulsified asphalt used shall meet the requirements of Standard Specification Item No. 301, "Asphalts, Oils and Emulsions". The water used shall be clean and free from industrial wastes and other objectionable matter.

### 310S.4 - Construction Methods

The emulsified asphalt mixture shall be applied by a self-propelled sprinkler that is equipped with positive and rapidly working cut-off valves and approved spray bars. The sprinkler shall be capable of maintaining the distribution of the mixture in a uniform and controllable rate of application and shall be operated, so as to uniformly distribute the mixture in the quantity required for the use.

The emulsion may be mixed in the sprinkler tank. The Contractor shall make suitable provisions for agitating the materials sufficiently to produce a uniform blend. The sprinkler tank shall have been calibrated within three (3) years from the date it is first used on this project. The Engineer shall be furnished an accurate and satisfactory record of such calibration. After beginning the work, if the yield of the emulsion applied appears to be in error, the distributor shall be calibrated in a manner satisfactory to the Engineer or designated representative before proceeding with the work.

An approved dispersal agent shall be added to water and sprayed on severely weathered asphalt surfaces to be treated in accordance with asphalt manufacturer's recommendations.

Where indicated on the Drawings, the "Emulsified Asphalt Treatment" shall be mixed with the base or subbase material. The emulsified asphalt and water mixture shall be applied and incorporated in the top portion of subbase or base course layers to the depth and width indicated on the Drawings or as directed by the Engineer or designated representative. Successive applications of a mixture of emulsified asphalt and water shall be completed for the area to be treated, with either a pressure distributor or an approved sprinkler, and the procedure shall be continued until all of the specified amount of emulsified asphalt has been incorporated in the material.

The percentage of emulsified asphalt in the mixture shall be regulated to ensure that the specified amount of emulsified asphalt is incorporated in the material while maintaining the proper moisture content.

The treated material shall be mixed by blading, then shaped and compacted, as required by the pertinent specifications for the particular course, to the lines, grades and typical sections indicated on the Drawings. The surface shall be maintained with light applications of emulsified asphalt and water mixture or raw water, as directed by the Engineer or designated representative, during curing of the course.

Temporary pavement markings will be in accordance with Item No. 864S, "Abbreviated Pavement Markings".

**310S.5 - Rates of Application**

Use	Rate of Application	
	Gallons/Square Yard	Liters/Square Meter
Dust Palliative	0.05 to 0.1	0.25 to 0.45
Base Course	0.35 to 0.5	1.60 to 2.25
Earthwork Seal	0.1 to 0.35	0.45 to 1.60
Prime Coat	See Specification Item No. 306S	
Pavement Seal	0.1 to 0.35	0.45 to 1.60

**310S.6 - Measurement**

Emulsified asphalt will be measured by the gallon of emulsified asphalt used in the emulsified asphalt and water mixture.

**310S.7 - Payment**

The work performed and the emulsified asphalt furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit bid price for "Emulsified Asphalt" of the type specified. The price shall include full compensation for furnishing all required materials, mixing water for application, Dispersal Agent and for all freight involved; for all hauling, mixing and distributing the mixture, as specified; and for all manipulation, labor, tools, equipment, temporary pavement markings and incidentals necessary to complete the work

Payment will be made under:

<b>Pay Item No. 310S-A:</b>	Emulsified Asphalt	Per Gallon.
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**END**

## ITEM NO. 311S - EMULSIFIED ASPHALT REPAVING

### 311S.1 - Description

This item shall govern the application of emulsified asphalt, of the type specified, as a binding agent in the recycling mixture of existing asphaltic surfaced streets. When used in the recycling process, the emulsified asphalt increases the asphalt content of the material being reprocessed to a design amount. The emulsified asphalt can be used either independently or in conjunction with an emulsified recycling agent.

### 311S.2 - Submittals

The submittal requirements of this specification item include:

- A. List of recommended materials (i.e. emulsified asphalt, recycling agent, etc.).
- B. Recommended Job Mix Formula, including rate of application and percent of emulsified asphalt in the mixture.

### 311S.3 - Materials

- A. When emulsified asphalt is used independently, it shall be SS-1 or CSS emulsion and conform to Item No. 301, "Asphalts, Oils and Emulsions".
- B. When emulsified asphalt is used in conjunction with an emulsified recycling agent, it shall be a cationic emulsion, CSS-1 and conform to Item No. 301, "Asphalts, Oils and Emulsions".

### 311S.4 - Construction Methods

Emulsified asphalt shall be added to the recycled asphalt during the heater-scarifier operation. The Job Mixed Formula shall be determined from the tests performed before the project begins. The actual rate of application will be established based on field conditions and conform to Item No. 350S, "Heating, Scarifying and Repaving".

### 311S.5 - Measurement

Emulsified Asphalt will be measured by the gallon, complete in place.

### 311S.6 - Payment

The work performed and materials furnished as prescribed by this item and measured as provided for under "Measurement" will be paid for at the unit bid price for this item. The price shall include full compensation for the work, materials, tools and other accessories needed to complete the work.

**END**

## ITEM NO. 312S - SEAL COAT

### 312S.1 - Description

This item shall govern the construction of a surface treatment composed of a single application of asphalt or latex-asphalt covered with aggregate for the sealing of existing pavements in accordance with the details on the Drawings and this specification item.

### 312S.2 - Submittals

The submittal requirements of this specification item include:

- A. Recommended design mix (emulsion type, aggregate type, type and % of polymer)
- B. Test results on the emulsion (Saybolt Furol Viscosity, storage stability, demulsibility, sieve test, distillation test and residue tests).
- C. Test results on the aggregate (gradation and percent wear).
- D. Characteristics (i.e. manufacturer, rate of application, speed, etc.) of the proposed distributor and aggregate spreader.
- E. List of facilities and equipment proposed for temperature measurements.
- F. List of facilities and equipment proposed for storage and handling of asphaltic materials.

### 312S.3 - Materials

#### A. Asphaltic Materials

Asphaltic material shall conform to Item No. 301S, "Asphalts, Oils and Emulsions" as follows:

##### 1. Patching

Patching shall be completed with Class C or D HMAC (to match existing pavement) conforming to Item No. 340S, "Hot Mix Asphaltic Concrete Pavement". Use of HMAC that does not match the Class of the existing surface finish will require approval of the City Engineer.

##### 2. Sealing

- a. Cool Weather of 65 to 80°F: HFRS-2.
- b. Warm Weather over 81°F: RS-2.

#### B. Aggregate

Aggregate material shall conform to Item No. 302S, "Aggregate for Surface Treatments". Unless otherwise specified on the drawings, the aggregate grading shall meet Grade 5.

#### C. Aggregate (Stockpiled)

Aggregate may be stockpiled only with permission of the Engineer or designated representative at locations designated for stockpiling. The Contractor shall be responsible for all remedial pollution control measures during the cleanup of the stockpiling.



D. Latex Additive

The latex shall be an emulsion of styrene-butadiene low-temperature copolymer in water. The emulsion shall have good storage stability and possess the following properties:

Monomer ratio, Butadiene/Styrene	(73 ± 5)/(27 ± 5)
Minimum solids content, % by weight (mass)	45
Viscosity of emulsion at 77°F ± 1°F, Cps, Maximum No. 3 spindle, 20 rpm, Brookfield RVT Viscometer	2000

The manufacturer shall furnish the actual styrene-butadiene rubber (SBR) content for each batch of latex emulsion. This information shall accompany all shipments to facilitate proper addition rates.

312S.4 - Equipment

Equipment will consist of the following: asphalt storage and heaters, distributors, aggregate spreaders, blade equipped tractor and drag broom, pneumatic rollers, water truck with pump and rotary broom.

All storage tanks, piping, retorts, booster tanks and distributors used in storage or handling of asphaltic material shall be kept clean and in good operating condition at all times and they shall be operated in such manner that there will be no contamination of the asphaltic material. The Contractor shall provide and maintain in good working order a recording thermometer to continuously indicate the temperature of the asphaltic material at the storage-heating unit, when storing of asphalt is permitted.

The distributor shall have pneumatic tires of such width and number that the load produced on the street surface shall not exceed 650 pounds per inch of tire width and shall be so designed, equipped, maintained and operated that asphaltic material at even heat may be applied uniformly on variable widths of surface at readily determined and controlled rates of from 0.05 to 0.2 gallons per square yard, with a pressure range of from 25 to 75 pounds per square inch, and with an allowable variation from any specified rate not to exceed 5 percent. Distributor equipment shall include tachometer, pressure gauges, volume measuring devices and a thermometer for reading temperatures of tank contents.

The aggregate spreading equipment shall be adjusted and capable of spreading aggregate at controlled amounts per square yard in a continuous manner.

The drag broom shall be lightweight street type, mounted on a frame, designed to spread aggregate uniformly over the surface of a bituminous pavement and equipped with pull plates for towing. Towing equipment shall be pneumatic tired.

Rollers shall conform to Item No. 232S, "Rolling (Pneumatic Tire)", Light Pneumatic Tire Roller.

Rotary brooms shall be suitable for cleaning the surfaces of bituminous pavements.

Vacuum sweepers shall be suitable for removing any loose aggregate without disturbing the compacted seal coat.

### 312S.5 - Construction Methods

Prior to commencement of this work, all erosion control, environmental protection measures and all traffic control devices shall be in place.

Seal coats may be applied when the surface on which the seal coat is to be placed is 60°F or above and the air temperature is above 50°F and rising, if the temperature is measured in the shade and away from artificial heat. Asphaltic material shall not be placed when general weather conditions are not suitable for a satisfactory seal coat or when the environment could be damaged.

#### A. Cracks and Holes

Cracks and holes will be patched by the Contractor prior to seal coat operations. Patching materials shall be hot mix, hot laid asphaltic concrete in conformance with Standard Specification Item No. 340S, "Hot Mix Asphaltic Concrete Pavement" or other asphaltic materials as approved by the Engineer or designated representative.

#### B. Cleaning Existing Surfaces

Prior to placement of the seal coat, loose dirt and other objectionable material shall be removed from the existing surface. The surface will be cleaned with a rotary broom. Hand brooms will be used in areas not accessible to rotary brooms. The Engineer or designated representative must approve all streets before application of any asphalt.

#### C. Mixing Asphalt

When the air temperature is 80°F or higher, latex shall be added to the asphalt at the rate of 1½ to 2 percent by weight [solid bases]. The actual rate shall be in accordance with the drawings and/or as approved by the Engineer or designated representative. The asphalt shall be heated to 150°F before adding the latex. The mixture shall be thoroughly mixed before application.

The finished latex-asphalt shall meet the following requirements:

Viscosity at 140 F, stokes	1500 maximum
Ductility at 39.2 F, 1 cm per min, cm	100 minimum

#### D. Application of Asphaltic Material

Immediately following the preparation of the existing surface by cleaning, the asphaltic material shall be applied at the rate of 0.25 to 0.30 gallon per square yard as determined by the Engineer or designated representative, so that uniform distribution is obtained at all points. Skip streaks on the pavement, due to defective distributor nozzles, will be reshot with a distributor at the expense of the Contractor.

The Contractor shall calibrate the spray bar nozzles by spreading building paper as required on the surface for a sufficient distance back from the end of each application so that flow through sprays may be started and stopped on the paper and so that all sprays will operate properly over the entire length being treated. Building paper so used shall be immediately removed and loaded on a truck. At

the end of each day, the paper shall be disposed of at a permitted site approved by the Engineer or designated representative.

Application temperatures will be determined by weather conditions but the temperature of the asphaltic material to be applied shall be between 150 and 160°F as determined by the Engineer or designated representative. When a street to be sealed is continuous through several intersections, sealed area will include all spandrels and stub-outs, unless otherwise directed by the Engineer or designated representative. Spandrels will be hand sprayed. Contractor shall not apply excessive amounts of asphaltic materials when hand spraying. Excessive materials applied shall be removed by the Contractor before spreading the aggregate.

The Contractor shall be required to seal all spandrels at the same time the adjacent streets are sealed, unless otherwise approved in writing by the Engineer.

During all applications, the surface of adjacent structures shall be protected in such a manner as to prevent their being splattered or marred. Building paper shall be spread on all manholes, valve boxes, junction boxes, etc. to protect the surface from asphaltic materials. The asphaltic material shall not be applied until the cover aggregate is available and ready to spread with assurance of continuous operation. No asphaltic material shall be placed which cannot be covered and rolled during daylight hours.

#### E. Spreading the Aggregate

The Contractor shall employ a mechanical aggregate spreader, which applies the aggregate uniformly over the surface at the rate of 15 to 20 pounds per square yard. The actual rate shall be as directed by the Engineer or designated representative.

The covering material in the quantity specified shall be spread uniformly over the bituminous material as soon after application as possible. The aggregate shall be spread in the same width of application as for the asphaltic material and spread uniformly with the aggregate spreading equipment.

Trucks spreading aggregate shall be operated backward so that bituminous material will be covered before truck wheels pass over it. The aggregate shall be applied to a thickness that will not produce blanketing or stacking. Any blanketing or stacking shall be removed prior to rolling. Backspotting or sprinkling cover aggregate shall be done by hand spreading, which will be continued during the operations whenever necessary, as directed by the Engineer or designated representative.

#### F. Brooming and Rolling

Rolling shall be started as soon as sufficient aggregate is spread to prevent pick-up and continued until no more aggregate can be worked into the surface. The surface shall be blanket rolled. The Contractor shall manage the Work so that all rolling of all cover aggregate applied that day is accomplished with a minimum of four complete coverages with pneumatic rollers prior to sundown.

In lieu of the rolling equipment specified, the Contractor may, upon written permission from the Engineer or designated representative, operate other compacting equipment that will produce equivalent relative compaction in the same period of time as the specified equipment.

In lieu of the rolling equipment specified, the Contractor may, upon written permission from the Engineer or designated representative, operate other compacting equipment that will produce equivalent relative compaction in the same period of time as the specified equipment.

Rollers shall be maintained in good repair and operating condition and shall be approved by the Engineer or designated representative.

The Contractor will be responsible for maintaining all streets for 48 hours after each street has been seal coated. Maintenance will consist of brooming, rolling and adding more aggregate as directed by the Engineer or designated representative.

#### G. Asphaltic Material Contractor's Responsibility

The Contractor shall furnish vendor's certified test report for asphaltic material shipped for the project. The report shall be delivered to the Engineer or designated representative before permission is granted for use of the material. Any change of source shall be reported prior to delivery.

#### 312S.6 - Traffic Control Facilities

The Contractor shall arrange the seal coat operation in such a manner as to avoid excessive inconvenience to the public in the seal coat area.

The Contractor shall notify all abutting property owners along the street prior to initiation of the seal coat operation.

The Contractor shall have on the project site sufficient barricades, flag-persons and traffic control devices to assure a minimum of inconvenience to traffic around the construction area in conformance with the General Conditions of the Standard Contract Documents. If the Contractor's arrangements are satisfactory to the Engineer or designated representative, the seal coat operation will not be allowed to commence.

After the seal coat has been applied, the Contractor shall post appropriate warning signs along these streets as directed by the Engineer or designated representative and maintain such signs for 48 hours.

#### 312S.7 - Final Cleanup

The Contractor shall vacuum sweep the completed seal coat and curb areas to remove loose aggregate as required during the first week after the traffic is allowed on the street.

#### 312S.8 - Measurement

All accepted Seal Coat will be measured by one of the following methods:

- A. "Asphaltic Material" will be measured in gallons at the applied temperature at the point of application on the street.
- B. "Aggregate" will be measured by the cubic yard in vehicles as applied on the street.
- C. "Aggregate (Stockpiled)", if required to be furnished, will be measured by the cubic yard of material in vehicles at the point of stockpiling.
- D. "Complete in Place" will be measured by the square yard of surface area treated.

#### 312S.9 - Payment

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit bid prices stipulated in the bid for "Seal Coat, Asphaltic

Material", "Seal Coat, Aggregate", "Seal Coat, Aggregate (Stockpiled)" or "Seal Coat, Complete in Place". The unit bid prices shall each include full compensation for: a) furnishing, delivering and placing all materials; b) patching, brooming, compacting and rolling; c) cleaning the existing surface, covering excess asphaltic material, removing excess aggregate and cleaning gutters and cleaning stockpiles sites; d) a 48 hour maintenance period and e) all labor, equipment, tools and incidentals necessary to complete the work required as indicated on the drawings.

Payment will be made under one of the following:

<b>Pay Item No. 312S-A:</b>	Seal Coat, Asphaltic Material	Per Gallon.
<b>Pay Item No. 312S-B:</b>	Seal Coat, Aggregate	Per Cubic Yard.
<b>Pay Item No. 312S-C:</b>	Seal Coat, Aggregate (Stockpiled)	Per Cubic Yard.
<b>Pay Item No. 312S-D:</b>	Seal Coat, Complete in Place	Per Square Yard.

END

ITEM NO. 313S - CLEANING AND/OR SEALING JOINTS AND CRACKS (ASPHALTIC CONCRETE)

313S.1 - Description

This item shall govern the cleaning and/or sealing of joints and cracks that are 1/16 inch or greater in asphaltic concrete pavement in conformity to the lines, grades and details indicated on the Drawings or as established by the Engineer or designated representative.

313S.2 - Submittals

The submittal requirements of this specification item include:

- A. Sealant Type (Polymer Modified Emulsion, Rubber-Asphalt or Self-Leveling Low Silicone) and method of application (crack sealing, joint sealing, squeegee, etc),
- B. Manufacturer certification that the product to be supplied meets or exceeds the specification requirements,
- C. Manufacturer recommended procedures for preparation, dispensing, application, curing etc of the sealant, and
- D. Listing of the equipment proposed for the Work.

313S.3 - Materials

Joints and/or cracks shall be sealed with the materials indicated on the Drawings. The materials shall meet the requirements shown below:

Material	Specification	Recommended Use
Polymer Modified Emulsion	301S; Subarticle 301S.3.1.1	Fine Cracks 1/16 to 1/8 in
Rubber-Asphalt Crack Sealing Compound	301S; Subarticle 301S.3.1.2	Cracks: $\geq 1/8$ inches
Self-Leveling Low Modulus Silicon	Class 5, TxDOT DMS-6310	Joints

Fine aggregate used to cover the crack-sealing compound shall meet with the approval of the Engineer or designated representative.

The sealing compound shall be delivered in the manufacturer's original sealed containers. Each container shall be legibly marked with the name of the manufacturer, the trade name of the sealer, the manufacturer's batch number or lot, the pouring temperature, and the safe heating temperature.

313S.4 - Equipment

Equipment, tools and machinery necessary for proper prosecution of the Work shall be on the project and shall be approved by the Engineer or designated representative prior to the initiation of the joint and crack cleaning and sealing operations

### 313S.5 - Heating and Application Equipment

#### A. Polymer Emulsified Emulsion

Polymer Emulsified Emulsion may be heated in a conventional asphalt distributor or in an asphalt heater equipped with an agitator to ensure that the emulsified asphalt is circulated during the heating process and achieves a uniform temperature rise. Temperature gauges shall be provided at strategic locations to enable the operator to accurately control the temperature of the emulsion to avoid overheating the material. The unit shall be equipped with a gear-driven asphalt pump with adequate pressure to dispense the emulsion in joints and cracks.

#### B. Rubber-Asphalt Crack Sealing Compound

The sealant shall be heated in a double jacketed heater using a heat transfer oil so that no direct flame comes in contact with the shell of the vessel containing the sealing compound. The heater reservoir shall be equipped with an agitator to ensure that the sealing compound is circulated during the heating process to achieve a uniform temperature rise and to maintain the desired temperature. Accurate temperature gauges and positive temperature controls shall be provided to monitor the temperature of the vessel contents and prevent overheating the material. The heater shall be equipped with a gear-driven asphalt pump with adequate pressure to dispense the rubber-asphalt crack sealing compound.

#### C. Self-Leveling Low Modulus Silicone

The sealant shall be prepared and dispensed using the manufacturer's recommended equipment.

### 313S.6 - Joint and Crack Cleaning Equipment

All equipment used in cleaning joints and cracks shall be capable of delivering a sufficient volume of filtered air, free of oil, water or other contaminants, to ensure the removal of all loose debris from the joints or cracks to be sealed.

When specified on the Drawings, joints shall be routed. The router shall be of sufficient size to rout the joints to the widths and depths shown on the Drawings.

### 313S.7 - Construction Methods

The bonding surface of cracks and joints shall be cleaned of infiltrated material with compressed air or other methods approved by the Engineer or designated representative to a depth at least twice the joint or crack width. When routing of the joints is indicated on the Drawings, the joints shall be routed and blown clean with filtered compressed air. All material removed from joints and cracks shall be removed from the paved surface of the roadway.

No sealing of any joints or cracks shall be done when the joints or cracks are damp, unless drying of the joints and cracks with compressed air can be demonstrated and meets with the approval of the Engineer or designated representative.

The joint or crack sealing material shall be applied using a pressure nozzle. Polymer modified emulsion and rubber- asphalt crack sealing compound shall penetrate and completely fill each crack and/or joint. All cracks and/or joints filled with these materials shall be squeegeed. The amount of sealing compound used shall be limited so that after the squeegee has been applied, the finished band shall be no more than 1½ inches wide and shall not exceed a depth of 1/8 in. above the pavement surface.

Self-leveling low modulus silicone joint sealing compound shall be applied so that it penetrates the joint and fills so that the top of the sealant shall be 1/4 to 3/8 inch below the pavement surface.

When directed by the Engineer or designated representative, a light coating of fine aggregate shall be applied to the cracks and joints before opening to traffic to prevent tracking.

When the number of cracks is so great that crack sealing in the manner described previously is impractical, the area shall be squeegee sealed. Areas to be squeegee sealed shall be indicated on the Drawings or established by the Engineer or designated representative. When all cracks in the area have been cleaned, the crack sealing material shall be applied and the excess shall be squeegeed over the area between the cracks. All polymer modified emulsion or hot poured rubber squeegee sealed areas shall be covered immediately after application with a light coating of fine aggregate.

#### 313S.8 - Measurement

Accepted work performed under this item shall be included in the unit price bid for other pay items and will not be measured and paid for unless a separate pay item is provided in the contract documents.

If a pay item is included in the contract documents, acceptable work for "Polymer Modified Emulsion", "Rubber Asphalt Joint and Crack Sealer" or "Self-leveling Low Modulus Silicone" shall be measured by the linear foot of cracks sealed.

If a pay item is included in the contract documents, acceptable work for "Polymer Modified Emulsion", "Rubber Asphalt Joint and Crack Sealer" or "Self-leveling Low Modulus Silicone" shall be measured by the pound of crack sealer used.

If a pay item is included in the contract documents, acceptable work for Squeegee seal with "Polymer Modified Emulsion" or "Rubber Asphalt Joint and Crack Sealer" shall be measured by the square yard of surface area sealed. The square yard calculations will be based on neat dimensions of the sealed area.

#### 313S.9 - Payment

When included as a pay item in the contract documents, the work performed and materials furnished as provided by this item and measured in accordance with Article 313S.8, "Measurement", will be paid for at the appropriate unit bid price bid. The unit bid prices shall include full compensation for cleaning and, if necessary, routing the crack/joint; furnishing, heating, hauling, and placing the crack sealer; all freight involved and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment, when included as a contract pay item, will be made under:

<b>Pay Item No. 313S-A:</b>	Polymer Modified Emulsion Joint and Crack Sealer	Per Lineal Foot.
<b>Pay Item No. 313S-B:</b>	Rubber Asphalt Joint and Crack Sealer	Per Lineal Foot.
<b>Pay Item No. 313S-C:</b>	Self-leveling Low Modulus Silicone Joint and Crack Sealer	Per Lineal Foot.
<b>Pay Item No. 313S-D:</b>	Polymer Modified Emulsion Joint and Crack Sealer	Per Pound of Sealer Used



<b>Pay Item No. 313S-E:</b>	Rubber Asphalt Joint and Crack Sealer	Per Pound of Sealer Used.
<b>Pay Item No. 313S-F:</b>	Self-leveling Low Modulus Silicone joint and Crack Sealer	Per Pound of Sealer Used.
<b>Pay Item No. 313S-G:</b>	Polymer Modified Emulsion Squeegee Sealing	Per square yard.
<b>Pay Item No. 313S-H:</b>	Rubber Asphalt Squeegee Sealing	Per square yard.

END

## ITEM NO. 315S - MILLING ASPHALTIC CONCRETE PAVEMENT AND NON-PORTLAND CEMENT CONCRETE BASES

### 315S.1 - Description

This item shall govern for the planing or the planing and texturing of existing asphaltic concrete pavement, asphalt stabilized and other non-Portland Cement Concrete base to depths indicated at the locations shown on the Drawings or as directed by the Engineer or designated representative. The item shall also include removal, and disposal or salvage/stockpiling the milled materials at the locations designated by the Engineer or designated representative.

When shown on the Drawings, the salvaged asphaltic concrete pavement and/or stabilized base, including any accompanying surface treatment, plant mix seal and micro-surfacing, may be allowed or required for use in other construction items of this project

### 315S.2 - Submittals

The submittal requirements of this specification item include:

- A. Characteristics (i.e. manufacturer, power, stability, speed, etc.) and capabilities (depth of cut, dust control, etc.) of the proposed milling equipment.
- B. Proposed plan for grade reference, control point spacing and support system.
- C. Proposed dust control plans including proposed equipment (type street sweeper, loader, water trucks, sprayers, etc.).

### 315S.3 - Equipment

The equipment for removing the pavement surface shall be a power operated planing machine or grinder with a minimum 2 feet cutting width. For detail work and cutting widths less than 2 feet, equipment with less than 2 feet cutting width shall be allowed. The equipment shall be self-propelled with sufficient power, traction and stability to maintain accurate depth of cut and slope. The equipment shall be capable of removing in one pass, asphaltic concrete pavement of a thickness of 1 inch and any required thickness less than 1-inch in a minimum 3-foot width. Machines capable of removing, in one pass, a depth greater than 1-inch will be permitted.

The grade reference used by the Contractor may be of any type approved by the Engineer or designated representative. Control points, if required by the Drawings, shall be set at intervals not to exceed 50 feet. The Contractor shall set the grade reference from the control points. The grade reference shall have sufficient support so that the maximum deflection shall not exceed 1/16 inch between supports.

The machine shall have a manual system providing for uniformly varying the depth of cut while the machine is in motion, thereby making it possible to cut flush to all inlets, manholes, or other obstructions within the paved area. The speed of the machine shall be variable in order to leave the desired grid pattern as specified in sections 315S.4 and 315S.5.

The machine shall be equipped with an integral loading and reclaiming means to immediately remove material being cut from the surface of the roadway and discharge the cuttings into a truck, all in one operation. The machine shall be equipped with means to control dust created by the cutting action. Adequate backup equipment (mechanical street sweepers, loaders, water truck, sprayers, brooms etc.) and personnel will also be provided to keep flying dust to a minimum and to ensure that all cuttings are

removed from the street surface daily. Stockpiling of planed material will not be permitted on the project site.

Various machines may be permitted to make trial runs to demonstrate the capabilities of that machine and to determine the acceptability of that machine to the Engineer or designated representative. Any machine that is incapable, in the opinion of the Engineer or designated representative, of meeting these requirements will not be permitted.

#### 315S.4 - Construction Methods

- A. General. The pavement surface shall be removed for the length, depth and width and to the typical section shown on the Drawings, and to the lines and grades established by the Engineer or designated representative. The planed surface shall provide a satisfactory riding surface free from gouges, continuous longitudinal grooves, ridges, oil film and other imperfections and shall have a uniform textured appearance.

When an existing asphaltic concrete pavement overlay is to be removed from an underlying PC concrete pavement, all of the asphaltic concrete pavement shall be removed, leaving a uniform surface of PC concrete, unless otherwise directed by the Engineer or designated representative.

- B. Surface Milling. Surface milling shall be taken to a minimum depth of 1.5 inches or deeper as may be dictated by delamination of asphalt layers during the milling operation, to a depth of 1 inch below the lip gutter transitioning to the existing surface in 3 feet or as indicated on the Drawings for resurfacing operations. The pavement surface shall be removed to the appropriate milling depths around all castings within the area to be milled. When milling is used for leveling without the addition of asphalt, the milled surface shall be free of ridges deeper than 3/16 inch.

Pavement, which is adjacent to steep curbs, inlets, manholes or other obstructions and that is not removed by the planing machine, shall be removed by other methods, acceptable to the Engineer or designated representative.

The pavement and curb surfaces shall be swept with a street sweeper or other sweeping equipment approved by the Engineer or designated representative to remove all debris leaving a clean and presentable condition.

- C. Edge Milling. Edge milling at the gutter lip shall be taken to a minimum depth of 1/4 inch less than the overlay thickness and shall transition to the existing surface in a minimum of 6 feet.
- D. Spot Milling. Milling for spot repairs shall be completed in successive passes to the depth specified. Ramping for spot repairs shall be minimized. "Transition milling required at the beginning and ending of the overlay shall be taken to a minimum depth of the overlay thickness and transition to the existing surface for the length specified in the plans.
- E. Miscellaneous. Unless otherwise specified, the milling material shall remain the property of the Contractor. Temporary stockpiling shall not be permitted on site. Temporary pavement markings shall conform to Item No. 864S, "Abbreviated Pavement Markings".

### 315S.5 - Surface Texture (Temporary Traffic Only)

In those areas where traffic will temporarily be permitted, the texture produced shall be a grid pattern or any other pattern with discontinuous longitudinal striations that will provide, in the opinion of the Engineer, a satisfactory riding surface.

When the planed pavement will not be overlaid, the minimum texture depth resulting from the number of measurements directed by the Engineer shall not be less than 3/64 inch, unless specified otherwise on the Drawings. When these texture requirements are not met, the Contractor shall cease operations until the Engineer is satisfied that changes in the texturing procedures will produce an acceptable texture.

The Contractor shall take care to prevent damage to armor joints, sealed expansion joints and/or other appurtenances.

The surface of the pavement, after planing, shall have a smooth riding quality and shall be true to the established line, grade and cross section.

### 315S.6 - Measurement

Work prescribed by this item will be measured by the square yard of surface area for actual quantities based on the neat dimensions indicated for surface and transition milling, spot repairs and edge milling to the specified width. Ramping for spot repairs shall not be measured for payment. Surface milling for spot repairs shall be included in the unit price bid for the spot milling area measured.

Measurement will be made only one time regardless of the number of passes required by the machine to secure the depth desired.

### 315S.7 - Payment

The work performed in accordance with this item and measured as provided under "Measurement", will be paid for at the unit bid price per square yard for "Milling Asphaltic Concrete Paving and Non-Portland Cement Bases". The price shall include full compensation for removal of all materials to the depth shown; minimizing the dust escaping to the atmosphere; loading, hauling, unloading and satisfactorily storing or disposing of the material; and for all labor, tools, equipment, manipulation, temporary pavement markings and incidentals to complete the work, including mobilization of the milling machine.

No payment will be made for work done by any machine on a trial run to demonstrate its ability to meet this specification unless the work performed is acceptable under this specification.

Payment will be made under the following:

<b>Pay Item No. 315S-A:</b>	Surface Milling	Per Square Yard.
<b>Pay Item No. 315S-B:</b>	Profile Milling	Per Square Yard.
<b>Pay Item No. 315S-C:</b>	Transition Milling	Per Square Yard.
<b>Pay Item No. 315S-D:</b>	Edge Milling	Per Square Yard.
<b>Pay Item No. 315S-E:</b>	Spot Milling	Per Square Yard.

END

ITEM NO. 316S - POLYMERIZED ASPHALT INTERLAYER SEAL

316S.1 - Description

This item shall govern the sealing of an existing pavement surface with a single application of polymerized asphalt covered with aggregate prior to the construction of asphalt overlays.

316S.2 - Submittals

The submittal requirements of this specification item include:

- A. Recommended design mix (emulsion type, aggregate type, type and % of polymer)
- B. Test results on the emulsion (Saybolt Furol Viscosity, storage stability, demulsibility, sieve test, distillation test and residue tests).
- C. Test results on the aggregate (gradation and percent wear).
- D. Characteristics (i.e. manufacturer, rate of application, speed, etc.) of the proposed distributor and aggregate spreader.
- E. List of facilities and equipment proposed for temperature measurements.
- F. List of facilities and equipment proposed for storage and handling of asphaltic materials.

316S.3 - Material

A. Polymerized Asphalt Emulsion

The asphalt must be mixed with 3% of HFRS-2P polymer or as determined by the Engineer or designated representative prior to emulsification. The emulsion is classified as a high float, rapid setting, anionic type emulsion for underseal coat. The product shall meet the following characteristics and test requirements.

1. Tests on emulsion:

	Minimum	Maximum
Viscosity, Saybolt Furol at 122°F, sec.	150	400
Storage stability, 1 day, %	-	1
Demulsibility, 35 ml of 0.02 N CaCl <sub>2</sub> , %	40	-
Sieve Test, %	-	0.1
** Distillation Test:		
Oil Distillate by Volume of Emulsion, %	-	1/2
Residue, % by weight (mass)	65	-

\*\* The temperature on the lower thermometer shall be brought slowly to 350°F plus or minus 10°F and maintained at this temperature for 20 minutes. The total distillation shall be completed in 60 minutes plus or minus 5 minutes from the first application of heat.

The material after setting undisturbed for 24 hours shall show no white milky separation, but shall be smooth and homogeneous throughout.

2. Test Results on Residue from Distillation

Tests on Residue from Distillation	Minimum	Maximum
Float Value at 140°F (60°C), sec.	1200	-
Penetration at 77°F (25°C), 100g, 5 sec., 0.1 mm	100	140
Ductility, 77°F , 5 cm/min, cm (25°C, 50 mm/min, mm)	100 (1000)	-
Viscosity at 140°F, poises (60°C, Pa-s)	1500 (150)	-
Solubility in Trichloroethylene, %	97.5	-

B. Aggregate

Aggregate material shall be crushed limestone or dolomite. The percent of wear as determined by test method Tex-410-A (Los Angeles Abrasion Test) shall not exceed (35) percent. The aggregate, when tested by TxDOT Test Method Tex-200-F, Part I, shall meet the following gradation requirements:

Sieve Sizes	% by Weight (mass)
Retained on 1/2" sieve	0
Retained on 3/8 " sieve	0—5
Retained on No. 4 sieve	15—45
Retained on No. 10 sieve	90—100
Retained on No. 20 sieve	95—100

316S.4 - Equipment

(Revised 11/16/20)

316S - 2 POLYMERIZED ASPHALT INTERLAYER SEAL

The equipment for construction of the interlayer seal shall include the following: asphalt storage tanks and heaters, distributors, aggregate spreaders, blade equipped tractor and drag broom, pneumatic rollers, water truck with pump and rotary broom.

All equipment used in storing or handling asphaltic material shall be kept clean and in good operating condition at all times and shall be operated in such manner that there will be no contamination of the asphalt material. It shall be the responsibility of the Contractor to provide and maintain a recording thermometer to continuously indicate the temperature of the asphalt material at the storage-heating unit, when storing of asphalt is permitted.

The distributor shall have pneumatic tires of such width and number that the load produced on the street surface shall not exceed 650 pounds per inch of tire width and shall be so designed, equipped, maintained and operated that asphaltic material at even heat may be applied uniformly on variable widths of surface at readily determined and controlled rates of from 0.05 to 0.2 gallons per square yard, with a pressure range of from 25 to 75 pounds per square inch, and with an allowable variation from any specified rate not to exceed 5 percent. Distributor equipment shall include tachometer, pressure gauges, volume measuring devices and a thermometer for reading temperatures of tank contents.

The aggregate spreading equipment shall be adjusted and capable of spreading aggregate at controlled amounts per square yard in a continuous manner.

The drag broom shall be light weight street type, mounted on a frame, designed to spread aggregate uniformly over the surface of a bituminous pavement and equipped with pull plates for towing. Towing equipment shall be pneumatic tired.

Rollers shall conform to Item No. 232S, "Rolling (Pneumatic Tire)", Light Pneumatic Tire Roller.

Rotary brooms shall be suitable for cleaning the surfaces of bituminous pavements.

Vacuum sweepers shall be suitable for removing any loose aggregate without disturbing the compacted seal coat.

#### 316S.5 - Construction Methods

Prior to commencement of this work, all erosion control, environmental protection measures and all traffic control devices shall be in place.

Seal Coats may be applied when the surface on which the seal coat is to be placed is 60°F or above and the air temperature is above 50°F and rising, if the temperature is measured in the shade and away from artificial heat. Asphaltic material shall not be placed when general weather conditions are not suitable for a satisfactory seal coat or when the environment could be damaged.

##### A. Cracks and Holes

Cracks and holes will be patched by the Contractor prior to seal coat operations. Patching materials shall be hot mix, hot laid Asphaltic Concrete Pavement in conformance with Item 340S, "Hot Mix Asphaltic Concrete Pavement", or other asphaltic materials as approved by the Engineer or designated representative.

##### B. Cleaning Existing Surfaces

Prior to placement of the seal coat, loose dirt and other objectionable material shall be removed from the existing surface. The surface will be cleaned with a rotary broom. Hand brooms will be used in areas not accessible to rotary brooms. The Engineer or designated representative must approve all streets before application of any asphalt.

C. Application of Asphaltic Material

Immediately following the preparation of the existing surface by cleaning, the asphaltic material shall be applied at the rate of 0.2 to 0.24 gallon per square yard as determined by the Engineer or designated representative, so that uniform distribution is obtained at all points. Skip streaks on the pavement, due to defective distributor nozzles, will be reshot with a distributor at the expense of the Contractor.

The Contractor shall calibrate the spray bar nozzles by spreading building paper as required on the surface for a sufficient distance back from the end of each application so that flow through sprays may be started and stopped on the paper and so that all sprays will operate properly over the entire length being treated. Building paper so used shall be immediately removed and loaded on a truck. At the end of each day, the paper shall be disposed of at a permitted site approved by the Engineer or designated representative.

Application temperatures will be determined by weather conditions but the temperature of the asphaltic material to be applied shall be between 150 and 160°F as determined by the Engineer or designated representative. When a street to be sealed is continuous through several intersections, sealed area will include all spandrels and stub-outs, unless otherwise directed by the Engineer or designated representative. Spandrels will be hand sprayed. Contractor shall not apply excessive amounts of asphaltic materials when hand spraying. Excessive materials applied shall be removed by the Contractor before spreading the aggregate.

The Contractor shall be required to seal all spandrels at the same time the adjacent streets are sealed, unless otherwise approved in writing by the Engineer or designated representative.

During all applications, the surface of adjacent structures shall be protected in such a manner as to prevent their being splattered or marred. Building paper shall be spread on all manholes, valve boxes, junction boxes, etc. to protect the surface from asphaltic materials. The asphaltic material shall not be applied until the cover aggregate is available and ready to spread with assurance of continuous operation.

No asphaltic material shall be placed which cannot be covered and rolled during operating hours established for that street as stipulated on the drawings.

D. Spreading the Aggregate

The Contractor shall employ a mechanical aggregate spreader, which applies the aggregate uniformly over the surface at the rate of 15 to 20 pounds per square yard. The actual rate shall be as directed by the Engineer or designated representative.

The covering material in the quantity specified shall be spread uniformly over the bituminous material as soon after application as possible. The aggregate shall be spread in the same width of application as for the asphaltic material and spread uniformly with the aggregate spreading equipment.



Trucks spreading aggregate shall be operated backward so that bituminous material will be covered before truck wheels pass over it. The aggregate shall not be applied in such thickness to cause blanketing or stacking. Any blanketing or stacking shall be removed prior to rolling. Backspotting or sprinkling cover aggregate shall be done by hand spreading, which will be continued during the operations whenever necessary, as directed by the Engineer or designated representative.

#### E. Brooming and Rolling

Rolling shall be started as soon as sufficient aggregate is spread to prevent pick-up and continued until no more aggregate can be worked into the surface. The surface shall be blanket rolled. The Contractor shall manage the Work so that all rolling of all cover aggregate applied that day is accomplished prior to sundown with a minimum of four complete coverages with pneumatic rollers.

In lieu of the rolling equipment specified, the Contractor may, upon written permission from the Engineer or designated representative, operate other compaction equipment that will produce equivalent relative compaction in the same period of time as the specified equipment.

Rollers shall be maintained in good repair and operating condition and shall be approved by the Engineer or designated representative.

The pony blading or drag brooming should start as soon as possible after the rolling has started and the surface has set sufficiently to prevent excessive marking of the seal surface. Further pony blading or drag brooming should be done as often as necessary to keep cover aggregate uniformly distributed over the street surface. At no time shall there be less than 2 pneumatic tire rollers on the job. The use of the pony blade or drag broom in connection with the rolling will be left to the opinion of the Engineer or designated representative as to which gives the desired results.

The Contractor will be responsible for maintaining all streets for 48 hours after each street has been seal coated. Maintenance will consist of brooming, rolling and adding more aggregate as directed by the Engineer or designated representative.

#### F. Curing of Interlayer Seal

The Contractor shall allow the interlayer seal to cure a minimum of 24 hours before applying the HMAC overlay unless otherwise approved by the Engineer or designated representative.

#### G. Asphaltic Material Contractor's Responsibility

The Contractor shall furnish vendor's certified test report for asphaltic material shipped for the project. The report shall be delivered to the Engineer or designated representative before permission is granted for use of the material. Any change of source shall be reported prior to delivery.

#### 316S.6 - Traffic Control Facilities

The Contractor shall schedule and conduct the seal coat operations to avoid excessive inconvenience to the public in the seal coat area.

The Contractor shall notify all abutting property owners along the street prior to initiation of the seal coat operation.

The Contractor shall have on the project site sufficient barricades, flag-persons and traffic control devices to assure a minimum of inconvenience to traffic around the construction area in conformance with the

General Conditions of the Standard Contract Documents. If the Contractor's arrangements are not satisfactory to the Engineer or designated representative, the seal coat operation will not be allowed to commence.

After the seal has been applied, the Contractor shall post appropriate warning signs along these streets as directed by the Engineer or designated representative and maintain such signs for 48 hours.

#### 316S.7 - Final Cleanup

The Contractor shall vacuum sweep the completed seal coat and curb areas to remove loose aggregate as required during the first week after the traffic is allowed on the street.

#### 316S.8 - Measurement

All accepted Polymerized Asphalt Underseal Coat will be measured by one of the following methods:

- A. "Polymerized Asphalt Emulsion" will be measured in gallons at the applied temperature at the point of application on the street.
- B. "Aggregate" will be measured by the cubic yard in vehicles as applied on the street.
- C. "Complete in Place" will be measured by the square yard of surface area treated, including polymerized asphalt emulsion and aggregate.

#### 316S.9 - Payment

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit bid prices stipulated in the bid for "Polymerized Asphalt Underseal Coat", "Polymerized Asphalt Emulsion", "Polymerized Underseal Coat, Aggregate" or "Polymerized Asphalt Underseal Coat, Complete in Place". The unit bid prices shall include full compensation for: a) furnishing, delivering and placing all materials; b) patching, brooming, compacting and rolling; c) cleaning the existing surface and gutters, covering excess asphaltic material, removal of excess aggregate and cleaning stockpiles sites; d) a 48 hour maintenance period and e) all labor, equipment, tools and incidentals necessary to complete the required work as indicated on the Drawings.

Payment will be made under one of the following:

<b>Pay Item No. 316S-A:</b>	Polymerized Asphalt Underseal Coat, Polymerized Asphalt Emulsion	Per Gallon.
<b>Pay Item No. 316S-B:</b>	Polymerized Asphalt Underseal Coat, Aggregate	Per Cubic Yard.
<b>Pay Item No. 316S-C:</b>	Polymerized Asphalt Underseal Coat, Complete in Place	Per Square Yard.

**END**

## ITEM NO. 320S - TWO COURSE SURFACE TREATMENT

### 320S.1 - Description

This item shall govern the construction of a wearing surface composed of a double application of asphaltic material, each covered with aggregate, constructed on existing pavements, a prepared base course or surface in accordance with these specifications.

### 320S.2 - Submittals

The submittal requirements of this specification item include:

- A. Recommended design mix (asphaltic material, aggregate type, modifier type and %)
- B. Test results on the asphaltic material (Viscosity, penetration, solubility, ductility, stability, distillation test, residue tests, etc.).
- C. Test results on the aggregate (gradation and percent wear).
- D. Characteristics (i.e. manufacturer, rate of application, speed, etc.) of the proposed distributor and aggregate spreader.
- E. List of facilities and equipment proposed for temperature measurements.
- F. List of facilities and equipment proposed for storage and handling of asphaltic materials.

### 320S.3 - Materials

All material shall be of the type(s) and grade(s) shown on the Drawings and shall conform to the pertinent material requirements for the following items:

#### A. Asphaltic Materials

The asphaltic materials used shall conform to Item No. 301S, "Asphalts, Oils and Emulsions" as follows:

- 1. Air Temperature 65 to 80° F, HFRS-2
- 2. Air Temperature over 81° F, RS-2

#### B. Aggregate

The aggregate materials shall conform to Item No. 302S, "Aggregate for Surface Treatments" as follows:

- 1. First Course
  - Grade 3
- 2. Second Course
  - Grade 5

#### C. Aggregate (Stockpiled)

When the Drawings include the Item, "Aggregate (Stockpiled)", aggregate of the type and grade specified for the surface treatment shall be stockpiled within the limits of the project at sites designated on the drawings or as directed by the Engineer or designated representative. Stockpile sites shall be leveled, if required and prepared as specified herein. The Contractor shall load, haul, distribute and apply the stockpiled aggregate in accordance with specification requirements governing for this item. The stockpile areas and remaining stockpiles shall be left in a neat condition satisfactory to the Engineer or designated representative.

#### D. Temporary Pavement Markings

Temporary pavement markings shall conform to Item No. 864S, "Abbreviated Pavement Markings".

#### 320S.4 - Construction Methods

Prior to commencement of this work, all required erosion control and tree protection measures shall be in place and the utilities located and protected as specified in the City of Pflugerville Engineering Design Manual & Construction Standards. Construction equipment shall not be operated within the drip line of trees unless otherwise indicated. Construction materials shall not be stockpiled under the canopies of trees. Excavation or embankment materials shall not be placed within the drip line of trees until tree wells are constructed.

The two course surface treatment shall be applied when the air temperature is above 50°F and rising. Air temperature shall be taken in the shade and away from artificial heat. The two course surface treatment shall not be applied when the temperature of the roadway surface is below 60°F.

When latex modified asphalt cement is specified, the two course surface treatment shall be applied when the air temperature is above 70°F and rising. Air temperature shall be taken in the shade and away from artificial heat. The two course surface treatment shall not be applied when the temperature of the roadway surface is below 70°F.

Asphaltic material shall not be placed when general weather conditions, in the opinion of the Engineer or designated representative, are not suitable.

The area to be treated shall be cleaned of dirt, dust or other deleterious matter by sweeping or other approved methods. If deemed necessary by the Engineer or designated representative, the surface shall be lightly sprinkled just prior to the first application of asphaltic material.

The Contractor shall be responsible for the proper preparation of all stockpile areas before aggregates are placed thereon, including leveling, cleaning of debris necessary for protection of the aggregate to prevent any contamination thereof and cleanup of any stockpile area at the completion of the work.

All storage tanks, piping, retorts, booster tanks and distributors used in storing or handling asphaltic materials shall be kept clean and in good operating condition at all times and shall be operated in such manner that there will be no contamination of the asphaltic material with foreign material. It shall be the responsibility of the Contractor to provide and maintain in good working order a recording thermometer at the storage heating unit at all times.

Application temperatures will be determined by weather conditions within the limits recommended in Specification Item No. 301S, "Asphalts, Oils and Emulsions", as determined by the Engineer or designated representative.

The Contractor shall provide all necessary facilities for determining the temperature of the asphaltic material in all of the heating equipment and in the distributor for determining the rate at which it is applied and for securing uniformity at the junction of two distributor loads. The distributor shall have been calibrated within three (3) years from the date it is first used on this project. The Contractor shall furnish the Engineer or designated representative with an accurate and satisfactory record of such calibration. After beginning the work, should the rate of the asphaltic material appear to be inappropriate, the distributor shall be adjusted to provide a satisfactory rate before proceeding with the work.

When a uniform application of asphaltic material is not being achieved, the Engineer or designated representative may require that the Contractor provide an operator at the rear of the distributor to manually control the spray bar operations.

Asphaltic material for each course may be applied for the full width of the surface treatment in one application, unless the width exceeds 26 feet. No traffic or hauling will be permitted over the freshly applied asphaltic material. The asphaltic material shall not be applied until immediate covering is assured.

#### A. First Course

Asphaltic material for the first course shall be applied on the clean surface by an approved type of self-propelled pressure distributor so operated as to distribute the material, evenly and smoothly, under a pressure necessary for proper distribution at a rate of 0.30 to 0.35 gallons per square yard or as directed by the Engineer or designated representative.

Aggregate for the first course shall be immediately and uniformly applied and spread by an approved self-propelled continuous feed aggregate spreader, unless otherwise indicated or authorized by the Engineer in writing. The aggregate shall be applied at the approximate rate of 15 to 20 lbs. per square yard or as directed by the Engineer or designated representative. The Contractor shall be responsible for the maintenance of the surface of the first course until the second course is applied.

The entire surface shall then be broomed, bladed or raked as required by the Engineer and shall be thoroughly rolled in accordance with Specification Item No. 230S, "Rolling (Flat Wheel)" with power rollers of the three-wheel or tandem, self-propelled type, weighing not less than 3 tons nor more than 6 tons. All wheels shall be flat.

In lieu of the rolling equipment specified, the Contractor may, upon written permission from the Engineer or designated representative, operate other compacting equipment that will produce equivalent relative compaction in the same period of time as the specified equipment. If the substituted compaction equipment fails to produce the desired compaction within the same period of time as would be expected of the specified equipment, as determined by the Engineer or designated representative, its use shall be discontinued. Rollers shall be maintained in good repair and condition and shall be approved by the Engineer or designated representative prior to their use.

#### B. Second Course

It is the intent of this specification that the application of asphalt and aggregate for the second course be applied within the same day or immediately thereafter and prior to opening the roadway to traffic.

The second course shall consist of asphaltic material and aggregate applied and covered in the manner specified for the first application. The surface shall then be broomed, bladed or raked as required by the Engineer or designated representative and thoroughly rolled in accordance with Standard Specification Item No. 232S, "Rolling (Pneumatic Tire)" with a pneumatic tire roller.

Asphaltic materials for the course shall be applied at the rate of 0.25 gallons per square yard or as directed by the Engineer or designated representative. Aggregate for the second course shall be applied at the rate of 14 to 18 lbs. per square yard or as directed by the Engineer or designated representative.

The Contractor shall be responsible for the maintenance of the surface treatment until the work is accepted by the Engineer or designated representative. All holes or failures in the surface shall be repaired by use of additional asphalt and aggregate. All fat or bleeding surfaces shall be covered with approved cover material in such a manner that the asphaltic material will not adhere to or be picked up by the wheels of vehicles.

Temporary pavement markings shall be placed in accordance with Item No. 864S, "Abbreviated Pavement Markings".

**320S.5 - Measurement**

A "Two Course Surface Treatment" application shall be measured by the square yard of completed and accepted two-course surface treatment.

**320S.6 - Payment**

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid at the unit bid price for two course surface treatment. The price shall each include full compensation for: a) cleaning and sprinkling the base; furnishing, preparing, hauling and placing all materials, and rolling, b) all freight involved; c) all manipulations, labor, tools, equipment cleanup, and temporary pavement markings and d) all incidentals necessary to complete the work.

Payment will be made under the following:

<b>Pay Item No. 320S-A:</b>	Two Course Surface Treatment Plan Quantity	Per Square Yard
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**END**

## ITEM NO. 340S - HOT MIX ASPHALTIC CONCRETE PAVEMENT

### 340S.1 - Description

This item shall govern base, level up, and pavement surface courses composed of a compacted mixture of aggregate and asphaltic cement mixed hot in a mixing plant. The hot mix asphaltic (HMA) concrete pavement shall be constructed on a previously completed and approved subgrade, subbase material, base material, concrete slab or existing pavement.

### 340S.2 - Submittals

The submittal requirements of this specification item may include:

- A. A mix design submittal including the plant corrected Job Mix Formula (JMF) for the hot mix asphaltic concrete.
- B. Certification that the aggregate materials meet appropriate quality requirements.
- C. Particle-size gradation and specific gravity tests on all aggregate materials.
- D. Certification that the asphalt cement for paving materials meet appropriate quality requirements.

### 340S.3 - Materials

The Contractor shall furnish materials to meet the requirements specified herein and shall be solely responsible for the quality and consistency of the product delivered to the Project.

- A. Aggregate: The aggregate shall be composed of coarse aggregate, a fine aggregate and, if required or allowed, mineral filler and reclaimed asphalt pavement (RAP). RAP use will be allowed in all base course mixtures except as specifically excluded herein, in the Contract Documents or on the Drawings, provided no more than 20% RAP is used.

RAP use will not be permitted in pavement surface courses.

No reclaimed asphaltic shingle (RAS) will be allowed for use unless approved by the Engineer or the City.

Aggregates shall meet the quality requirements of Table 1 and other requirements as specified herein. The aggregate contained in RAP will not be required to meet Table 1 requirements unless indicated otherwise on the Drawings.

1. Coarse Aggregate: Coarse aggregate is defined as that part of the aggregate retained on the No. 10 sieve and shall consist of clean, tough, durable fragments of crushed stone or crushed gravel of uniform quality throughout.

Gravel from each source shall be crushed to the extent that it has a minimum of 85% of the particles retained on the No. 4 sieve with two or more mechanically induced crushed faces as determined by TxDOT Test Method TEX-460-A (Part I). The material passing the No. 4 sieve and retained on the No. 10 sieve must be the produced from crushing aggregate that was originally retained on the No. 4 sieve.

2. Reclaimed Asphalt Pavement (RAP): RAP is defined as a salvaged, milled, pulverized, broken or crushed asphaltic pavement. The RAP to be used in the mix shall be crushed or broken to the extent that 100 percent will pass the 2-inch sieve.

The RAP shall be stockpiled in such a manner that assures that it will not become contaminated by dirt or other objectionable materials. Unless indicated otherwise on the Drawings, stockpiled, crushed RAP must not exhibit a decantation more than 5 percent or a plasticity index more than 8, when tested in accordance with TxDOT Test Method Tex-406-A, Part I, or Test Method Tex-106-E, respectively.

3. Fine Aggregate: Fine aggregate is defined as that part of the aggregate passing the No. 10 sieve and shall be of uniform quality throughout. A maximum of 15 percent of the total aggregate may be field sand or other uncrushed fine aggregate.

Screenings shall be supplied from sources whose coarse aggregate meets the abrasion and magnesium sulfate soundness loss requirements shown in Table 1.

- a. Unless indicated otherwise on the Drawings, stone screenings, which are the product of a rock crushing operation, are required and shall meet the following gradation requirements when tested in accordance with TxDOT Test Method Tex-200-F, Part I.

Material	Percent by Weight
Passing 3/8 inch sieve	100
Passing No. 10 sieve	70—100
Passing No. 200 sieve	0—15

- b. Crushed gravel screenings may be used with, or in lieu of, stone screenings only when indicated on the Drawings. Crushed gravel screenings must be the product of crushing aggregate that was originally retained on the No. 4 sieve and must meet the gradation for stone screenings shown above.

4. Mineral Filler: Mineral filler shall consist of thoroughly dried stone dust, Portland Cement (PC), fly ash, lime or other mineral dust approved by the Engineer or designated representative. The mineral filler shall be free from foreign matter.

PC manufactured in a cement kiln fueled by hazardous waste shall be considered as an approved product if the production facility is authorized to operate under regulation of the Texas Natural Resource Conservation Commission (TNRCC) and the U. S. Environmental Protection Agency (EPA). Supplier shall provide current TNRCC and EPA authorizations to operate the facility.

Fly ash obtained from a source using a process fueled by hazardous waste shall be considered as an approved product if the production facility is authorized to operate under regulation of the Texas Natural Resource Conservation Commission (TNRCC) and the U. S. Environmental



Protection Agency (EPA). Supplier shall provide current TNRCC and EPA authorizations to operate the facility.

The addition of baghouse fines or other collected fines will be permitted if the mixture quality is not adversely affected in the opinion of the Engineer or designated representative. In no case shall the amount of material passing the No. 200 sieve exceed the tolerances of the job-mix formula or the master gradation limits.

When tested by Tex-200-F (Part I or Part III, as applicable), the mineral filler shall meet the following gradation requirements. Baghouse fines are not required to meet the gradation requirements.

<b>Material</b>	<b>Percent by Weight</b>
Passing No. 30 Sieve	95—100
Passing No. 80 Sieve, not less than	75
Passing No. 200 Sieve, not less than	55

**TABLE 1: AGGREGATE QUALITY REQUIREMENTS \***

<b>Requirement</b>	<b>Test Method</b>	<b>Amount</b>
<b>COARSE AGGREGATE</b>		
Deleterious Material, percent, maximum	Tex-217-F, I	1.5
Decantation, percent, maximum	Tex-217-F, II	1.5
Los Angeles Abrasion, percent, maximum	Tex-410-A	40
Magnesium Sulfate Soundness Loss 5 cycle, percent, maximum	Tex-410-A	30
<b>FINE AGGREGATE</b>		
Linear Shrinkage, maximum	Tex-107-E, II	3
<b>COMBINED AGGREGATES</b>		
Sand Equivalent Value, minimum	Tex-203-F	45

\* - Aggregates, without added mineral filler or additives, combined as used in the job-mix formula (Plant Corrected).

B. Asphaltic Material:

1. Paving Mixture: Asphalt cement for the paving mixture shall conform to the requirements of Standard Specification Item No. 301S, "Asphalts, Oils and Emulsions", for AC-20 or PG64-22, Styrene (SBS) Modified Asphalt Cement, AC-SBS Blend AC-45P or PG76-22S, unless otherwise indicated in the Project Documents.

2. Tack Coat: Tack Coat shall conform to Standard Specification Item No. 307S, "Tack Coat".

C. Additives: Additives to facilitate mixing and/or improve the quality of the asphaltic mixture or tack coat may be used with the authorization of the Engineer or designated representative. The Contractor may choose to use either lime or a liquid anti-stripping agent to reduce moisture susceptibility of the aggregate.

#### 340S.4 - Paving Mixtures

An asphalt mixture design is developed by a laboratory process, which includes the determination of the quality and quantity of the asphalt cement and the individual aggregates, and the testing of the combined mixture (Laboratory Design). The Laboratory Design is subsequently revised to produce an appropriate job mix formula.

The job mix formula (JMF) lists the quantity of each component to be used in the mix after the laboratory design has been adjusted by running it through a particular plant (i.e. the mix design is Plant Corrected). The JMF will be the standard to which the Acceptance Plan will be applied. The JMF of one drum or batching unit shall not be used for another unit.

The Contractor shall submit to the Engineer on forms provided by the Engineer or designated representative, an asphalt mixture design reviewed, signed and sealed by a Registered Professional Engineer licensed in the State of Texas or certified by a TxDOT Level II Certified Asphalt Technician. An asphalt mixture design shall be submitted for a comprehensive review every two (2) years. Mix designs older than one year will not be accepted without a review of current test data of the proposed materials and current mix design to ensure that the materials meet specification requirements.

The JMF (Plant Corrected) shall be submitted to the Engineer or designated representative on a form provided by the Engineer through the Construction Inspector or Project Manager of the Project for review, for each individual Project, a minimum of three (3) working days before the mixture is to be placed. Under no circumstances will a mixture be placed before its use is reviewed and approved by the Engineer or designated representative.

Performance of the mix design shall remain the responsibility of the Contractor.

A. Mixture Design: The mix shall be designed in accordance with TxDOT Construction Bulletin C-14 and Test Method Tex-204-F to conform with the requirements herein. The master grading limits of the appropriate type and the JMF will be plotted on a graduated chart with sieve sizes raised to the 0.45 power and will be submitted to the Engineer or designated representative with the asphalt mixture design.

The Bulk Specific Gravity of aggregates in RAP will be determined on extracted aggregates.

- B. Types: The blend of coarse aggregate, fine aggregate, and mineral filler, if allowed, that is established by TxDOT Test Method Tex-200-F, Dry Sieve Analysis, shall conform to the master gradation shown in Table 2 for the type of specified mixture. The voids in the mineral aggregate (VMA) will be determined as a mixture design requirement only, in accordance with TxDOT Test Method Tex-207-F, and shall not be less than the value indicated in Table 2.

**TABLE 2: Master Grading - Percent Passing by Weight (Mass) or Volume**

Sieve Size US (SI)	Type A Coarse Base	Type B Fine Base	Type C Coarse Surface	Type D Fine Surface	Type F Fine Mixture
1½"	100				
1¼"	95—100				
1"		100			
7/8 "	70—90	95—100	100		
5/8 "		75—95	95—100		
1/2"	50—70			100	
3/8 "		60—80	70—85	85—100	100
1/4"					95—100
No. 4	30—50	40—60	43—63	50—70	
No. 10	20—34	27—40	30—40	32—42	32—42
No. 40	5—20	10—25	10—25	11—26	9—24
No. 80	2—12	3—13	3—13	4—14	3—13
No. 200	1—6*	1—6*	1—6*	1—6*	1—6*
VMA % minimum	11	12	13	14	15
Rec. Min. Lift	3"	2"	1¼"	1"	3/4"

- C. Tolerances: Fluctuations in the aggregate gradation and asphalt content of the Job Mix Formula (JMF) shall not vary by more than the following criteria but the aggregate gradation shall be limited to the range of the master gradation as established by Tex-210-F.

SIEVES	Percent By Weight
2" Sieve through No. 10" Sieve	±5.0
No. 40 through No. 200 Sieve	±3.0
Asphalt Content	±0.5

- D. Stability and Density: The mixture shall be designed at or near optimum density, as indicated on the Drawings, to conform to the following percent of Maximum Theoretical Density as measured by TxDOT Test Method Tex-227-F and Stability conforming to TxDOT Test Method Tex-208-F. The laboratory mixture shall be molded in accordance with TxDOT Test Method Tex-206-F and the Bulk Specific Gravity determined in accordance with TxDOT Test Method Tex-207-F.

	Optimum Laboratory Density (%)		Laboratory Density (%)	
			Min.	Max.
Local Streets Surface Courses	96	95.5	97.5	35 Min.
Collectors & Arterials Surface Courses	96	95.5	97.5	40—60
All Base Courses	96	95.5	97.5	35 Min.

- E. Job Mix Formula Field Adjustments: The Contractor shall produce a mixture of uniform composition closely conforming to the reviewed JMF, that falls within the limits of the tolerances given above and the Acceptance Plan.

If it is determined by the City of Pflugerville that adjustments to the JMF are necessary to achieve the specified requirements, the Engineer or designated representative may allow adjustments of the JMF within the following limits without a laboratory redesign of the mixture. The adjusted JMF shall not exceed the master grading criteria for the type of mixture specified. The proposed JMF adjustments shall not exceed 5 percent on any one sieve, 1/2-inch size and larger, or 3 percent on the sieve size below the 1/2-inch sieve of the JMF (Plant Corrected) reviewed for the Project.

When the proposed adjustments exceed either the 5 or 3 percent limits, and the Engineer or designated representative determines that the impact of these changes may adversely affect pavement performance, a new laboratory mixture design will be required.

The asphalt content may be adjusted with the concurrence of the Engineer or designated representative to maintain desirable laboratory density near the optimum value while achieving other mix requirements. However, increasing the asphalt content of the mixture in order to reduce pavement air voids will not be allowed. Also, if the percent air voids is determined to be less than 4 percent, adjustments shall be made to the plant production by the Contractor, within the tolerances as outlined above, so that an adequate air void level is attained.

#### 340S.5 - Equipment

The trucks that deliver the hot mix asphalt concrete material to the project shall be of sufficient number to insure a continuous paving operation. All equipment used for the production, placement and compaction of the mixture shall be maintained in good repair and operating conditions to the satisfaction of the Engineer or designated representative. All equipment shall be made available for inspection. If the Engineer or designated representative expresses concern about the condition of any equipment, it shall not be used until it is repaired to the satisfaction of the Engineer or designated representative.

- A. **Mixing Plants:** Plants may be of the weigh-batch type, the modified weigh-batch type or drum-mix type equipped with suitable material conveyers, power units, mixing equipment, aggregate proportioning devices, dryers, bins, dust collectors and sensing and recording devices as appropriate for the mixing plant type. The mixing plants shall meet the requirements specified in Section 340.3, 'Equipment' of TxDOT Specification Item No. 340, "Dense-Graded Hot-Mix Asphalt (Small Quantity)".
- B. **Spreading and Finishing Paving Machine:** The paving machine shall be self-propelled and equipped with a heated compacting screed capable of producing a finish surface meeting the requirements of the street cross-section indicated on the Drawings and all surface criteria. Extensions to the screed shall have the same heating and compacting capabilities as the primary unit, except for use on variable depth tapered areas and/or as approved by the Engineer or designated representative.

The paving machine shall be equipped with an approved automatic dual longitudinal screed control system and an automatic transverse screed control system. The longitudinal controls shall be capable of operating from any longitudinal grade reference including a string line, ski, mobile string line or matching shoe. Unless indicated otherwise on the Drawings, the Contractor may use any one of these grade references. The selected grade reference equipment shall be maintained in good operating condition by personnel trained in the use of the specific type of equipment.

The Contractor shall furnish all labor and equipment required for establishing and maintaining appropriate grade reference.

- C. **Rollers:** The Contractor shall select rollers conforming to Item No. 230S, "Rolling (Flat Wheel)" and Item No. 232S, "Rolling (Pneumatic Tire)". Rollers that do not conform to these requirements shall be immediately removed from the Project.
- D. **Motor Grader:** A self-propelled power motor grader may only be used when its use is approved by the Engineer or designated representative. It shall have a blade of not less than 12 feet and a wheelbase of not less than 16 feet. Smaller graders may be used for small irregular areas when approved by the Engineer or designated representative.
- E. **Material Transfer Equipment:** Equipment for transferring the HMA mixture from the hauling units or the roadbed to the spreading and finishing machine will be allowed unless indicated otherwise on the Drawings.

Windrow pick-up equipment, if permitted by the Engineer or designated representative, shall be constructed in such a manner that substantially all of the HMA mixture deposited on the roadbed is picked up and loaded into the spreading and finishing machine. The HMA mixture shall not be contaminated with foreign material. The loading equipment shall be designed so that it does not interfere with the spreading and finishing machine in obtaining the required line, grade and surface without resorting to hand finishing.

- F. Straightedges and Templates: The Contractor shall provide a ten-foot straightedge acceptable to the Engineer or designated representative for surface testing. Satisfactory templates shall be provided as required by the Engineer or designated representative.

#### 340S.6 - Stockpiling Aggregates

Aggregates shall be stockpiled to facilitate blending. When the aggregate is not stockpiled on a hard, non-contaminant base, the bottom six-inch depth of the stockpiles shall not be used in asphaltic mixtures. Where space is limited at the plant site, the aggregate stockpiles shall be separated by walls or other appropriate barriers.

Aggregates shall be stockpiled and handled in a manner that will insure minimization of segregation and contamination. Aggregate and RAP stockpiles shall only contain material from a single source.

#### 340S.7 - Mixture Temperature

The Contractor shall select a target temperature for discharge of the HMA mixture from the mixer between 250°F and 350°F that is suitable to weather and Project conditions. The target temperature shall be reported to the Engineer or designated representative daily and recorded in the Daily Progress Report. The HMA mixture temperature shall not vary by more than 25°F from the target temperature for discharge from the mixer. HMA mixtures that are discharged from the mixer at a temperature exceeding 360°F or a temperature more than 50°F below the target temperature shall not be accepted and shall not be placed on the Project.

#### 340S.8 - Mixture Storage

A surge-storage system may be used to minimize production interruptions during a normal day of operation. When approved by the Engineer or designated representative, overnight storage of HMA mixture in insulated storage bins may be used provided that material temperature and physical properties of the HMA mixture are not adversely affected. HMA mixtures that include hardened lumps shall not be used. Stored HMA mixtures shall not be exempt from any requirements provided in this specification.

When a surge-storage system is used, it shall be equipped with a device such as a gob hopper or other device approved by the Engineer or designated representative to prevent segregation in the surge-storage bin.

#### 340S.9 - Mixture Moisture Content

Hot mix asphalt (HMA) mixtures produced from any plant shall not have a moisture content in excess of 1 percent by weight when discharged from the mixer. The moisture content shall be determined in accordance with TxDOT Test Method Tex-212-F, Part II, except that the sample shall be left in the oven a total of not less than four (4) hours.

## 340S.10 - Construction Methods

- A. General: The Contractor shall be responsible for the production, transportation, placement and compaction of the specified HMA paving mixture to the requirements of this specification. The Contractor shall also be responsible for providing a safe environment for inspection personnel to inspect the equipment and to acquire samples.

All hot mix asphalt concrete pavement surface courses shall be placed with a spreading and finishing (lay-down) machine only. All hot mix asphalt concrete pavement base layers with the possible exception of the first lift of the base layer shall also be placed with a spreading and finishing (lay-down) machine. Longitudinal pavement joints shall be located under the proposed lane lines. Density tests shall be taken prior to opening to traffic.

The first lift of a base layer may be placed with a motor grader if approved in advance by the Engineer or designated representative. The loose measure thickness of this first lift shall not exceed 6 inches. If placed with a motor grader, the first lift shall achieve a minimum in-place relative density of 89% as determined by TxDOT test procedures Tex-207-F and Tex-227-F. All subsequent lifts should be placed with a spreading and finishing (lay-down) machine and shall be subject to the requirements of Section 340S.12, "Acceptance Plan". Density tests will be taken randomly to confirm compliance with the specification requirements.

For hot mix asphalt overlays, an automatic screed shall be used with outriggers.

Any material delivered to the Project that by visual inspection can reasonably be expected not to meet specification requirements (i.e. segregated or burned material, deficient or excess asphalt, low mixing temperature, visible contaminants, etc.), as determined by the Engineer or designated representative, shall not be used or left in place.

Equipment shall be inspected prior to use and, if found to be defective or in an operating condition that could potentially affect the quality of the finished pavement, as determined by the Engineer or designated representative, its use shall not be allowed. Leakage of fuels, oils, grease, hydraulic or brake fluids or other contaminants onto the prepared surface or newly-laid HMA layer will not be allowed and may require replacement of the affected pavement area.

The HMA paving mixture, when placed with a spreading and finishing machine, shall not be placed when the air temperature is below 50°F and is falling, but it may be placed when the air temperature is above 40°F and is rising.

The paving mixture, when used as a level-up course or when spread with a motor grader, shall not be placed when the air temperature is below 60°F and is falling, but it may be placed when the air temperature is 50°F and is rising. An HMA layer with a thickness of 1½ inches and less shall not be placed when the temperature of the surface on which the layer is to be placed is below 50°F. The temperature shall be taken in a shaded area away from artificial heat.

Additional surface temperature requirements may be included in the Contract Documents or indicated on the Drawings.

Surfaces to be paved shall be finished, primed, cured, broomed and tacked, as appropriate, to the satisfaction of the Engineer or designated representative. If the surface on which the first course of the paving mixture is to be placed is a flexible base course, and a cut-back asphalt is to be used as a prime coat, the flexible base shall have been primed and cured a minimum of 24 hours before the

paving mixture may be placed. The 24-hour restriction will not apply to a flexible base that has been primed with material other than a cutback. However, the surface on which the tack coat and/or paving mixture are to be placed shall be in a dry condition.

Pavement shall be opened to traffic as soon as possible after temporary pavement markings or permanent markings are in place as indicated on the Drawings) or as directed by the Engineer or designated representative. Construction traffic allowed on pavements open to the public will be subject to all laws governing traffic on streets and highways.

- B. Tack Coat: The surface upon which the tack is to be placed shall be cleaned thoroughly to the satisfaction of the Engineer or designated representative. The surface shall be given a uniform application of tack coat as governed by Standard Specification Item No. 307S, "Tack Coat". The tack coat shall be applied, as directed by the Engineer or designated representative, with an approved sprayer at a rate not to exceed 0.05 gallons per square yard of surface area. Where the paving mixture will adhere to the surface on which it is to be placed without the use of a tack coat, the tack coat may be eliminated when approved by the Engineer or designated representative. All contact surfaces of curbs, castings and all structures and all joints shall be painted with a thin uniform application of tack coat.

During the application of tack coat, care shall be taken to prevent splattering of adjacent pavement, curb and gutter and structures. Before the Work can be accepted, all splatter shall be removed by the Contractor at the Contractor's expense.

- C. Transporting Hot Mix Asphaltic (HMA) Concrete: The HMA mixture shall be hauled to the Work site in tight vehicles that were previously cleaned of all foreign material. Dispatching of the vehicles shall normally be arranged so that all material delivered is placed and all rolling completed during daylight hours. Nighttime paving may be allowed, when approved in advance by the Engineer or designated representative.

In cool weather or for long hauls, truck bodies containing the HMA mixture shall be covered.

If necessary, to prevent the HMA mixture from adhering to the truck body, the inside of the truck may be given a light coating of a release agent satisfactory to the Engineer or designated representative.

- D. HMA Placement: The HMA mixture shall be dumped and spread on the approved prepared surface with the spreading and finishing machine. When properly compacted, the finished pavement shall be smooth, of uniform Texture and density and shall meet the requirements of the typical cross sections and the surface tests. In addition, the placement of the HMA mixture shall be done without tearing, shoving, gouging or segregating the mixture and without producing streaks in the HMA layer.

Discharge of the HMA mixture into the finishing machine shall be controlled so that the spreading and finishing machine is not bounced or jarred and the required lines and grades shall be obtained without resorting to hand finishing except as permitted below in this Section.

Unless indicated otherwise on the Drawings, dumping of the HMA material in a windrow and then placing the HMA mixture in the finishing machine with windrow pick-up equipment will be permitted provided the temperature of the HMA mixture does not drop more than 50°F below the target temperature before being placed by the finishing machine.



Under no circumstances will the HMA material be permitted to be dumped on or near the job site and then reloaded for hauling to the site of placement. Exceptions may be allowed if approved by the Engineer or designated representative.

The windrow pick-up equipment shall be operated in such a manner that substantially all the mixture deposited on the roadbed or prepared surface is picked up and loaded into the finishing machine without contamination by foreign material. The windrow pick-up equipment will also be so operated that the finishing machine will obtain the required line, grade and surface without resorting to hand finishing. Any operation of the windrow pick-up equipment resulting in accumulation and subsequent shedding of accumulated material into the HMA mixture will not be permitted.

When approved by the Engineer or designated representative, level-up courses may be spread with a motor grader that meets the requirements of this specification item.

The spreading and finishing machine shall be operated at a uniform forward speed consistent with the plant production rate, hauling capability and roller train capacity to result in a continuous operation. Stopping of the spreading and finishing machine between trucks is to be held to a minimum. If, in the opinion of the Engineer or designated representative, delivery of material is adversely affecting the condition of the HMA layer (excessive stopping of the spreading and finishing machine, loss of mixture temperature, etc.), the Engineer or designated representative may require paving operations to cease until acceptable methods are provided to minimize starting and stopping of the spreading and finishing machine.

The hopper gates of the spreading and finishing machine shall be adjusted to provide an adequate and consistent flow of material. This shall result in enough material being delivered to the augers so that they are operating approximately 85 percent of the time or more. The augers shall provide means to supply adequate flow of material to the center of the paver. Augers shall supply an adequate flow of material for the full width of the mat being placed, as approved by the Engineer or designated representative. Augers should be kept approximately one-half to three-quarters full of HMA mixture at all times during the paving operation.

When the HMA mixture is placed in a narrow strip along the edge of an existing pavement, or is used to level up small areas of an existing pavement or is placed in small irregular areas where the use of a finishing machine is not practical, the finishing machine may be eliminated when permitted by the Engineer or designated representative.

The paving material adjacent to castings and flush curb and gutter and structures shall be finished uniformly high so that when compacted, it will be slightly above but not more than 1/8 inch above the edge of the casting or gutter lip.

Construction joints of successive courses of HMA material shall be offset at least 6 inches. Longitudinal joints in the layer shall be placed to coincide with lane lines as directed the Engineer or designated representative. Transverse joints shall be offset a minimum of 5 feet.

- E. Compaction: The pavement layers/lifts shall be compacted thoroughly and uniformly to obtain the compaction and cross section meeting the requirements indicated on the Drawings and this specification item.

Regardless of the method used for compaction, all rolling to achieve specified density shall cease before the temperature of the HMA mixture drops below 175°F.

Rolling with a pneumatic tire roller shall be used to seal the surface. Rolling with a tandem or other steel-wheel roller shall be provided if required to iron out any roller marks. Surface sealing and removal of roller marks may be accomplished at HMA temperatures below 175°F.

Vibratory rollers shall not be allowed in the vibrating mode on layers with a plan thickness less than 1½ inches.

The motion of the rollers shall be slow enough to avoid other than usual initial displacement. If any displacement occurs, it shall be corrected to the satisfaction of the Engineer or designated representative.

The roller shall not be allowed to stand on pavement, which has not been compacted to minimum density requirements. In order to prevent adhesion of the surface mixture to the steel-wheel rollers, the wheels shall be thoroughly moistened with water; however an excess of water will not be allowed. Necessary precautions shall be taken to prevent the dropping of diesel, gasoline, oil, grease or other foreign matter on the pavement, either when the rollers are in operation or when standing.

The edges of the pavement along curbs, headers and similar structures, and all places not accessible to the roller, or in such positions as will not allow thorough compaction with the rollers, shall be thoroughly compacted with lightly oiled tamps.

Rolling with a trench roller will be required on widened areas, in trenches and other limited areas where satisfactory density cannot be obtained with the approved rollers.

#### 340S.11 - Sampling and Testing

The HMA mixture shall be tested daily at the Project site for conformance to specification requirements. The Engineer or designated representative shall utilize a random selection method to determine sample locations based on the Contractor's anticipated production. Each day's anticipated production shall be divided into three (3) essentially equal single-pass, sub-area lots. Each day's sample locations shall be equally distributed over the three (3) sub-areas. If, due to the weather or plant malfunctions, the Contractor's daily-anticipated production is not attained, the random locations will not be recalculated. Also, no more than one location of the three (3) sub-areas shall be located in an irregular shaped area such as a cul-de-sac.

Unless directed otherwise by the Engineer or designated representative, a minimum of three bag samples and three correlating 6-inch cores will be obtained from each day's production.

Bag samples shall be taken during lay-down operations. The primary sampling point for the bag samples shall be from the windrow if a windrow elevator is used. If a windrow elevator is not used, the sample shall be taken from the middle of the paving machine hopper. This sampling location will require a stoppage in the paving operation in order for the Inspector to safely secure a sample from the hopper. One core shall be taken for every 2,000 single-pass square yards with a minimum of three (3) cores for all projects. One core shall be taken at the same station and pass sampled for each of the bag samples. Cores shall be taken by the City's designated laboratory within 48 hours of pavement laydown unless otherwise directed by the Engineer or designated representative.

For total areas of less than 500 square yards, a total of only two bag samples and two correlating cores will be obtained. If the Contractor desires additional testing, it shall be at its own entire expense.

The Engineer or designated representative may alter, increase or waive the testing schedule to ensure that the Work performed, and the material used meet specification requirements. Acceptability of the completed pavement shall be based on the average of test results for the Project as defined in Section 340S.12, "Acceptance Plan" of this item.

Gradation, asphalt content and stability value of the HMA mixture shall be reported for each of the bag samples. The stability value reported for each of the bag samples shall be the average of three (3) tests per bag.

Pavement thickness and density shall be determined from 6-inch field cores. For each day's placement, density of cores for which no corresponding bag samples were taken shall be determined by using the average Maximum Theoretical Density of the day's three (3) bag samples or as may otherwise be determined by the Engineer or designated representative.

When, in the opinion of the Engineer or designated representative, test results appear unrepresentative, additional testing may be authorized. The retesting will be at the expense of the Contractor and the results of the retesting shall be averaged with the results of the original testing. If the results of retesting indicate that the original test results were erroneous, the original test results will be discarded. In the instance of erroneous original test results the subsequent first set of retests will be at the expense of the City of Pflugerville.

Pavements with low-density results may be recorded; but the pavement shall not receive any additional compactive effort.

Pavements that will not or cannot be cored within 48 hours shall be closed to both public and construction traffic.

#### 340S.12 - Acceptance Plan

For the purpose of the Acceptance Plan only, the "Paving Project" of each of the specified mixture types shall be defined by the Engineer or designated representative before the paving operation begins

Considerations for defining the Paving Project shall include paving operations staged due to traffic considerations, pavement structural section (i.e. with varying layer thicknesses), time required for paving, changes to the Job Mix Formula, phasing of large projects, or other factors affecting the consistency in the production, lay-down/compaction, use of completed portions, and/or aging of in-place material.

Acceptability of the completed pavement structure for a Paving Project shall be based on all daily averages of three test results and when approved by the Engineer or designated representative the overall average of all test results for each of the mixture/layer types specified on the Drawings.

Pay adjustments for two or more acceptance factors shall be accumulative. Pay adjustments of 100% unit price reduction shall require removal and replacement of the Work. Replacement materials shall be subject to all requirements of this specification. Alternatively, the Engineer or designated representative may allow the Work to remain in place without payment provided that the Work is warranted for an extended period under conditions as determined by the Engineer or designated representative. The decision of the Engineer or designated representative related to the removal and replacement of the Work shall be the final authority.

#### A. Non-Pay-Adjustment Acceptance Factors:

1. **Surface Characteristics:** Unless otherwise directed by the Engineer or designated representative, all pavements shall be tested for smoothness. Surfaces shall be tested with a 10-foot straightedge parallel to the roadway centerline and perpendicular to the centerline on flat, cross-slope sections. Maximum allowable deviation in 10 feet shall be 1/8 inch parallel to the centerline and 1/4 inch perpendicular to the centerline. Sections exceeding these maximums shall be corrected to the satisfaction of the Engineer or designated representative. The completed surface must meet the approval of the Engineer or designated representative for surface smoothness, finish and appearance.

If the surface ravels, ruts or deteriorates in any manner prior to the end of the warranty period, it will be the Contractor's responsibility to correct this condition at its own entire expense to the satisfaction of the Engineer or designated representative in conformance with the requirements of this specification.

For HMAC rehabilitation and overlay projects, if cracks develop in the pavement surface within the one-year warranty period, the Contractor shall seal the cracks in accordance with Standard Specification Item No. 313S, "Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)".

For new HMAC roadways constructed in accordance with the Drawings and specifications, if cracks less than 1/4 inch in width develop in the pavement surface within the one year warranty period the Contractor shall seal the cracks in accordance with Standard Specification Item No. 313S, "Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)".

If cracks equal to or greater than 1/4 inch in width develop in the pavement surface within the one-year warranty period, the cracking shall be reviewed and evaluated by the Engineer or designated representative before corrective action is taken.

2. **Stability:** Stability test results shall be used as indicators of potential problems. Where stability test results fall below the range specified in this specification, additional tests shall be taken as directed by the Engineer or designated representative for further evaluation and monitoring of the paving mixture. This additional stability testing will be at the expense of the Contractor. When, in the opinion of the Engineer or designated representative, the stability is deemed unacceptable for the intended use of the pavement, the paving mixture shall be removed and replaced to the limits indicated by test results or may be left in place on conditions acceptable to the Engineer or designated representative. When the paving mixture is removed and replaced, it shall be at the sole expense of the Contractor.
3. **Laboratory Density:** Laboratory density results as determined by TxDOT Test Method Tex-207-F shall be used as indicators of potential problems. Where laboratory density test results are less than 95.5% or more than 97.5% of mix design maximum density, additional tests shall be taken as directed by the Engineer or designated representative for further evaluation and monitoring of the paving mixture. This additional laboratory density testing will be at the expense of the Contractor. When, in the opinion of the Engineer or designated representative, the laboratory density is deemed unacceptable for the intended use of the pavement, the paving mixture shall be removed and replaced to the limits indicated by test results.

The removal and replacement of the paving mixture shall be the full roadway width and shall be at the sole expense of the Contractor.

4. **Limited Areas:** Irrespective of an acceptable overall Paving Project average for any or all of the Pay-Adjustment Acceptance Factors, limited substandard portions of the Work, as determined

by the Engineer or designated representative, shall be remedied or removed and replaced to the satisfaction of the Engineer or designated representative at the sole expense of the Contractor.

- B. Pay-Adjustment Acceptance Factors: The City Engineer may consider adjusting contract unit prices in lieu of remove/replace. Price adjustments approved by the City Engineer for paving mixtures that fail to meet acceptance criteria for gradation, asphalt content, density and mat thickness in accordance with the following:

**Gradation Acceptance Schedule (Tex-210-F)**

Sieve	Deviation From Job Mix Formula		Percent Contract Unit Price Reduction
	Daily Average	Overall Average	
Total retained on No. 10	±6.5	±5.0	0
	6.6±	5.1±	10
Passing No. 200	±3.9	±3.0	0
	4.0±	3.1±	5

**Asphalt Content Acceptance Schedule (Tex-210-F, Part II)**

Deviation from the Job Mix Formula		Percent Contract Unit Price Reduction	
Daily Average	Overall Average	Local Streets*	All Others
±0.5	±0.4	0	0
±0.51 to ±0.60	±0.41 to ±0.50	15	25
+0.61 to +0.70	+0.51 to +0.60	25**	100; Remove and Replace
-0.61 to -0.70	-0.51 to -0.60	100; Remove and Replace	100; Remove and Replace
Over ±0.70	Over ±0.60	100; Remove and Replace	100; Remove and Replace
*A local or residential street that serves as access to residence or other abutting property.			
**If the street has an ADT of 500, or less, with 1%, or less, of truck traffic, plus a 2 year warranty; otherwise, Remove and Replace			

**Density Acceptance Schedule (Tex-207-F/Tex-227-F)**

*Percent Density	Percent Contract Unit Price Reduction

Daily Average	Overall Average	1½" Thickness or Greater	Less than 1½" Thickness
Above 96.5 90.5 to 96.5 90.5 to 87.6 Less than 87.6	Above 96 91 to 96 90.9 to 88.1 Less than 88.1	100; Remove and Replace 0 0.625 per 0.10% deficiency in density 100: Remove and Replace	100; Remove and Replace 0 0.50 per 0.10% deficiency in density 100; Remove and Replace
*Core bulk density divided by max. theoretical density			

### Thickness Acceptance Schedule

Variance Percent of Thickness		Percent Contract Unit Price Reduction
Daily Average	Overall Average	
0—15.0	0—10	0
15.1—20.0	10.1—16	20
20.1—30.0	16.1—25	50
Over 30.0	Over 25	100; Remove and Replace or mill/overlay 1" minimum

The Density Acceptance Schedule For Irregularly Shaped Areas; Hike And Bike Trails And Utility Trenches (see following table) will apply to utility trenches of widths less than 4 feet and to irregular shaped areas and hike and bike trails in which an appropriate rolling pattern cannot be established making it difficult to achieve compaction.

### Density Acceptance Schedule For Irregularly Shaped Areas; Hike And Bike Trails and Utility Trenches (Tex-207-F/Tex-227-F)

*Percent Density	Percent Contract Unit Price Reduction	
Daily Average	1½" Thickness or Greater	Less than 1½" Thickness
Above 96.5 96.5 to 89.0 89.0 to 86.1 Less than 86.1	100; Remove and Replace 0 0.625 per 0.10% deficiency in density 100: Remove and Replace	100; Remove and Replace 0 0.50 per 0.10% deficiency in density 100; Remove and Replace
*Core bulk density divided by maximum theoretical density		

The Density Acceptance Schedule will apply to utility trenches 4 feet or wider.

Core thicknesses greater than Drawing requirements shall be factored into the average thickness calculation as the Drawing required thickness. If total thickness of lift(s) proves to be less than required, the Contractor may remove and replace the overlay deficient areas as agreed to by the Engineer or designated representative. Overlays to correct thickness deficiencies shall be not less than one (1) inch thick. Overlays shall require milling of the asphalt in order to prevent a "featheredge" of the overlaying pavement.

The extent of the area to be overlaid or removed and replaced shall be determined by additional cores with thicknesses greater than or equal to the required thickness. All additional coring that is necessary to determine the area shall be paid for by the Contractor.

#### 340S.13 - Measurement

Work performed and material placed shall be measured under one of the following methods. When Drawing quantity measurement is specified, adjustment of quantity may be made as follows. If the quantity measured as outlined vary from those shown on the Drawings by more than 5%, either party to the Contract may request in writing and adjustment of the quantity by each separate bid item. The party to the Contract which requests the adjustment shall present to the other party one copy of measurements and calculations showing the revised quantity in question. This revised quantity, when approved by the Engineer or designated representative, shall constitute the final quantity for which payment will be made. However, no adjustment will be made for any quantity, which exceeds the Drawing required thickness.

- A. Method A: Asphaltic concrete pavement shall be measured by the ton (2,000 pounds) of the type actually used in completed and accepted Work in accordance with the Drawings and specifications.

The measurement shall be made on approved truck scales that meet the requirements of the National Institute of Standards and Technology Handbooks 44 and 112 except that the required accuracy shall be 0.4 percent of the load being weighed. The Contractor shall furnish a report of calibration from a scale mechanic licensed by the Texas Department of Agriculture certifying that the scales meet this requirement.

- B. Method B: Asphaltic concrete pavement shall be measured by the square yard of specified total thickness of the type of paving mixture actually used in completed and accepted Work in accordance with Drawings and specifications. Multiple lifts of the same type shall be considered as one for square yard measurement purposes.
- C. Method C: Asphaltic concrete pavement shall be measured by the lineal foot of specified total thickness of the type of paving mixture actually used in completed and accepted Work in accordance with Drawings and specifications. Multiple lifts of the same type shall be considered as one for linear foot measurement purposes.

#### 340S.14 - Payment

Work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit bid prices or pay adjusted unit price for Hot Mix Asphalt Concrete Pavement, of the types and thicknesses specified. The unit bid prices shall include full compensation for furnishing all labor, equipment, time, materials and incidentals necessary to complete the Work.

Removal of existing hot mix asphalt concrete transition areas prior to overlay, tack coat, saw cutting and temporary pavement markings will not be measured or paid for directly but shall be included in the unit price bid for Standard Specification Item No. 340S, "Hot Mix Asphaltic Concrete Pavement."

Payment for Work meeting these specifications will be made under one of the following:

<b>Pay Item No. 340S-B:</b>	Hot Mix Asphaltic Concrete Pavement, _____ inches, Type _____ .	Per Square Yard.
<b>Pay Item No. 340S-L:</b>	Hot Mix Asphaltic Concrete Pavement, _____ in., Type _____ , Level-up Course.	Lump Sum
<b>Pay Item No. 340S-M:</b>	Crack Sealing Mobilization,	Lump Sum
<b>Pay Item No. 340S-S:</b>	Crack Sealing,	per Lineal Foot

END



ITEM NO. 341S - PAVING FABRIC

341S.1 - Description

This item shall consist of the furnishing and installation of a fabric underseal in accordance with this specification and as indicated on the Drawings. This work shall consist of a single application of asphalt covered with 1 layer of the fabric with or without sand.

341S.2 - Submittals

The submittal requirements of this specification item include:

- A. Catalog cuts,
- B. Samples of material selected,
- C. Testing results,
- D. Manufacturer's recommended installation procedures, and
- E. Manufacturer certification of compliance with this specification.

341S.3 - Material

A. Tack Coat

Asphalt cement tack coat shall conform to Item No. 301S, "Asphalt, Oils and Emulsions", AC-10.

B. Sand

Washed concrete sand shall be Aggregate Grade No. 1 and shall conform to Item No. 403S, "Concrete for Structures".

C. Paving Fabric

Fabric shall be constructed exclusively of thermoplastic fibers. These fibers may be oriented in the fabric in either a random or an aligned orientation and the fibers may be either continuous or discontinuous throughout the fabric.

The fabric itself shall be mildew resistant, rot proof and shall be designed for use with asphalt cements at temperatures up to 325°F.

1. Physical Requirements

The fabric supplied shall meet the following requirements when sampled and tested in accordance with the methods specified.

TEST	METHOD	REQUIREMENT	
		Minimum	Maximum
Original Physical Properties			
Fabric weight, oz./sq. yd	TxDOT Tex-616-J*	3.5	9.0

TEST	METHOD	REQUIREMENT	
		Minimum	Maximum
Original Physical Properties			
"Apparent elongation" at "breaking load" on warp-wise and fill-wise specimens, percent	ASTM D 5034 Method G**	50	150
"Breaking load", on warp-wise and fill-wise specimens, pounds	ASTM D 5034 Method G**	80	—
Asphalt retention, gal/yd <sup>2</sup> .	TxDOT Tex-616-J*	0.15	0.60
Change in area, %		—	±15

\* TxDOT Tex-616-J, "Testing of Construction Fibers"

\*\* ASTM D 5034, grab method G, "Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)"

## 2. Packaging Requirements

The fabric shall be packaged in rolls of the length and width specified on the Drawings or as directed by the Engineer or designated representative. The fabric itself shall be uniformly wound onto suitable cylindrical forms or cores to aid in handling and unrolling. Each roll of fabric and the form or core upon which it is rolled shall be packaged individually in a suitable sheath, wrapper or container to help protect the fabric from damage due to ultraviolet light and moisture during normal storage and handling.

## 3. Identification Requirements

Each roll shall be identified by a label or tag securely fixed to the outside of the roll on one end. This label or tag must list the following required information (example of each shown in parenthesis):

- A unique roll number, serially designated (Roll No. 31275)
- Manufacturer lot number or control numbers, if any (Lot 290 Control 6740)
- Name of fabric manufacturer (Afghan Fabrics)
- Date of manufacture (Jan. 16, 1999)
- Brand name of the product ("Fabiweld"),
- Manufacturer's style or catalog designation of the fabric, if any ("300-X")
- Roll width in inches or yards (Width 150 inches)
- Roll length in yards (Length 100 yards)

- gross weight of the entire package which is to include fabric, core, wrapping and sheath or container identification tag, etc (Gross 147 pounds)
- Tare weight of core, wrapping sheath or container identification tag, etc (Tare 18 pounds)
- Net weight of fabric alone (Net Wt. 129 pounds)

#### 4. Sampling Requirements

Sampling for testing purposes shall be acquired in accordance with TxDOT Test Method "Tex-735-1, Sampling of Construction Fabrics".

#### 5. Basis for Rejection

If any individual roll fails to meet the fabric weight requirement when the entire roll is weighed then that roll is subject to rejection. If any individual sample, selected at random from 100 rolls (or fraction thereof), fails to meet any specification requirement, then that roll shall be rejected and two additional samples shall be taken, 1 from each of 2 other additional rolls selected at random from the same 100 roll lot (or fraction thereof). If either of these 2 additional samples fails to comply with any portion of the specification, then the entire quantity of rolls represented by that sample shall be rejected.

#### 6. Testing Requirements

Testing shall be conducted in accordance with the test methods identified in this specification item.

#### 7. Manufacturers Certification

The manufacturer will furnish certification of compliance with the specifications with each batch of rolls.

### 341S.4 - Equipment

#### A. Asphalt Distributor

A hydrostatic type distributor shall be used which is capable of spraying the asphaltic binder at the temperature and application rate specified on the Drawings or as directed by the Engineer or designated representative. The Contractor shall provide all necessary facilities for determining the temperature of the asphaltic material. The distributor shall apply the asphalt cement evenly and smoothly under a pressure necessary for proper distribution. It must be adjustable to give a uniform spray pattern over the entire width of application.

The distributor shall be equipped with a hand spray with only 1 nozzle. The hand spray must be easily controlled and have a positive shut off valve. Hand spraying shall be kept to a minimum and limited to areas where a distributor cannot be used.

#### B. Fabric Handling Equipment

The fabric may be placed with machine laydown equipment or by manual method. A length of ASA standard 1-inch pipe to handle the roll width being used, together with a suitable roll braking device, shall be used for the manual method.

C. Asphalt Storage and Handling Equipment

All equipment used in storing or handling asphalt cement shall be kept clean and in good working order at all times, and shall be operated in such a manner that there will be no contamination of the asphalt cement. The Contractor shall provide and maintain a recording thermometer to continuously indicate the asphalt cement temperature at the storage-heating unit.

D. Miscellaneous Equipment

Stiff bristle brooms to smooth fabric and scissors for cutting the fabric shall be used. Buckets and squeegees can be used for applying asphalt tack coat to fabric laps and joints. A pneumatic roller to smooth fabric into the asphalt binder may be needed should rain or other unforeseeable conditions cause bubbles or wrinkling.

E. Roller

A light pneumatic tire roller conforming to Item No. 232S, "Rolling (Pneumatic Tire)" shall be used.

341S.5 - Construction Methods

A. General

It shall be the responsibility of the Contractor to produce, transport, furnish and place the tack coat and paving fabric in accordance with these specifications and as approved by the Engineer or designated representative.

The tack coat shall not be applied when the air temperature is below 60°F and falling, but may be applied when the air temperature is above 50°F and rising. In addition the tack coat shall not be applied when the temperature of the surface on which it is to be placed is below 60°F. The tack coat shall only be placed when the humidity, general weather conditions, temperature and moisture condition of the base, in the opinion of the Engineer or designated representative, are suitable.

Application temperature of the tack coat will be selected within the limits recommended in Standard Specification Item No. 301S, "Asphalts, Oils and Emulsions", as approved by the Engineer or designated representative. The Contractor shall apply the asphalt cement at a temperature within 15°F of the temperature selected.

B. Level-up Courses

Placing a level-up course with a spreading and finishing machine, where required, shall precede the placement of the tack coat and paving fabric and shall conform to Standard Specification Item No. 340S, "Hot Mix Asphaltic Concrete Pavement".

C. Surface Preparation

The surface area upon which the fabric layer is to be placed shall be cleaned of dirt, dust or other deleterious material by sweeping or other approved methods.

D. Application of Asphalt Cement

Asphalt cement shall be applied ahead of the fabric placement in widths 6 inches wider than the fabric, except when placed against a curb and gutter.

The asphalt tack coat shall be uniformly applied with the specified distributor. Hand spraying shall be kept to a minimum. Tack coat shall be applied at a rate between 0.15 and 0.28 gallons per square yard. The exact rate to be used shall be approved by the Engineer or designated representative. The rate may require slight adjustment as directed by the Engineer or designated representative to prevent an excessive application.

String lines shall be set by the Contractor for alignment as required by the Engineer or designated representative.

#### E. Fabric Laydown

Immediately upon application of the asphalt cement tack coat, the fabric shall be aligned and carefully broomed and/or rolled onto the fresh asphalt cement tack coat with equipment approved by the Engineer or designated representative. The fabric shall be placed essentially wrinkle free. Air bubbles shall be removed by brooming to insure complete contact with the roadway surface. In the event the initial alignment is not satisfactory and causes the fabric to wrinkle during placement, the fabric shall be cut out and realigned overlapping the previous material and proceeding as before. The replacement fabric shall be lapped 6 inches minimum and additional asphalt cement tack coat shall be applied to satisfy the absorption of the resulting double layer.

If the edges of the fabric tend to be displaced because of air currents, the Engineer or designated representative may require that the edges be secured at 15-foot intervals. In the event this procedure does not prove satisfactory, then work will be suspended until conditions are more favorable.

All fabric transverse joints shall be lapped a minimum of 6 inches. Laps shall be in the direction of travel when traffic is allowed directly on the fabric. In lapping joints, the top fabric shall be folded back to allow application of a light coat of asphalt cement. The top fabric shall then be placed back onto the asphalt cement, broomed and squeegeed out smoothly. Rolling and/or brooming the fabric into the asphalt cement at the joints shall be accomplished in such a way that the air bubbles, which form under the fabric will be removed. This may be accomplished by brooming from the center of the fabric toward the outer edges. The fabric shall be neatly cut and contoured at all joints as directed by the Engineer or designated representative.

Adjacent longitudinal rolls of fabric shall overlap a minimum of 4 inches. Additional asphalt cement shall be applied to satisfy the absorption of the resulting double layer.

The fabric shall be carefully cut to fit around utility castings.

When required by the Engineer or designated representative, the installed fabric shall be covered with a thin layer of clean sand or clean crusher screenings at a rate sufficient to absorb any excess asphalt cement. If localized areas appear, which indicate excessive amounts of tack coat (bleeding), they shall be blotted with concrete sand.

If for any reason, there is bond loss before application of the HMAC overlay, it shall be corrected by pneumatic rolling until adhesion is restored. If traffic must be temporarily allowed on the membrane prior to the overlay, the fabric shall be lightly sanded (1 to 2 pounds/square yard) for protection during the period of use.

Turning of the laydown machine and other vehicles shall be gradual and kept to a minimum to avoid damage to the fabric membrane. If equipment tires tend to stick to the fabric membrane during the overlay operation, a small quantity of sand shall be broadcast ahead of the paving equipment.

F. Asphaltic Overlay

The Asphaltic Concrete shall conform to Item No. 340S, "Hot Mix Asphaltic Concrete Pavement" and be placed as soon as possible after the paving fabric has been rolled into the tack coat.

G. Manufacturers Recommendations

In other matters not specifically detailed on the Drawings or included herein, the Contractor shall use recommended procedures as prescribed by the manufacturer of the fabric.

341S.6 - Measurement

Accepted work performed as prescribed by this item will be measured by the square yard of surface area covered. Level-up and finished Hot Mix Asphaltic Concrete courses, performed where required, will be measured and paid in conformance with Standard Specification Item No. 340S, "Hot Mix Asphaltic Concrete Pavement".

341S.7 - Payment

The work performed as prescribed by this item will be paid for at the unit bid price per square yard for "Paving Fabric". The unit bid price shall include full compensation for: a) preparation of the surface to receive the fabric; b) furnishing and placement of all materials, including asphalt cement tack coat and paving fabric, sand and all other materials and manipulation, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item No. 341S-A:</b>	Paving Fabric	Per Square Yard.
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**END**

## ITEM NO. 350S - HEATING, SCARIFYING AND REPAVING

### 350S.1 - Description

This item shall govern for Asphaltic Concrete surface rehabilitation, a process that consists of a simultaneous multistep process of softening the existing asphaltic concrete surface with heat, scarifying to the depth shown on the Drawings, and thoroughly remixing, leveling and compacting the material. Scarified material shall be blended with fresh hot asphaltic concrete mixture, and when required with an asphalt recycling agent. The item shall also include the application of temporary lane markers and their removal when no longer needed.

### 350S.2 - Submittals

The submittal requirements of this specification item include:

- A. Recommended Recycled Job Mix Formula (type and % of asphaltic material, recycling agent, etc.)
- B. Test results on the recycled mixture (asphalt content, stability, penetration).
- C. Characteristics (i.e. manufacturer, depth of application, speed, etc.) of the proposed heater-scarifier machine.
- D. List of facilities and equipment proposed for blending an asphalt recycling agent during mixing operations.
- E. List of facilities and equipment proposed for spreading and finishing the recycled mixture.
- F. Plan, pattern and equipment proposed for compaction of the recycled mixture.

### 350S.3 - Materials

#### A. Recycled Asphaltic Concrete

The Contractor shall establish a Job Mix Formula for the scarified asphalt based on samples obtained by the City from the areas to be repaved. The Contractor shall submit a copy of the mix design to the Engineer or designated representative for review prior to commencing field operations. The Job Mix Formula shall restore the recycled material to the following values:

Item	Test	Values
Asphalt Content	Tex-210-F	5±.3
Stability	Tex-208-F	40—55
Penetration	Tex-502-C	55—90

Although the overlay process is integral to the work provided by this specification, the overlay and level-up material requirements, measurement and payment shall be governed by Item No. 340S "Hot Mix Asphaltic Concrete Pavement".

## B. Binding Agents

### 1. Recycling Agent

When a rejuvenating or plasticizing agent is required it shall conform to Item No. 351S, "Recycling Agent".

### 2. Asphaltic Materials

Asphaltic materials shall be SS-1 or CSS-1 and conform to Item No. 301S, "Asphalts, Oils and Emulsions".

## C. Traffic Tape

Temporary traffic lane tape shall conform to Item No. 864S "Abbreviated Pavement Markings".

## 350S.4 - Equipment

The equipment for heating, scarifying, mixing, placing and finishing shall be approved by the Engineer or designated representative. The equipment shall consist of the following:

### A. Heater-Scarifier

The heater-scarifier shall be a self-contained machine specifically designed to reprocess upper layers of existing asphaltic pavements. The heater-scarifier machine shall be self-propelled and capable of heating and scarifying the existing asphalt surface to a minimum depth of 3/4 inch, uniformly spraying binding agents onto the scarified material, thoroughly mixing and screeding the scarified and enriched material to the desired longitudinal profile and transverse section.

#### 1. Heating Component

The heating component shall have a radiant heating mechanism capable of heating asphaltic concrete pavements sufficiently to allow scarification of the material to the desired depth without breaking aggregate particles without, overheating, charring or burning the existing asphaltic surface, and without producing undesirable pollutants. The entire heating unit shall be enclosed and vented to contain the heat and prevent damage to trees and shrubs, while meeting the State and Federal air pollution control laws. If excessive smoke is produced or the asphaltic mixture is burned, the Engineer or designated representative may require that operations be discontinued. Operations shall not be resumed until adjustments have been made to the satisfaction of the Engineer or designated representative.

#### 2. Scarifying Component

The scarifying component shall consist of multiple racks of teeth capable of penetrating and loosening the heated existing asphaltic surface of a minimum of 3/4 inch. The racks shall be vertically and sectionally adjustable to clear obstructions in the pavement surface. The final scarifying shall be within 1/4 inch of the specified finished pavement cross-section and slope.

#### 3. Blending the Recycling Agent

A system for adding and uniformly blending an asphalt recycling agent during the mixing operation. The system shall be synchronized to provide a uniform application at the specified rate with a tolerance of  $\pm 5$  percent from the design rate.



#### 4. Mixing and Distribution

A unit capable of gathering the heated and scarified asphaltic concrete pavement, adding and uniformly mixing the fresh asphaltic concrete, and distributing the blended mixture over the width being processed.

#### 5. Spreading and Finishing Component

The spreading and finishing component shall be self-propelled or integral to the power train of the heater-scarifier. It shall have electronic screed control capability and shall produce a high quality, smooth surface conforming to the requirements of the typical cross section and Specification Item No. 340S, "Hot Mix Asphaltic Concrete Pavement".

#### 6. Pugmill

An onboard pugmill, if required on the Drawings.

#### B. Rollers

Equipment shall conform to the requirements of Item No. 230S, "Rolling (Flat Wheel)" and Item No. 232S, "Rolling (Pneumatic Wheel)". One flat steel wheel roller and one pneumatic roller, at a minimum, shall be used to compact the materials.

#### 350S.5 - Construction

The work provided by this specification shall be performed when the air temperature is a minimum of 50°F and rising and the pavement surface temperature is 50°F or higher. The air temperature shall be taken in the shade away from artificial heat.

The area to be resurfaced shall be cleaned of all dirt and objectionable material by blading, brooming or other approved methods, prior to beginning heater-scarification operations. Level-up operations shall be completed as directed by the Engineer or designated representative. The existing asphaltic pavement surface shall be evenly heated, scarified and reworked to the widths and depths shown on the Drawings or a minimum depth of 3/4 inch. Heating shall be controlled to assure uniform heat penetration without causing differential softening of the pavement. Charring of the asphalt will not be permitted.

The scarified material shall be gathered, mixed and distributed to the desired longitudinal profile and transverse section. The asphalt recycling agent, when required, shall be applied uniformly to the scarified material prior to mixing and leveling unless otherwise approved by the Engineer or designated representative. The rate of application shall be as selected by the Engineer or designated representative based on laboratory tests on pavement samples. The required amount of fresh hot mix asphaltic concrete shall be added and thoroughly mixed with the scarified material, and the blend shall be leveled and compacted.

All work under this item shall be in conformity with the typical sections shown on the Drawings and to the lines and grades as established by the Engineer or designated representative.

The heated and scarified material shall have a temperature between 225°F and 265°F as measured immediately behind the scarifier.

There shall be no burning of trees, shrubs, or other landscaping adjacent to the pavement. It shall be the responsibility of the Contractor to protect the adjacent landscape from heat damage.

Application of the binding agent shall be adjusted in areas with level-up material. Under no circumstances shall the scarifying penetrate into an existing flexible base course. The overlay HMAC shall be placed on the scarified material while the road surface temperature is still above 200°F. The recycled material and overlay course shall be rolled simultaneously. The overlay course shall be compacted to the specified thickness and applicable density in accordance with Item No. 340S "Hot Mix Asphaltic Concrete Pavement." In order to insure a full thickness welded mat at longitudinal seams, 4 inches of the newly laid adjoining mat shall be heated so that a minimum of 2 inches can be cut back.

The varying properties of existing asphalt pavements, as encountered in the field may dictate that the depth of scarification, binding agent rate of application or the overlay thickness be adjusted, as required or directed by the Engineer or designated representative, to maintain the design depth of combined recycled and new hot mix.

Compaction shall begin before the material temperature drops below 190°F. All rolling shall be completed before the mixture temperature drops below 175°F unless determined by the Engineer or designated representative that a higher minimum temperature is required for proper compaction.

Rolling shall be continued until desired compaction is obtained and all roller marks are eliminated. A minimum of one (1) tandem roller and one (1) pneumatic-tire roller shall be provided for each work site unless otherwise directed by the Engineer or designated representative.

The Contractor may, with permission from the Engineer or designated representative, operate other compacting equipment that will produce equivalent compaction as the specified equipment. If the substituted compaction equipment fails to produce the compaction expected of the specified equipment, as determined by the Engineer or designated representative, its use shall be discontinued.

The edges of the pavement along curbs, headers and similar structures, and all places not accessible to the roller, or locations at which thorough compaction is not possible, shall be thoroughly compacted with tamps.

Temporary lane marking shall be placed as soon as surface temperature permits. All marking shall conform to the Texas Manual of Uniform Traffic Control Devices for Street and Highways. Unless otherwise specified or directed by the Engineer or designated representative, the placement pattern shall be 24 inches of tape at 80-foot intervals parallel to the flow of traffic. All temporary lane marking tape shall be removed by the Contractor when no longer needed.

#### 350S.6 - Measurement

Asphalt "Heating, Scarifying and Repaving" as described above shall be measured by the square yard of surface area of completed and accepted work. The asphalt recycling agent or asphaltic material will be included in the unit price bid for Item No. 350S, "Heating, Scarifying and Repaving", unless included as a separate pay item in the contract. When included for payment, it shall be measured in gallons. Temporary traffic tape and placement shall be included in the unit price bid for this item.

#### 350S.7 - Payment

This item will be paid for at the contract unit bid price for "Heating, Scarifying and Repaving" as provided. The price shall include full compensation for all work including all labor, equipment, materials, heating, scarifying, mixing, rolling, temporary traffic tape and incidentals necessary to complete the work.

The binding agents will be included in the unit price bid for the item of construction in which the item is used, unless included in the contract as a separate item. When included for payment the binding agent will be paid for at the unit price bid for "Recycling Agent" or "Asphaltic Materials", (SS-1 or CSS-1) as indicated.

Payment will be made under the following:

<b>Pay Item No. 350S-A:</b>	Heating, Scarifying and Repaving	Per SquareYard.
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Payment, when included as a contract pay item, will be made under:

<b>Pay Item No. 350S-CS:</b>	Asphaltic Materials,	Per Gallon.
<b>Pay Item No. 350S-R:</b>	Recycling Agent,	Per Gallon.
<b>Pay Item No. 350S-SS:</b>	Asphaltic Materials,	Per Gallon.

**END**

ITEM NO. 351S - RECYCLING AGENT

351S.1 - Description

This item shall govern the requirements and uses for recycling agents used in the repaving of asphaltic surfaced streets. Recycling agents are used to restore the plasticity to existing asphaltic paving. Either the agent is used independently or an emulsified agent is used in conjunction with cationic emulsified asphalt.

351S.2 - Submittals

The submittal requirements of this specification item include:

- A. Type of recycling agent (petroleum oil or petroleum oil emulsion) including an emulsion designation as cationic or anionic.
- B. Physical and chemical test results on emulsified recycling agent (Saybolt-Furol viscosity, % residue, miscibility, test results of residue from evaporation, etc.).

351S.3 - Materials

The asphalt recycling agent shall be either a petroleum oil, referred as a recycling agent, or a petroleum oil emulsion, referred to as emulsified recycling agent. These agents may be used alone or the emulsified recycling agent may be used in conjunction with emulsified asphalt having the same particle charge, i.e., a cationic emulsified asphalt may be used with a cationic emulsified recycling agent and an anionic emulsified asphalt may be used with an anionic emulsified recycling agent. The supplier must state the charge of the emulsified recycling agent being furnished, i.e., cationic or anionic. Specific physical and chemical requirements are listed below:

**EMULSIFIED RECYCLING AGENT**

Test on emulsion:		Requirements	
		Minimum	Maximum
Viscosity, Saybolt Furol @ 77°F, SFS		15	100
Residue*, % w *		60	-
Miscibility **	No coagulation		
Sieve analysis, % w		-	0.1
Test of residue from Evaporation test		minimum	maximum
Flash point, C.O.C.,	400°F		
Viscosity @ 140°F, cSt		75	250
Viscosity @ 275°F, cSt		-	10.0

\* Residue shall be determined by the evaporation method set forth in ASTM D244, except that the sample shall be maintained at 300°F until foaming ceases, then cooled and weighed.

\*\* Performed according to Test Method TxDOT Test Method Tex-521-C except that 0.02 N calcium chloride solution shall be used in place of water.

The ability of the residue from the evaporation test to restore the original properties of aged asphalt cement shall be determined as follows. The residue shall be blended uniformly in the laboratory with a standard 14 to 16 penetration asphalt at a maximum rate of 20% by weight of the asphalt. The resulting blend must comply with all the requirements of Specification Item subarticle 301S.3.(B) for AC-20 asphalt cement

The standard asphalt cement for the above blend shall be obtained by subjecting an AC-20, meeting all requirements of this item, to the thin film oven test as specified in TxDOT Test Method Tex-510-C except that the test period shall be increased so as obtain the required penetration.

When a petroleum oil recycling agent is specified, it shall meet the same requirements indicated above for the Residue from Evaporation Test on emulsified recycling agent.

#### 351S.4 - Construction Methods

The rejuvenating agent, when required, shall be applied at a rate specified by the Engineer or designated representative in accordance with Item No. 350S, "Heating, Scarifying and Repaving".

#### 351S.5 - Measurement

"Recycling Agent" will be measured by the gallon complete in place. 351S.6 - Payment

The work will be performed and materials furnished as prescribed by this item and measured as provided for under "Measurement" will be paid for at the unit bid price for this item. The price shall include full compensation for the work, materials, tools and other accessories needed to complete the work.

Payment, when included as a contract pay item, will be made under:

<b>Pay Item No. 351S-A:</b>	Recycling Agent, _____	Per gallon.
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**END**

## ITEM NO. 360S - CONCRETE PAVEMENT

### 360S.1 - Description

This item shall consist of a pavement and/or base of PC concrete, with or without reinforcement as indicated on the Drawings, with or without monolithic curbs, constructed as herein specified, on prepared subgrade or base course in conformity with the thickness and typical cross sections indicated on the Drawings. Concrete to be considered of satisfactory quality provided it is made (a) of materials accepted for job, (b) in the proportions established by the Contractor and (c) mixed, placed, finished and cured in accordance with the requirements of this specification.

### 360S.2 - Submittals

The submittal requirements of this specification item may include:

- A. Mix design option(s) of the class of concrete required on the project,
- B. The supplier of the concrete mix design(s) and type of mixing equipment, and
- C. Type of admixtures to be used with the concrete mixes.

### 360S.3 - Materials

#### A. Cementitious Materials

PC shall conform to ASTM C 150, Type I (General Purpose) and Type III (High Early Strength). Type III cement shall be used when high early strength concrete is indicated on the Drawings. If the use of high early cement is not specified and the Contractor desires to use it, the Contractor shall obtain written permission from the Engineer or designated representative prior to its use and shall assume all additional costs incurred by the use of such cement. All cement shall be of the same type and from the same source for a project unless written permission is first received from the Engineer or designated representative.

PC manufactured in a cement kiln fueled by hazardous waste shall be considered as an approved product if the production facility is authorized to operate under regulation of the Texas Commission on Environmental Quality (TCEQ) and the United States Environmental Protection Agency (USEPA). Supplier shall provide current TCEQ and EPA authorizations to operate the facility.

Bulk or sacked cement may be used and a bag shall contain 94 pounds net. All bags shall be in good condition at the time of inspection. Bulk cement shall be weighed on approved scales as herein prescribed.

All cement shall be stored in a suitable weather tight building or bin, which will protect the cement from dampness. The cement shall be so stored as to provide easy access for proper inspection. Any cement, which has become partially set or which contains hard lumps or cakes or cement salvaged from discarded or used bags, shall not be used.

Fly ash (denoted by TxDOT designations Type A and Type B) may replace 20 to 35 percent of a mix design's PC content by absolute volume. Fly ash shall not be used in mix designs with less than 5 sacks of PC per cubic yard unless specifically permitted by the Contract plans or project manual. Fly ash shall conform to the requirements of Item No. 405S, "Concrete Admixtures."

B. Admixtures

Concrete admixtures conforming to Item No. 405S, "Concrete Admixtures" may be used when approved by the Engineer or designated representative to minimize segregation, improve workability, reduce the amount of mixing water and to provide normal hot weather concreting provisions. The use of admixtures shall not alter the approved mix designs, except for water content.

C. Coarse Aggregate

Coarse aggregate shall consist of durable particles of gravel, crushed blast furnace slag and/or crushed stone of reasonably uniform quality throughout, free from injurious amounts of salt, alkali, vegetable matter or other objectionable material, either free or as an adherent coating on the aggregate. It shall not contain more than 0.25 percent by weight of clay lumps nor more than 1.0 percent by weight of shale nor more than 5.0 percent by weight of laminated and/or friable particles when tested in accordance with TxDOT Test Method Tex-413-A.

Coarse aggregate shall have a wear of not more than 45 percent when tested according to TxDOT Test Method Tex-410-A and when tested by standard laboratory methods shall meet the following grading requirements:

Retained on 1¾ inch sieve	0%
Retained on 1½ inch sieve	0 to 5%
Retained on ¾ inch sieve	30 to 65%
Retained on ⅜ inch sieve	70 to 90%
Retained on No. 4 sieve	95 to 100%

Loss by Decantation TxDOT Test Method \*Tex-406-A. 1.0% Maximum

\* In the case of aggregate made primarily from crushing of stone. If the material finer than the 200 sieve is definitely established to be the dust of fracture essentially free from clay or shale as established by Part III of TxDOT Test Method Tex-406-A, the percent may be increased to 1.5.

When the plans do not require a monolithic pour of curb or curb and gutter, the Contractor may elect to use the following gradation of coarse aggregate for curb or curb and gutter:

Retained on 1½ inch sieve	0%
Retained on ⅜ inch sieve	5 to 30%
Retained on No. 4 sieve	75 to 100%

Where the coarse aggregate is delivered on the job in 2 or more sizes or types, each type and/or size shall be batched and weighed separately.

All aggregates shall be handled and stored in such a manner as to prevent size segregation and contamination by foreign substances and maintain as nearly as possible in a uniform condition of moisture. When segregation is apparent, the aggregate shall be remixed with suitable equipment as required. At time of its use, the aggregate shall be free from frozen material and aggregate containing foreign materials will be rejected. Coarse aggregate that contains more than 0.5 percent free moisture by weight shall be stockpiled for at least 24 hours prior to use.

Adequate storage facilities shall be provided for approved materials. The intermixing of non-approved materials with approved materials either in stockpiles or in bins will not be permitted. Aggregates from different sources shall be stored in different stockpiles unless otherwise approved by the Engineer or designated representative.

D. Fine Aggregate

Fine aggregate shall be free from injurious materials of salt, alkali or vegetable matter. It shall not contain more than 0.5 percent by weight of clay lumps. When subjected to the color test for organic impurities, TxDOT Test Method Tex-408-A, the fine aggregate shall not show a color darker than standard.

Unless shown otherwise on the drawings, fine aggregate shall have an acid insoluble residue of at least 60% by weight when tested in accordance with Tex 612-J.

Unless specified otherwise, fine aggregate shall meet the following grading requirements:

Retained on 3/8 inch sieve	0%
Retained on No. 4 sieve	0 to 5%
Retained on No. 8 sieve	0 to 20%
Retained on No. 16 sieve	15 to 30%
Retained on No. 30 sieve	35 to 75%
Retained on No. 50 sieve	70 to 90%
Retained on No. 100 sieve	90 to 100%
Retained on No. 200 sieve	97 to 100%

Fine aggregate will be subjected to the Sand Equivalent Test, TxDOT Test Method Tex-203-F. The sand equivalent value shall not be less than 80.



E. Mineral Filler

Mineral filler shall consist of clean stone dust, crushed sand, crushed shell or other approved inert material. It shall meet the following requirements when tested in accordance with TxDOT Test Method Tex-401-A:

Retained on No. 30 sieve	0%
Retained on No. 200 sieve	0 to 35%

Where fine aggregate is delivered to the job in 2 or more sizes or types, each type and/or size of material shall be batched and weighed separately. Where mineral filler is used, it shall be batched and weighed separately. At the time of its use the fine aggregate shall be free from frozen material and aggregate containing foreign material will be rejected.

All fine aggregate shall be stockpiled for at least 24 hours prior to use.

F. Mixing Water

Water for use in concrete and for curing shall be free from oils, acids, organic matter or other deleterious substances and shall not contain more than 1,000 parts per million of chlorides as Cl nor more than 1,000 parts per million of sulfates as SO<sub>4</sub>.

Water from municipal supplies approved by the State Health Department will not require testing. Contractor shall sample and test water from other sources and submit test results to the Engineer or designated representative for approval 10 days prior to proposed use.

Tests shall be made in accordance with "Standard Method of Test for Quality of Water to be used in Concrete," AASHTO Method T-26.

G. Transit-mixed Concrete

The use of transit-mixed (ready-mixed) concrete will be permitted by the Engineer or designated representative provided the batching plant and mixer trucks meet requirements of quality specified herein.

When ready-mixed concrete is used, additional mortar (1 sack cement, 3 parts sand and sufficient water) shall be added to each batch to coat the drum of the mixer or agitator truck. Delivery of concrete to the site of the work and its discharge from the truck mixer, agitator or non-agitating equipment shall be in accordance with the requirements of Item No. 410S, "Concrete Structures."

Ready-mixed concrete, batching plant and mixer truck operation shall include the following:

1. A ticket system will be used that includes a copy for the construction inspector. The ticket will have machine stamped time/date of the concrete batch, weight of cement, sand and aggregates; exact nomenclature and written quantities of admixtures and water. Any item missing or incomplete on the ticket may be cause for rejection of the concrete.

2. Sufficient trucks will be available to support continuous slab placements. The Contractor will satisfy the Engineer or designated representative that adequate standby trucks are available to support monolithic placement requirements.
3. A portion of the mixing water, required by the batch design to produce the specified slump, may be withheld and added at the job site but only with the permission of the Engineer or designated representative and under the Inspector's observation. When water is added under these conditions, it will be thoroughly mixed before any slump or strength samples are taken.

H. Joint Sealer

Unless otherwise shown on the plans, joint sealant for concrete pavement used on airport runways and/or taxiways shall be TxDOT Class 5. All other joint sealant shall be TxDOT Class 2.

As a minimum, the joint sealant shall comply with the following. The manufacturer of the joint sealant shall furnish certification that the product to be supplied meets or exceeds the specification.

1. Class 2 (Hot Poured Rubber-Asphalt). This sealer shall conform to Standard Specification Item No. 313S, "Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)". The sealer must be compatible with asphaltic concrete.
2. Class 5 (Low Modulus Silicone Sealant for Concrete Pavement). This material shall conform to Item No. 413S, "Cleaning and/or Sealing Joints and Cracks (Portland Cement Concrete)" and shall be furnished in a one-part silicone formulation, which does not require a primer for bond to concrete. A backer rod shall be required which will be compatible with the sealant. No bond or reaction shall occur between the rod and sealant. The sealant shall adhere to the sides of the concrete joint. It shall not crack or break when exposed to temperatures below 32°F (0°C).

The sealant material shall have the following properties:

Color	Gray
Flow, MIL-2-8802D, Sec 4.8.4, max	0.2
Working time, minutes	10
Tack-free time at 77°F ±2°F, MIL-2-8802D	
Sec 4.8.7, minutes	60
Cure time at 77°F, days	7—14
Full Adhesion, days	14—21

**As Cured - after 7 days at 77°F and 40% Relative Humidity**

Elongation, minimum percent	1200
Durometer Hardness, Shore A, ASTM D 2240, min	15
Joint movement capability, percent	+100/-50
Tensile Strength, maximum elongation, percent	100
Peal strength, psi	25

I. Backer Rod

Backer Rod shall be expanded closed cell polyethylene foam compatible with sealant. No bond or reaction shall occur between rod and sealant. Backer Rod shall be of sufficient width to be in compression after placement.

J. Joint Filler

Boards for expansion joint filler and for contraction and longitudinal joints shall be of the size, shape and type indicated.

Board shall be obtained from Redwood, Cypress, Gum, Southern Yellow Pine or Douglas Fir timber. They shall be solid heartwood and shall be free from sapwood, knots, clustered birdseye, checks and splits. Occasional sound or hollow birdseye, when not in clusters, will be permitted provided the board is free from any other defects that will impair its usefulness as a joint filler. With the exception of Redwood and Cypress, all boards shall have a creosote or pentachlorophenol treatment of 6 pounds per cubic foot. When oven dried at 230°F to a constant weight, the weight of the board per cubic foot (minus treatment), shall not be less than 20 pounds nor more than 35 pounds.

K. Asphalt Board

Asphalt board when used as indicated shall be of required size, full depth of concrete placement and uniform thickness. When used in transverse joints, it shall conform approximately to shape of the pavement crown as indicated. Asphalt board shall consist of 2 liners of 0.016-inch asphalt impregnated paper filled with a mastic mixture of asphalt and vegetable fiber and/or mineral filler. Boards shall be smooth, flat and straight throughout and shall be sufficiently rigid to permit easy installation. Boards that crack or shatter during installing and finishing operations will not be acceptable. Board shall be furnished in lengths equal to 1/2 the pavement width or in lengths equal to the width between longitudinal joints and may be furnished in strips or scored sheets of the required shape. When tested in accordance with TxDOT Test Method Tex-524-C the asphalt boards shall not deflect from the horizontal more than 3/4 inch in 3½ inches. The asphalt board shall be placed such that they will not interfere with the bonding of the joint sealer.

L. Load Transmission Devices for Expansion and Contraction Joints

Approved load transmission devices, when indicated, shall meet the requirements specified herein:

Smooth steel bar dowels, used when indicated, shall be of the size and type indicated and shall be open-hearth, basic oxygen or electric-furnace steel conforming to the properties specified for grade 60 in ASTM A 615. The free end of dowel bars shall be smooth and free of shearing burrs.

When indicated, one end of each dowel bar shall be encased in an approved cap having an inside diameter of 1/16 inch greater than the diameter of the dowel bar. The cap shall be of such strength, durability and design as to provide free movement of the dowel bar and shall be approved by the Engineer or designated representative prior to use. One end of the cap shall be filled with a soft felt plug or shall be void in order to permit free movement of the dowel bar for a distance equivalent to 150 percent of the width of the expansion joint used. The dowel caps and dowel bars shall be held securely in place by bar ties as indicated on the drawings. Mechanical methods of implanting dowel bars in the plastic concrete may be used when approved by the Engineer or designated representative.

Where required, dowel bars shall be coated with a plastic material meeting the requirements indicated.

Where red lead and oil bar coating is indicated, the red lead may be of any standard commercial grade and the oil shall be clean and no lighter than Standard No. 30 SAE grade. Approved thinner and dryer may be added to the red lead, but the material upon application shall be of such consistency that will provide a uniform and heavy coating on the bar. Where asphalt bar coating is indicated, the material may be any standard grade of oil asphalt and shall be applied hot. Cutback asphalt will not be permitted for bar coating.

#### M. Metal Installing Devices for Joint Assembly

Metal installing devices for expansion and contraction joint assemblies (such as welded wire bar chairs, bar stakes and marker channels, channel caps, etc.) shall be as indicated or may be similar devices of equivalent or greater strength, approved by the Engineer or designated representative, that will secure joint assembly in correct position during the placing and finishing of concrete. Load transmission devices used in joint assemblies shall be secured in position by a transverse metal brace of the type and design indicated or may be secured in position by other approved devices of equivalent or greater strength that will provide positive mechanical connection between the brace and each unit (or than by wire tie) and prevent transverse movement of each load transmission device.

#### N. Steel Reinforcement

Steel reinforcing bars as required including tie bars shall be open-hearth, basic oxygen or electric-furnace new billet steel of Grade 60 or Grade 40 for concrete reinforcement as indicated. Bars that require bending shall be Grade 40 conforming to the requirements of ASTM A 615.

High yield reinforcing steel shall be either (a) open-hearth, basic oxygen or electric-furnace new billet steel conforming to ASTM A 615 Grade 60 or (b) rail steel bars for concrete reinforcement, conforming to ASTM A 616 Grade 60. Bars produced by piling method will not be accepted. High yield reinforcing steel bars shall be further identified by a special marking rolled into each bar. All reinforcing steel shall be deformed bars conforming to the requirements of pertinent ASTM Specifications.

Where prefabricated deformed wire mats are indicated or permitted, the wire shall be cold worked deformed steel wire conforming to the requirements of ASTM A 496, except that steel shall be made

by open-hearth, electric-furnace or basic oxygen processes. The prefabricated deformed wire mats shall conform to the requirements of ASTM A 497, except that wires used shall be deformed and transverse wires shall project beyond the centerline of each edge longitudinal wire as indicated. Mats that have been bent or wires dislocated or parted during shipping or project handling shall be realigned to within 1/2 inch of original horizontal plane of the mat. Mats with any portion of the wires out of vertical alignment more than 1/2 inch after realignment and/or wires dislocated or mutilated so that, in the opinion of the Engineer, they do not represent the original mat, shall be rejected. The reinforcement may be clamped or wired so that the reinforcement will retain the horizontal and vertical alignment as indicated or as approved by the Engineer or designated representative. Deformed wire may be used for tie bars and load transfer bars that require bending. The nominal size, area and theoretical weight of reinforcing steel wires covered by this provision are as listed in Table II. When fabricated steel bars or rod mats are indicated, the mats shall meet requirements of ASTM A 184.

Steel wire fabric reinforcement shall be of the gage and spacing indicated and shall conform to the requirements of ASTM A 82. Longitudinal and transverse wires shall be electrically welded together at all points of intersection and the welds shall be of sufficient strength that they will not be broken during handling or placing. All welding and fabrication of fabric sheets shall conform to the requirements of ASTM A 185. Welded steel wire fabric shall be furnished in sheets as indicated and steel having been previously bundled into rolls will not be accepted. An approved hinge will be permitted in each sheet to provide for each sheet longitudinally. When wire fabric is used, it will replace only the longitudinal and transverse bars. The tie bars and load transmission units at joints will not be affected.

<b>Table II: DIMENSIONAL REQUIREMENTS FOR DEFORMED STEEL WIRE FOR CONCRETE REINFORCEMENT</b>				
<b>Deformed Wire Size No.</b>	<b>Unit Weight Pounds Per Ft.</b>	<b>Diameter Inches</b>	<b>Cross-Sectional Area, Sq. Inches</b>	<b>Perimeter Inches</b>
D-1	0.034	0.113	0.01	0.355
D-2	0.068	0.159	0.02	0.499
D-3	0.102	0.195	0.03	0.612
D-4	0.136	0.225	0.04	0.706
D-5	0.170	0.252	0.05	0.791
D-6	0.204	0.276	0.06	0.867
D-7	0.238	0.296	0.07	0.936
D-8	0.272	0.319	0.08	1.002

D-9	0.306	0.338	0.09	1.061
D-10	0.340	0.356	0.10	1.118
D-11	0.374	0.374	0.11	1.174
D-12	0.408	0.390	0.12	1.225
D-13	0.442	0.406	0.13	1.275
D-14	0.476	0.422	0.14	1.325
D-15	0.510	0.437	0.15	1.372
D-16	0.544	0.451	0.16	1.416
D-17	0.578	0.465	0.17	1.460
D-18	0.612	0.478	0.18	1.501
D-19	0.646	0.491	0.19	1.542
D-20	0.680	0.504	0.20	1.583
D-21	0.714	0.517	0.21	1.624
D-22	0.748	0.529	0.22	1.662
D-23	0.782	0.541	0.23	1.700
D-24	0.816	0.553	0.24	1.737
D-25	0.850	0.564	0.25	1.772
D-26	0.884	0.575	0.26	1.806
D-27	0.918	0.586	0.27	1.841
D-28	0.952	0.597	0.28	1.876
D-29	0.986	0.608	0.29	1.910
D-30	1.020	0.618	0.30	1.942

D-31	1.054	0.628	0.31	1.973
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O. Polyethylene Film

Polyethylene film shall be opaque pigmented white in color and shall be manufactured from virgin resin without additives or scrap. It shall be sufficiently strong and tough to permit its use under the conditions existing on street paving work without being torn or otherwise rendered unfit for the purpose during the curing period. The film shall have a minimum thickness of 4 mils (0.004 inch), shall have a minimum tensile strength of 1,700 psi at 77°F in the longitudinal direction and 1,200 psi at 77°F in the transverse direction and shall have a minimum elongation of 200 percent at 77°F in the longitudinal direction and 150 percent at 77°F in the transverse direction. The permissible percent moisture loss shall not exceed 2 percent after 24 hours and 4 percent after 72 hours. Tests for tensile strength and elongation will be conducted in accordance with ASTM Designation: D 882, Method A. Tests for moisture retention will be conducted in accordance with ASTM Designation: C 156.

P. Membrane Curing Compound

Membrane curing compound shall conform to Item No. 409S, "Membrane Curing," Type 2 white pigmented.

Q. Asphalt Curing

Where asphalt is to be placed on a concrete base, asphalt shall be used for curing concrete base, the material shall conform to Item No. 301S, "Asphalts, Oils and Emulsions" for RS-2 or RS-2h or as indicated on the drawings.

360S.4 - Equipment

A. General

All equipment necessary for construction of this item shall be on the Project and shall be approved by Engineer or designated representative as to conditions before the Contractor will be permitted to begin construction operations on which the equipment is to be used. When approved by the Engineer or designated representative in writing, a commercial or independently operated batching plant for measuring materials outside limits of the project may be used.

B. Mixer

The mixer furnished may be either a paving mixer (operated at site of construction or centrally located), a stationary mixer (central mixer) or a paving mixer (truck mounted) that will produce adequately mixed concrete meeting the specified requirements. The mixer, or mixers, shall conform to the following requirements:

1. Each mixer shall have attached in a prominent place a manufacturer's plate showing rated capacity of the drum in terms of volume of mixed concrete and the recommended speed of rotation of the mixing drum or blades.

2. The stationary mixer (central mixer) or truck mounted paving mixer shall be operated at the manufacturer's recommended speed.
3. The size of the paving mixer shall not be less than that of a 27-E paver, as established by the Mixer Manufacturer's Bureau of Associated General Contractors. The paving mixer shall be operated at a drum speed of not less than 16 revolutions per minute and not more than 22 revolutions per minute. Pickup and throw over blades in the drum of the mixer shall be replaced when worn down 3/4 inch or more.
4. Each truck mounted paving mixer shall be approved by the Engineer or designated representative prior to use on the project. It shall be classified as a "paving mixer" by the manufacturer and shall be so designed that a uniform and low slump concrete (approximately 1½ inch slump) can be mixed without aggregate size segregation. The mixer shall be capable of discharging the low slump concrete at a speed of 10 seconds per cubic yard or faster.
5. Each mixer shall be equipped with an approved automatic device for satisfactorily timing the mix and locking the discharging device in order to prevent the discharging of the mixer before the end of the required mixing period. This timing device shall operate a sounding device to signal plainly the completion of the mixing time. When permitted by the Engineer a light signal device may be used.
6. Multiple drum mixers will be permitted provided their operation is properly synchronized. The mixing time shall be determined exclusive of the time required to transfer concrete from one drum to the next drum.
7. Each mixer shall be equipped with a water-measuring device so constructed that it will measure the water within 1 percent of the total amount required for each batch. Unless the water is to be weighed, the water measuring equipment shall include an auxiliary tank with a capacity greater than that of the measuring tank and from which the measuring tank will be filled by gravity flow. The measuring tank shall be open to the atmosphere and shall be so placed and constructed that the water for a batch can be discharged into a calibrated tank or weighing device for checking the accuracy of water measurement without seriously delaying the paving operations. The Contractor shall have a calibrated tank or weighing device available at all times at a location satisfactory to the Engineer or designated representative.
8. If a paving mixer is furnished and operated at the site of construction, it shall be equipped with a power controlled boom and bucket, so designed as to permit uniform distribution of the concrete for the full width between pavement forms. Alternate equipment for distributing concrete may be substituted when approved by the Engineer in writing, provided uniform distribution is obtained without segregation.
9. If central mixed concrete is used on the project, the Contractor shall provide equipment designed to provide uniform distribution for the concrete for the full width between pavement forms without segregation.

#### C. Transit-mix Trucks

When transit-mix (ready-mix) concrete is used, additional mortar (1 sack cement, 3 parts sand and sufficient water) shall be added to the batch to coat the drum of the mixer or agitator truck. This shall be required for every load of concrete. The mixing speed shall be attained as soon as all ingredients



are in the mixer. Each complete batch (containing all the required ingredients) shall be mixed not less than 70 nor more than 100 revolutions of the drum at mixing speed.

A portion of the mixing water, required by the batch design to produce the desired slump, may be withheld and added at the job site, but only with permission of the Engineer and under the Engineer's supervision. When water is added at the job site, 25 revolutions (minimum) at mixing speed, will be required to flush down the blades after charging shall be accurately measured and included in the quantity of mixing water. The introduction of the initial mixing water, except blade wash down water and that permitted in this Article shall be prior to or simultaneous with the charging of the aggregates and cementitious material.

Mixing and agitating speed shall be as designated by the mixer manufacturer. All revolutions after prescribed mixing shall be at agitating speed. Except for short periods of time during discharge, the drum shall be kept in continuous motion from the time the mixing is started until the discharge is completed.

Additional mortar, consisting of 1 sack cement, 3 parts sand and sufficient water, shall be added to the batch to coat the drum of the transit mixer or agitator truck. This shall be required for every load of concrete.

The loading of transit-mixers shall not exceed 63 percent of the drum volume. When used as an agitator only, the loading of truck mixers shall not exceed 80 percent of the drum volume.

The batching plant and transit-mix trucks shall operate under the following system:

1. A ticket system will be used that includes a copy for the construction inspector. The ticket will have machine stamped time/date of water/cement batch; weight of cement, fly ash (if applicable), water, sand and aggregates; exact nomenclature and quantities of admixture. Any item missing or incomplete on the ticket will be cause for rejection. Coded readouts may be used if approved in advance by the Engineer.
2. Sufficient trucks will be available to support continuous placements. The Contractor will satisfy the Engineer that adequate standby trucks are available to support monolithic placement when required.
3. A portion of the mixing water, required by the batch design to produce the desired slump, may be withheld and added at the job site, but only with the permission of the Engineer and under the Inspector's observation. When water is added under these conditions, it will be thoroughly mixed before any slump or strength samples are taken.

#### D. Hauling Equipment

Batch hauling equipment for the transportation of measured materials from the batching plant to the mixer shall be equipped with tight covers, which shall be used to prevent excessive evaporation of moisture or any loss of material.

If a central mixer is used, concrete may be transported to the point of delivery in truck agitators or non-agitating trucks.

If a truck mounted paving mixer is used, it may be used to transport the concrete after mixing is complete.

If non-agitator trucks are used they shall conform to the following requirements:

The bed of non-agitating hauling equipment shall be a smooth, mortar-tight, metal container. The hauling equipment shall be capable of delivering the concrete to the work site in a thoroughly mixed and uniform mass and capable of discharging the concrete at a satisfactory controlled rate without segregation. If in the opinion of the Engineer any appreciable segregation or accumulation of excess water and/or mortar occurs on the surface of the concrete, this may be cause for rejection and this method of transporting the concrete to the point of delivery shall be suspended as directed by the Engineer.

E. Subgrade or Subbase Planer and Templates

Unless a stabilized subbase is provided, an approved subbase planer shall be provided, mounted on visible rollers riding on the forms and having adjustable cutting blades which shall trim the subgrade to the exact section as indicated. The planer frame shall be heavy enough to remain on the forms at all times and shall be of such strength and rigidity that, under a test made by changing the support from the wheels to the center, it shall not develop a deflection for more than 1/8 inch. Tractive power equipment used to pull the planer shall not be such as to produce ruts or indentations in the subgrade.

When the slip form method of paving is to be used, the subgrade planer will be operated on a prepared track grade or controlled by an electronic sensor system operated from a string line that establishes the horizontal alignment and the elevation of the subbase.

A template for checking the contour of the subbase shall be provided and operated by the Contractor. The template shall rest upon the side forms and shall be of such strength and rigidity that, under a test made by changing the support to the center, it shall not show a deflection of more than 1/8 inch. It shall be provided with accurately adjustable rods projecting downward to the subgrade at 1-foot intervals and these rods shall be adjusted to the required cross section of the bottom of the slab when the template is resting upon the side forms. Where stabilized subbase is provided, use of a scratch template will be required.

F. Forms

Side forms shall be of metal of approved cross section. The preferred depth of the form shall be equal to the required edge thickness of the pavement. Forms with depth greater than the required edge thickness of the pavement will be permitted.

The length of form sections shall not be less than 10 feet and each section shall provide for staking in position with not less than 3 pins. Flexible or curved forms of wood or metal of proper radius shall be used for curves of 200-foot radius or less. Forms shall be of ample strength and shall be provided with adequate devices for secure setting so that when in place they will withstand, without visible springing or settlement, the impact and vibration of the spreading and finishing machinery. In no case shall the base be less than 6 inches for a form 6 inches or more in height. The forms shall be free from warps, bends or kinks and shall be sufficiently true to provide a reasonably straight edge on the concrete. The top of each form section, when tested with a straightedge shall conform to the requirements specified for the surface of the completed pavement. Sufficient forms shall be provided for satisfactory prosecution of the work.

Outside curb forms shall be of wood or metal of a section satisfactory to the Engineer or designated representative, straight, free of warp and shall be in a depth at least equal to the depth of the curb.

They shall be mounted on the paving forms and securely attached thereto and maintained in true position during the placing of the concrete. Inside curb forms, if required, shall be of approved material and of such design as to provide the curb required and shall be rigidly attached to the outside forms.

#### G. Concrete Spreader

Use of concrete spreader shall be required and it shall be a self-propelled machine having sufficient power and traction to spread and strike off concrete without slippage on the forms. It shall be equipped with a power-driven device for spreading the concrete uniformly between the forms. The spreading device may be either a reciprocating blade, a screw conveyer or a belt conveyer. The spreader shall be capable of striking off the surface of the concrete between the forms in the longitudinal direction of the slab at any required elevation.

Mechanically operated concrete spreaders of other designs, which uniformly distribute the concrete with a minimum of segregation, may be used when approved by the Engineer.

#### H. Slipform Paver

With prior approval, the Contractor may place concrete with slip form paver. This paver shall be equipped with a longitudinal transangular finishing float adjustable to crown and grade and be satisfactory to the Engineer or designated representative. The float shall extend across the pavement practically to the side forms and/or the edge of slab. A "string line" shall be used to provide grade control for the paver.

#### I. Mechanical Vibratory Equipment

All concrete placed for pavement shall be consolidated by approved mechanical vibrators operated ahead of the transverse finishing machine and designed to vibrate the concrete internally and/or from the surface. Vibratory members shall extend across the pavement practically to but shall not come in contact with the side forms. Mechanically operated vibrators shall be mounted in such manner as not to interfere with transverse or longitudinal joints. The internal-type vibrators shall be spaced at not more than 24 inches and shall be equipped with synchronized vibratory units. Separate vibratory units shall be spaced at sufficiently close intervals to provide uniform vibration and consolidation to the entire width of the pavement. The frequency in air of the interval spud type vibratory units shall be not less than 8,000 cycles per minute and not less than 5,000 cycles per minute for tube types and the method of operation shall be as directed by the Engineer or designated representative. The Contractor shall have a satisfactory tachometer available for checking vibratory the elements.

The pavement vibrators shall not be used to level or spread the concrete but shall be used only for purposes of consolidation. The vibrators will not be operated where the surface of the concrete, as spread, is below the elevation of the finished surface of the pavement, except for the first lift of concrete where double strike off method of placement is employed and the vibrators shall not be operated for more than 15 seconds while the machine upon which they are installed is standing still.

The pan type vibratory units shall apply the vibrating impulses directly to the surface of the concrete. The operating frequency shall be not less than 3,500 cycles nor more than 4,200 cycles per minute in air. The Contractor shall have a satisfactory tachometer available for checking the speed of the vibratory elements.

Approved hand manipulated mechanical vibrators shall be furnished in the number required for provision of proper consolidation of the concrete along forms, at joints and in areas not covered by mechanically controlled vibrators. These vibrators shall be sufficiently rigid to insure control of the operating position of the vibrating head.

Complete and satisfactory consolidation of the concrete pavement is a most important requirement of this specification. Cores taken shall be carefully examined for voids, honeycombing or other evidence of incomplete consolidation. If such evidence is present, changes in the consolidation procedures and/or equipment will be made to insure satisfactory consolidation.

## J. Finishing Equipment

### 1. Transverse Finishing Machine

The Transverse finishing machine shall be provided with 2 screeds accurately adjusted to the crown of the pavement, shall be self-propelled and mounted in a substantial frame equipped to ride on the forms, or may be slip form finished, and shall be so designed and operated as to strike off and consolidate the concrete.

### 2. Longitudinal Finishing

A transverse drag float may be used in lieu of the longitudinal finishing machine with the Engineer's approval. Finishing machines shall be maintained in a tight and good operating condition, accurately adjusted to the required crown or profile and free from deflection, wobble or vibration tending to affect the precision of finish. Machines failing to meet these requirements will be rejected by the Engineer or designated representative and the Contractor shall provide approved equipment.

Where hand finishing is permitted under this specification, the Contractor shall provide a strike template and a tamping template both of 4 by 10 inch lumber or equivalent metal section and at least 2 feet longer than the width of the pavement. Both templates to conform to the crown section of the pavement and the tamp, if of wood, shall have a steel face not less than 3/8 inch in thickness. The Contractor shall also provide a longitudinal float of approved design and not less than 14 feet in length.

The Contractor shall furnish and maintain at least two standard 10-foot steel straightedges on the work site at all times during the paving operations. The Contractor shall operate same in the presence of the Engineer or designated representative.

The Contractor shall furnish a sufficient number of bridges to ride on the forms and span the pavement for finishing operations and for the installation and finishing of joints. All necessary finishing and edging tools shall be furnished as may be required to complete the pavement as indicated.

## 360S.5 - Proportioning of Concrete

### A. Proportions

Concrete shall be composed of Cementitious Materials, fine aggregate, coarse aggregate, mineral filler and/or admixture if used and water, mixed in the proportions designated by the approved Mix Design and in the manner set forth in this specification. On the basis of job and laboratory investigations of the proposed materials, the Contractor will fix proportions by weight of water, coarse

aggregate, fine aggregate, cementitious materials, admixture and mineral filler where required, in order to produce concrete of the specified strength and workability for the actual delivery time and site conditions to be encountered. Where curbs are placed separately, the Engineer or designated representative may allow aggregate gradation conforming to Class A Concrete, Item No. 403, "Concrete for Structures."

B. Concrete Strength

The concrete mix to be designed to produce a concrete with the following requirements:

<b>Table 1: CONCRETE PAVEMENT</b>		
<b>Item</b>	<b>Test</b>	<b>Value</b>
Entrained Air	Tex-416-A	3 to 6 percent
Water-Cement Ratio gal. /sack, Maximum		6.25
Sacks Cement, Minimum, 94 pounds ea		6 per cubic yard
Coarse Aggregate Factor		0.65 min—0.85 max.
Compressive Strength after 7 Days, psi	Tex-418-A	4000
Compressive Strength after 28 Days, psi	Tex-418-A	4500
Maximum Concrete Mix Temperature °F		95
Retarder: Regular Concrete increase in time over 360S.7(3), minutes, Maximum	60	

<b>Table 2: HIGH EARLY STRENGTH CONCRETE</b>		
<b>Item</b>	<b>Test</b>	<b>Value</b>
Cement Type		III
Entrained Air	Tex-416-A	3 to 6 percent

<b>Table 2: HIGH EARLY STRENGTH CONCRETE</b>		
<b>Item</b>	<b>Test</b>	<b>Value</b>
Water-Cement Ratio gal. /sack, Maximum		6.25
Sacks Cement, Minimum, 94 pounds ea		7 per cubic yard
Coarse Aggregate Factor		0.65 min-0.85 max
Slump, inches	Tex-415-A	1/2 to 2
Compressive Strength, after 24 hours, psi	Tex-418-A	2,100
Compressive Strength, after 3 Days, psi	Tex-418-A	2,750
Compressive Strength, after 7 Days, psi	Tex-418-A	4,500
Compressive Strength, after 28 Days, psi	Tex-418-A	4,925
Maximum Concrete Mix, Temperature °F		95

The Contractor may submit a mix design using high range water reducing admixtures conforming to Item No. 405S, "Concrete Admixtures" in lieu of the concrete pavement mix specified and shall meet the following requirements:

<b>Table 3: HIGH RANGE WATER REDUCING ADMIXTURES: SUPERPLASTERSIZER CONFORMING TO SPECIFICATION ITEM NO. 405S, "CONCRETE ADMIXTURES"</b>		
<b>Item</b>	<b>Test</b>	<b>Value</b>
Entrained Air	Tex-416-A	3 to 6 percent
Water-Cement Ratio, gal. /sack, Maximum		6.25
Sacks Cement, Minimum, 94 pounds ea		6 per cubic yard
Coarse Aggregate Factor		0.65 min.—0.85 max.
Slump, inches before Admixture	Tex-415-A	1/2 to 2
Slump, Inches after Admixture	Tex-415-A	4 to 10
Compressive Strength, after 3 Days, psi	Tex-418-A	3,125

Compressive Strength, after 7 Days, psi	Tex-418-A	4,500
Compressive Strength, after 28 Days, psi	Tex-418-A	4,925
Maximum Concrete Mix, Temperature, °F		100
Retarder, Regular Concrete Over 360S.7C, Minutes, Maximum	120	

<b>Table 4: Over Design Required to Meet Compressive Strength Requirements <sup>1</sup></b>					
Number of Tests <sup>2,3</sup>	Standard Deviation, psi				
	300	400	500	600	700
15	470	620	850	1,120	1,390
20	430	580	760	1,010	1,260
30 or more	400	530	670	900	1,130

Notes:

1. When designing the mix, add the tabulated amounts to the minimum design strength in Tables 1, 2 or 3. Maximum water-cement or water-cementitious ratio by weight
2. Number of tests of a concrete mixture used to estimate the standard deviation of a concrete production facility. Test of another mix within 1,000 psi of the specified strength may be used.
3. If less than 15 prior tests are available, the overdesign should be 1,200 psi for specified strengths from 3,000 to 5,000 psi and 1,400 psi for specified strengths greater than 5,000 psi.

High range water reducing admixtures shall be capable of maintaining the original slump until placement and screeding, which may be 2 hours, without the addition of water, additional admixture or other retempering or remixing techniques.

C. Workability of Concrete

Concrete shall be uniformly plastic, cohesive and workable. Workable concrete is defined as concrete which can be placed without honeycomb and without voids in the surface of the pavement after the specified finishing machine has been over a given area twice. Workability shall be obtained without producing a condition such that free water appears on the surface of the slab when being finished as specified. Where water appears on the surface of the concrete after finishing and this condition cannot be corrected by reasonable adjustment in the batch design, the bleeding to be immediately corrected by one of the following measures or a combination of two or more of the following listed measures:

1. Redesign of the batch;
2. Addition of mineral filler to fine aggregates;
3. Increase of cement content; or
4. Use of an approved air entraining agent or approved admixture.

In the event that the measures taken do not eliminate the bleeding immediately, concrete placement operations will be suspended, as directed by the Engineer or designated representative, by placing a bulkhead or "header" as indicated and according to applicable requirements for intentional stoppage of placement of concrete under Item No. 360S, "Concrete Pavement" and will remain suspended until such time as additional trial mixes demonstrate that a non-bleeding batch design has been achieved. Failing to achieve a satisfactory laboratory batch design the Contractor will be required to use different materials and to submit samples thereof for additional trial mixes and pilot cylinders.

The mix will be designed with the intention of producing concrete, which will have a slump of 1½ inches. The slump shall not be less than 1/2 inch nor more than 2 inches.

#### D. Mix Design

The Contractor shall perform at the Contractor's own expense and be responsible for the design of the concrete mix. The mix design shall be prepared and sealed by a person qualified and experienced in such work. Establish proportions on the basis either of laboratory trial batches or of field experience with the materials to be employed.

When ice is used to lower the concrete temperature during hot weather, concrete placement (Section 13 of Standard Specification Item No. 410S, "Concrete Structures"), the Contractor shall furnish a mix design (Section 6 of Standard Specification Item No. 403S, "Concrete for Structures") acceptable to the Engineer or designated representative for class of concrete specified. The addition of ice shall not exceed 50 percent of the total mix water weight.

Complete concrete mix design data shall be submitted to the Engineer or designated representative for approval at least 10 days before concrete placement begins. Submittal of the mix shall be accompanied by such test data and certifications as may be necessary to demonstrate compliance with specification requirements. Approval of this mix design shall in no way relieve the Contractor of responsibility for the quality of the concrete.

It shall also be the responsibility of the Contractor to determine and measure batch quantity of each ingredient, including water, not only for batch designs but for all concrete produced for the project, so that the mix conforms to these specifications.

Trial batches shall be made and tested using all the proposed ingredients prior to the placing of concrete and also when the aggregate and/or type, brand or source of cement or admixture is changed. When the brand and/or source of cement only is changed, the Engineer or designated representative may waive trial batches only if a prior record of satisfactory performance of the cement has been established.

Mix designs used successfully on previous or concurrent jobs may be approved by the Engineer or designated representative without trial batches if it is shown that there is no substantial change in any of the proposed ingredients.



The Contractor shall prepare a minimum of four concrete test cylinders of each mix design, cure and test two each at the age of 7 and 28 days. From these preliminary tests the water-cement ratio required to produce concrete of the specified strength will be selected by the Contractor for approval by the Engineer or designated representative. The Contractor may at any time present in writing a suggested mix design and if the Engineer or designated representative concurs with the suggested design, the Contractor shall conduct trial batches necessary to determine its acceptability under these specification requirements.

The Contractor shall furnish and operate the mixer approved for use on this project unless the concrete is to be furnished from a transit mix (ready-mix) plant. For mixing the concrete to be used in making the preliminary test specimens, a minimum 1 cubic yard batch shall be mixed or a batch of sufficient size to afford proper mixing, whichever is the greater. In lieu of the above mixer and procedure, the Contractor may furnish a portable mixer of sufficient rated capacity to mix a minimum 3-sack batch; in which case, the batch mixed for the preliminary test not to be less than the rated capacity of the mixer furnished. A coating batch will be mixed prior to mixing for test cylinders.

No additional compensation to be allowed for equipment, materials or labor involved in making job mix design test specimens.

After the mix proportions and water-cement ratio required to produce concrete of the specified strength have been determined, placing of the concrete may be started. The strength of the concrete in the completed pavement will be determined by a minimum of four compressive strength test specimens made, cured with a minimum of two each tested at 7 and 28 days as provided in TxDOT Bulletin C-11. Modifications of the mix design may be requested by the Contractor on basis of conformity of the strength of these test specimens with the requirements and intent of this specification.

Changes in the water-cement ratio and the mix design, including an increase in cement factor if necessary, will be made when the average 7 day and/or 28 day compressive strength of the concrete, as indicated by the last 10 compressive strength values obtained from tests of cylinders made from concrete of the same water-cement ratio, departs from the desired minimum average strength by more than 4 percent.

#### E. Construction Testing

Straightedge surface testing to be carried out as prescribed above.

The Engineer shall take test cylinders for compressive strength values on a random basis. The comparative results shall consist of the average of 2 cylinders each at 7 and 28 days for regular concrete, high early strength concrete and high range water reducing admixture concrete. Tests shall be made for each 500 square yards constructed, in accordance with TxDOT Bulletin C-11. Additional tests may be taken as determined by the concrete placement conditions or for adequately determining the strength of concrete where the early opening of the pavement to traffic is dependent upon concrete strength tests. No extra compensation will be allowed for materials and work involved in fulfilling these requirements.

## 360S.6 - Construction Methods

### A. Preparation of Subgrade

Where stabilized subbase is not provided, the subgrade shall be excavated as required, all unstable or otherwise objectionable material removed and all holes, ruts and depressions filled with approved material and compacted. Rolling and sprinkling shall be performed when and to the extent required and the roadbed shall be completed to or above the plane of the typical sections, lines and grades indicated or as established by the Engineer or designated representative. The subgrade shall be proof rolled and any soft areas shall be repaired before the forms are placed. In the event that the proof rolled subgrade is exposed to rainfall or other conditions, which may soften the subgrade, corrective measures shall be taken and the subgrade shall be proof rolled again.

The subgrade planer shall be operated from approved forms immediately ahead of paving operations and the subgrade shall be finished to the exact section of the bottom of the pavement as indicated. Where traveling form pavers are used, the subgrade planer shall operate on a prepared track grade or be controlled by electronic sensors operating from a stringline that establishes line and grade. It shall be tested with the approved template, operated and maintained by the Contractor. The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the pavement is placed and shall be kept thoroughly wetted down sufficiently in advance of placing any pavement to insure its being in a firm and moist condition for at least 2 inches below the prepared surface. Sufficient subgrade shall always be prepared in advance to insure satisfactory prosecution of the work.

No equipment or hauling shall be permitted on the prepared subgrade, except by special permission of the Engineer or designated representative, which will be granted only in exceptional cases and only where suitable protection in the form of 2-ply timber mats or other approved material is provided.

### B. Placing and Removing Forms

The subgrade under the forms shall be firm and cut true to grade so that each form section when placed will be firmly in contact for its whole length and base width and exactly at the established grade. Any subgrade under the forms below established grade shall be corrected, using suitable material, placed, sprinkled and rolled as directed. Forms shall be staked with at least 3 pins for each 10-foot section. A pin shall be placed at each side of every joint. Form sections shall be tightly joined and keyed to prevent relative displacement. Forms shall be cleaned and oiled each time they are used.

Forms shall be set for a sufficient distance in advance of the point where concrete is being placed to permit a finished and approved subgrade length of not less than 300 feet ahead of the mixer. Conformity of the grade and alignment of forms shall be checked immediately prior to placing concrete and necessary corrections made by the Contractor. Where any form has been disturbed or any subgrade becomes unstable, the form shall be reset and rechecked. In exceptional cases, the Engineer or designated representative may require suitable stakes driven to the grade of the bottom of the forms to afford additional support. Sufficient stability of forms to support the equipment operated and to withstand its vibration without springing or settlement shall be required. If forms settle and/or deflect over 1/8 inch under finishing operations, paving operations shall be stopped and the forms shall be reset to line and grade.

Forms shall be leveled using cement-stabilized material containing not less than 1½ sacks of cement per ton of mix as placed. The aggregate gradation and water content shall be determined by the Contractor. The cement-stabilized material shall be sufficiently plastic to insure filling voids underneath the paving forms. Paving equipment will not to be permitted on the forms until the cement-stabilized material has cured for at least 12 hours.

Forms shall remain in place for not less than 8 hours after the concrete has been placed. Forms shall be carefully removed in such a manner that little or no damage will be done to the edge of the pavement. Any damage resulting from this operation shall be immediately repaired. After the forms have been removed, the ends of all joints shall be cleaned and any honeycombed areas pointed up with approved mortar and the surfaces protected with curing material conforming to Item No. 409S, "Membrane Curing."

Immediately after pointing is complete, the form trench, if used, shall be filled with granular material or earth from the shoulders in such manner as to shed water from rainfall and prevent curing material from washing away from the edge of pavement. On completion of the required curing, the subgrade or shoulders adjacent to the pavement shall be placed and compacted in condition to maintain drainage.

#### 360S.7 - Concrete Mixing and Placing

##### A. Mixing Methods

The concrete shall be mixed in a mixer conforming to the requirements of this item.

##### B. Mixing

The aggregates, mineral filler if required, cementitious materials and water shall be measured separately, introduced into the mixer and mixed for a period of not less than 50 seconds nor more than 90 seconds, measured from the time the last aggregate enters the drum to the time discharge of the concrete begins. The required water shall be introduced into the mixing drum during the first 15 seconds of mixing. The entire contents of the drum shall be discharged before any materials of the succeeding batch are introduced.

The Engineer or designated representative may increase the minimum mixing time to that necessary to produce thoroughly mixed concrete based on inspection or appropriate uniformity tests. The mixing time may be varied at any time as necessary to produce acceptable concrete.

If a central mixer is used, the concrete shall be discharged into the specified hauling equipment and delivered to the road site. If truck agitators are used, the concrete shall be continuously agitated at not less than 1 nor more than 6 rpm as directed by the Engineer or designated representative.

The maximum size of the concrete batch, absolute volume, shall not exceed 120 percent of the rated size of the mixer (40.8 cubic feet maximum batch for 34 cubic foot paver). Spilling of material from the mixer drum shall be corrected by reducing the size of the batch. Retempering or remixing of concrete will not be permitted.

The initial batch of concrete mixed after each time the mixer is washed out shall be enriched by additional mortar. The additional mortar shall be 1 sack of cement and 3 parts of sand.

When transit-mix (ready-mix) concrete is permitted, the batching plant shall meet the requirements of Item No. 403S, "Concrete for Structures."

### C. Placement

Unless otherwise indicated, the concrete may be placed by using forms or by use of a slipform paver. Any concrete not placed as herein prescribed within 30 minutes after mixing shall be rejected and disposed of as directed except as provided otherwise herein. If in the opinion of the Engineer or designated representative, the temperature, wind and/or humidity conditions are such that the quality of concrete will not be adversely affected, the specified placing time may be extended by a maximum of 45 minutes. Concrete with high range water reducing admixture shall not be placed after the slump has dropped by 3 inches or more. Except by specific written authorization of the Engineer or designated representative, concrete shall not be placed when the temperature is below 40°F and falling but may be placed when the temperature is above 35°F and rising, the temperature being taken in the shade and away from artificial heat.

When the temperature of the air is above 85°F, an approved retarding agent will be required in concrete. The maximum temperature of all regular concrete placed shall not exceed 95°F, unless otherwise specified.

When concrete is being placed in cold weather, the Contractor shall have available a sufficient supply of an approved covering material to immediately protect concrete if the air temperature falls to 32°F or below, before concrete has been placed 4 hours. Such protection shall remain in place during the period the temperature continues below 32°F or for a period of not more than 5 days. Neither salt nor other chemical admixtures shall be added to the concrete to prevent freezing. The Contractor shall be responsible for the quality and strength of concrete under cold weather conditions and any concrete damaged by freezing shall be removed and replaced at the Contractor's expense. Concrete shall not be placed before sunrise and shall not be placed later than will permit finishing of the pavement during sufficient natural light.

Concrete shall be placed only on approved subgrade or subbase and unless otherwise indicated on the drawings, the full width of the pavement shall be constructed monolithically. The concrete shall be deposited on the subgrade or subbase in such manner as to require as little rehandling as possible. Where hand spreading is necessary, concrete shall be distributed to the required depth by use of shovels. The use of rakes will not be permitted. Workers will not be permitted to walk in the concrete with any earth or foreign material on their boots or shoes. The placing of concrete shall be rapid and continuous.

When the concrete is to be placed in separate lanes, the junction line shall not deviate from the true line more than 1/2 inch at any point and shall be finished as indicated on the drawings.

The mixer shall not be located on completed pavement, except as herein provided, but may be located on the subgrade of that lane of the pavement being constructed, as provided under "Preparation of Subgrade." When limited space, in the opinion of the Engineer or designated representative, requires operation of the mixer on completed pavement, the mixer may be so operated provided the concrete has attained the minimum average compressive strength required and provided suitable protection to the pavement in the form of 2-ply timber mats or otherwise approved material is provided.

Concrete shall be distributed to such depth that when consolidated and finished, the slab thickness indicated will be obtained at all points and the surface shall not, at any point, be below established grade. Special care shall be exercised in placing and spading concrete against forms and at all joints to prevent the forming of honeycombs and voids.

Concrete for the monolithic curbs shall be the same as for the pavement and if carried back from the paving mixer shall be placed within 20 minutes after being mixed. It may be placed from the separate mixer, if desired, but in any case must be placed while the pavement concrete is still plastic. When sawed joints are used, curbs shall be doweled as indicated and poured after sawing. Curbs doweled on and placed separately may be placed with an extrusion machine.

If a central mixer or batcher is used, the Contractor shall provide a system satisfactory to the Engineer or designated representative for determining that concrete delivered to the road meets the specified requirements for mixing and time of placing.

Unless otherwise indicated, 2 mixers or transit mixers will be required where the double strike off method is employed.

#### D. Reinforcing Steel and Joint Assemblies

All reinforcing steel, including steel, welded wire fabric reinforcement, tie bars, dowel bars and load transmission devices used in accordance with plan provisions shall be accurately placed and secured in position in accordance with details indicated on the drawings. Reinforcing bars shall be securely wired together at alternate intersections, following a pattern approved by the Engineer or designated representative and at all splices and shall be securely wired to each dowel intersected. When wire fabric is used, it shall replace only the longitudinal and transverse bars and shall be securely wired together at all splices and to each dowel intersected. When welded wire fabric is selected, the Contractor shall pour the lower half of the slab, place the welded wire fabric and place the remaining concrete. Tie bars shall be installed in the required position by the method and device indicated. Bar coating indicated and of material specified, shall be completed and the bars and coating shall be free of dirt or other foreign matter at the time of installation in the concrete.

Tightly adhered scale or rust which resists removal by vigorous wire brushing need not be removed except that excessive loss of section to the reinforcement due to rust shall be cause for rejection. Excessive loss of section shall be defined as loss of section to the extent that the reinforcement will no longer meet the physical requirements for the size and grade of steel specified.

Where indicated on the drawings, an assembly of parts at pavement joints, the assembly shall be completed, placed at required location and elevated and all parts rigidly secured in required position by the method and devices indicated on the drawings. Dowel bars shall be accurately installed in joint assemblies as indicated on the drawings, each parallel to the pavement surface and to the center line of the pavement and shall be rigidly secured in the required position by such means as indicated that will prevent their displacement during placing and finishing of the concrete. Unless specifically authorized by the Engineer or designated representative in writing, the load transmission devices shall be accurately installed in joint assemblies indicated, each unit vertical with its length parallel to the center line of the pavement and all units shall be rigidly secured in required position by such means as indicated that will prevent their displacement during placing and finishing of the concrete. Header boards, joint filler and other material used for forming joints shall be accurately notched to receive each load transmission device. All load transmission devices shall be free of rust and clean when installed in the concrete.

The Contractor has the option of substituting welded wire fabric in place of reinforcement bars. The welded wire fabric selected shall have an area and distribution of steel at least equal to the plan requirements. The Contractor shall submit their proposed design to the Engineer for approval before any material is ordered.

If welded wire fabric is used, the entire width of the bottom layer of concrete shall be struck off to conform to the cross section and elevation indicated on the drawings. The reinforcement shall then be placed immediately upon the concrete, after which the top layer of concrete shall be placed, struck off and screeded. Any portion of the bottom layer of concrete which has been placed more than 15 minutes without being covered with the top layer of concrete shall be removed and replaced with freshly mixed concrete at the Contractor's expense.

## E. Joints

### 1. General

All transverse and longitudinal joints when required in the pavement shall be of the types indicated and shall be at required location, on required alignment, in required relationship to tie bars and joint assemblies and in accordance with details indicated. When no transverse joints are indicated, joints shall not exceed 40 feet. Such stakes, braces, brackets or other devices shall be used as necessary to keep the entire joint assembly in true vertical and horizontal position. Where concrete base is overlaid by asphaltic concrete, the joints to be prepared as specified herein, but joint sealing will not be required unless indicated.

If necessary, for proper installation of the sealer, excessive spalling of the joint groove shall be repaired to the satisfaction of the Engineer.

Care shall be exercised during the construction of all joints to ensure that the concrete sections are completely separated by an open joint or by the joint materials and to ensure that the joints will be true to the outline indicated on the drawings. The Contractor shall install joint materials, which will function as a compatible system. Joint sealer shall not be placed where a bond breaker is present.

Green concrete or wet sawed joints are permitted provided the Contractor cleans the joint within 5 minutes after cutting with a 3,000 psi water blast followed by a minimum of 7-day cure and sand blast the saw cut immediately prior to placing joint sealer.

Dry sawed joints are permitted provided the Contractor sand blasts the saw cut immediately prior to placing joint sealer.

### 2. Expansion Joints

Transverse expansion joints shall be formed perpendicular to the centerline and surface of pavement and shall be constructed in accordance with the sequence of operations indicated on the drawings. After the transverse finishing machine and before the longitudinal finishing machine have passed over the joint, the Contractor shall test the joint filler for correctness of position and make any required adjustment in the position of the filler and shall install the joint seal space form as indicated on the drawings. After removal of the joint seal form as indicated on the drawings, the joint seal space above the joint filler shall be thoroughly sandblasted or machine routed to remove all projecting concrete, laitance, dirt or foreign matter. The concrete faces of the joint seal space shall be left true to line and section throughout the entire length of the joint. On completion of curing of the pavement, the joint sealing filler of the type specified shall be placed as indicated. The faces of the joint seal space shall be clean and surface dry at the time joint sealing filler is placed. On completion of the joint seal, the pavement adjacent to the joint shall be left free of joint sealing material. The joint seal space shall be exactly above and not narrower than the joint filler with no concrete overhangings.

### 3. Weakened Plane Joints

Weakened plane joints shall consist of transverse contraction joints and longitudinal joints and shall be formed or sawed as indicated on the drawings. When the joints are sawed, the saw shall be power driven, shall be manufactured especially for the purpose of sawing concrete and shall be capable of performing the work. Saw blades shall be as indicated. Tracks adequately anchored, the chalk, string line or other approved methods shall be used to provide true alignment of the joints. The concrete saw shall be maintained in good operating condition and the Contractor shall keep a standby power saw on the project at all times when concrete operations are under way.

If membrane curing is used, the portion of the seal, which has been disturbed by sawing operations, shall be restored by the Contractor by spraying the areas with additional curing seal.

Forming, finishing and sealing of the joint seal space shall conform to this item, described above and details indicated on the drawings.

### 4. Contraction Joints

Transverse contraction joints shall be formed or sawed joints perpendicular to the centerline and surface of the pavement and shall be constructed by the method and in the sequence of operations as indicated. Where sawed joints are used, contraction joints at intervals indicated shall be sawed as soon as sawing can be accomplished without damage to the pavement and before 24 hours after the concrete has been placed, the exact time to be approved by the Engineer or designated representative. The remaining contraction joints shall be sawed in a uniform pattern as directed by the Engineer or designated representative and they shall be completed before uncontrolled cracking of the pavement takes place. All joints shall be completed before placing concrete in succeeding lanes and before permitting traffic to use the pavement.

### 5. Longitudinal Joints

Longitudinal joints shall be of the type or alternate types indicated and shall be constructed of specified materials in accordance with provisions indicated on the drawings. Longitudinal joints shall be constructed accurately to required lines, shall be perpendicular to the pavement surface at the joint and the pavement surface over and adjacent to the joint shall be finished as specified on the drawings.

Longitudinal joints shall be sawed as soon as sawing can be accomplished without damage to the pavement. Sawing shall not cause damage to the pavement and the groove shall be cut with a minimum of spalling. No traffic (including construction traffic) shall be permitted on pavement until the longitudinal joint is cut.

### 6. Construction Joints

Intentional stoppage of the placing of the concrete shall be at either an expansion joint or at a weakened plane joint. The following provisions shall govern for each type of joint at which the placing of concrete is stopped:

- a) When the placing of concrete is stopped at an expansion joint, the complete joint assembly shall be installed and rigidly secured in required position as indicated. A bulkhead of

sufficient cross sectional area to prevent deflection, accurately notched to receive the load transmission devices or dowels, as the case may be, and shaped accurately to the cross section of the pavement shall be provided and installed as a back-up for the joint filler and rigidly secured in required position to permit accurate finishing of the concrete up to the joint. After the concrete has been finished to the joint, formation of the joint seal space and finishing of the joint shall be executed as specified herein and as indicated. The backup bulkhead shall remain in place until immediately prior to the time when concrete placement is resumed, then it shall be carefully removed in such manner that no element of the joint assembly will be disturbed. The exposed portion of the joint assembly shall be free of adherent concrete, dirt or other material at the time placing of concrete is resumed.

- b) When placing of concrete is stopped at a weakened plane joint, all applicable provisions of paragraph (a) above shall apply in addition to the following requirement:

The face of the bulkhead adjoining the slab end shall be notched and grooved to fit the exposed half section of the joint assembly and shall be shaped to form the slab end at the center of the joint as indicated on the drawings. The 1/2 width of joint seal space may be formed by a strip of required section placed and removed as indicated for construction of transverse contraction joints. The Contractor shall have available a bulkhead shaped to section of the pavement. This bulkhead must be drilled to permit the continuation of all longitudinal reinforcing steel through the construction joint and shall be of sufficient section and strength to prevent deflection.

- c) When load transmission devices are not provided in the design, intentional stopping of placement of concrete shall occur in the middle of a slab. Provisions shall be made to provide a bulkhead, which will accommodate tie bars of the same length, size and spacing as tie bars used for the longitudinal joints. When the concrete placement is resumed, the bulkhead shall be removed without bending tie bars or damaging the concrete. The joint seal space and sealer shall be the same as for longitudinal joints.

Immediately upon the unintended stoppage of the placing of concrete, the Contractor shall place the available concrete to a line and install the above-described bulkhead at right angles to the centerline of the pavement, perpendicular to the surface and at the required elevation. Concrete shall be placed and finished to this bulkhead. Any concrete remaining on the subgrade ahead shall be removed and disposed of as directed by the Engineer or designated representative. When placing of concrete is resumed before the concrete has set to the extent that the concrete will stand on removal of the bulkhead, the new concrete shall be rodded with the first. An edge created by a construction joint of this type shall have a joint seal space and shall be sealed as required for contraction joints.

## F. Joint Sealers

### 1. Class 2 Material

This material shall conform to Standard Specification Item No. 313S, "Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)".

For placement in vertical joints (curb faces, etc.) either of the following procedures may be used.



- a) An amount of the mixed material may be set aside until partial curing has taken place and carefully trowelled into the joint with a suitable tool.
- b) The portion of the joint in the roadway shall be poured and cured. The vertical curb faces shall then be taped or formed and the material poured into the vertical joint from the top.

## 2. Class 5 Material

This material together with backer rods shall be applied as indicated in accordance with manufacturer's recommendations.

### G. Asphalt Board

Premolded materials, wherever used, shall be anchored to the concrete on one side of the joint by means of copper wire or nails not lighter than No. 12 B and S gage. Such anchorage shall be sufficient to overcome the tendency of the material to fall out of the joint. The Contractor shall not contaminate joints to receive Class 5 Joint Material with asphalt from the asphalt board.

### H. Curbs

The curb shall be constructed in lengths equal to the adjoining pavement slab lengths and expansion joints shall be provided in the curb opposite each transverse expansion joint in the pavement. Expansion joint material shall be of the same thickness, type and quality as indicated for the pavement and shall be of the section as indicated for the curb. All expansion joints shall be carried through the curb, sidewalk and retaining walls when these items are indicated.

When sawed joints are provided for the pavement, the curb placement shall be delayed until all transverse joints have been sawed. To provide bond for the curb, dowel bars shall be placed as indicated on the drawings, while the pavement concrete is still plastic.

Weakened plane joints shall be formed in monolithic curbs at a spacing to coincide with the joints in the concrete pavement. The joints shall be formed by inserting in the curb an asphaltic board strip cut to conform to the shape of the curb. When the concrete is sufficiently set, the joint on the top and face of curb shall be grooved with an approved type of grooving tool.

A finish coat of mortar shall be applied on the exposed surfaces of the monolithic curbs. The mortar shall be composed of 1 part of PC and 2 parts of fine aggregate. A mortar coat will not be required for extruded curbs.

The curb face, lower radius and top of curb shall be plastered with the sand-cement mortar. The mortar shall be applied with a template or "mule" made to conform to the curb dimensions as indicated. All exposed surfaces of the curb shall be finished with a steel trowel and brushed to a smooth and uniform surface. The mortar finish as required shall be included in the unit price bid for this item.

### I. Machine Finishing

All concrete pavement shall be finished mechanically with approved self-propelled machines, except as herein provided. Hand finishing will be permitted on the transition from a crowned section to a superelevated section without crown on curves, on straight line superelevation sections less than 300 feet in length, on that portion of a widened pavement outside normal pavement width and on

sections where the pavement width is not uniform, isolated, narrow in width or required monolithic widths are greater than that of available finishing machines.

Machine finishing of pavement shall include the use of power-driven vibrators, power-driven transverse strike off and screed or such alternate equipment as may be substituted and approved under this item.

All concrete pavement shall be consolidated by a mechanical vibrator. As soon as concrete has been spread between the forms, the approved mechanical vibrator shall be operated to consolidate the concrete and remove all voids. Hand manipulated vibrators shall be used for areas not covered by the mechanical vibratory unit.

The transverse finishing machine shall first be operated to compact and finish pavement to the required section and grade, without surface voids. The machine shall be operated over each area as many times and at such intervals as directed. At least 2 trips will be required and the last trip over a given area shall be a continuous run of not less than 40 feet. After completion of finishing with the transverse finishing machine, a transverse drag float may be used.

The consistency of the concrete as placed should allow completion of finishing operations without the addition of water to the surface. When field conditions are such that additional moisture is needed for the final concrete surface finishing operation, the required water shall be applied to surface by fog spray only and shall be held to a minimum.

After finishing is complete and the concrete still workable, the surface shall be tested by the Contractor for trueness with an approved 10-foot straightedge. The straightedge shall be operated from the side of the pavement, placed parallel to the pavement centerline and passed across the slab to reveal any high spots or depressions. The straightedge shall be advanced along the pavement in successive stages of not more than 1/2 its length. Practically perfect contact of the straightedge with the surface will be required and the pavement shall be leveled to this condition, in order to ensure conformity with the surface test required below after the pavement has fully hardened. Any correction of the surface required shall be accomplished by adding concrete if required and by operating the longitudinal float over the area. The surface test with the straightedge shall then be repeated.

For one lane pavement placement and uniform widening, the equipment for machine finishing of concrete pavement shall be as directed by the Engineer or designated representative but shall not exceed requirements of these specifications.

After completion of the straightedge operation, as soon as construction operations permit, texture shall be applied with 1/8 inch wide metal tines with clear spacing between the tines being not less than 1/4 inch nor more than 1/2 inch.

If approved by the Engineer or designated representative, other equipment and methods may be used, provided that a surface texture meeting the specified requirements is obtained. The texture shall be applied transversely. It is the intent that the average depth resulting from the number of tests directed by the Engineer or designated representative be not less than 0.060 inch with a minimum texture depth of 0.050 inch for any one test when tested in accordance with TxDOT Test Method Tex-436-A. Should the texture depth fall below that intended, the finishing procedures shall be revised to produce the desired texture.

#### 1. Emergency Procedures

The Contractor shall have available at all times hand rakes with tines for the purpose of providing textures in the event of equipment breakdown.

The Contractor also shall have available a conventional garden spray-type can containing a commercially available monomolecular film compound. This shall be applied in the case of equipment breakdown or other emergencies to prevent the pavement from drying too rapidly. The use of this product will give the Contractor additional time to provide adequate texturing.

After completion of texturing and about the time the concrete becomes hard, the edge of the slab and joints shall be carefully finished with an edger and the pavement shall be left smooth and true to line.

#### J. Hand Finishing

Hand finishing shall be resorted to only in those conditions provided for above and upon specific authorization by the Engineer or designated representative. When hand finishing is permitted, concrete shall be struck off with an approved strike off screed to such elevation that when consolidated and finished the surface of the pavement to conform to the required section and grade. The strike template shall be moved forward with a combined transverse and longitudinal motion in the direction work is progressing, maintaining the template in contact with the forms and maintaining a slight excess of material in front of the cutting edge. The Concrete shall then be tamped with an approved tamping template to compact the concrete thoroughly and eliminate surface voids and the surface screed to required section.

After completion of a strike off, consolidation and transverse screeding, a hand-operated longitudinal float shall be operated to test and level the surface to the required grade.

Workers shall operate the float from approved bridges riding on the forms and spanning the pavement. The longitudinal float shall be held in contact with the surface and parallel to the centerline and operated with short longitudinal strokes while being passed from one side of the pavement to the other. If contact with the pavement is not made at all points, additional concrete shall be placed, if required and screed and the float shall be used to produce a satisfactory surface. Care shall be exercised to keep the ends of the float from digging into the surface of the pavement. After a section has been smoothed so that the float maintains contact with the surface at all points in being passed from one side to the other, the bridges may be moved forward half the length of the float and the operations repeated.

Other operations and surface tests shall be as required for machine finishing.

#### K. Surface Testing

After the concrete has been placed 12 hours or more, the Engineer or designated representative will test the surface of the pavement with a 10-foot straightedge placed parallel to the centerline. Unless specified otherwise, the surface shall not vary from the straightedge by more than 1/16 inch per foot from the nearest point of contact and in no case shall the maximum ordinate from a straightedge to the pavement be greater than 1/8 inch. Any high spots causing a departure from the straightedge in excess of that specified shall be ground down by the Contractor to meet the surface test requirements. Where the texture of the pavement is removed by extensive grinding, the texture shall be restored by grooving the concrete to meet the surface finishing specifications.

#### L. Curing

All concrete pavement shall be cured by protecting it against loss of moisture for a period of not less than 72 hours from the beginning of the curing operations. Immediately after finishing operations have been completed, the entire surface of the newly laid concrete shall be covered and cured in accordance with the requirements specified for whichever of the following methods the Contractor may elect. Newly laid concrete base to be overlaid by asphaltic concrete shall not be cured by "Membrane Curing" and surfaces not to be overlaid by asphaltic concrete shall not be cured by "Asphalt Curing." In all cases in which curing requires the use of water, the curing shall have prior right to water supply or supplies. Failure to provide sufficient cover material of the type the Contractor elects to use, failure to maintain saturation in wet curing methods, lack of water to adequately take care of both curing and other requirements or other failures to comply with curing requirements shall be cause for immediate suspension of concreting operations. The covering material used in curing shall be removed as necessary to saw joints or to comply with the requirements for "Surface Test." The concrete surface shall be maintained wet with a water spray if indicated and the covering material replaced immediately on completion of sawing and testing and any required surface correction.

#### 1. Waterproofed Paper Curing

Immediately after the finishing of the surface has been completed and the concrete has taken its initial set, it shall be wetted with water applied in the form of a fine spray and covered with waterproofed paper so placed and weighted as to cause it to remain in intimate contact with the surface. Waterproofed paper used for the curing of concrete pavement shall be of a type and quality approved by the Engineer. It shall be sufficiently strong and tough to permit its use under the conditions existing on street paving work without being torn or otherwise rendered unfit for the purpose during the curing period. The paper covering shall be maintained in place continuously for not less than the specified curing period.

The waterproofed paper shall be prepared to form blankets of sufficient width to cover the entire surface and both edges of the pavement slab and such blankets shall not be more than 60 feet in length. All joints in the blankets occasioned by joining paper sheets shall lap not less than 5 inches and shall be securely sealed with asphalt cement having a melting point of approximately 180°F. Blankets shall be placed to secure an overlap of at least 12 inches and this lap securely weighted to form a closed joint.

The waterproofed paper blankets shall be adequately weighted to prevent displacement or billowing due to wind and the paper folded down over the side of the pavement shall be secured by a continuous bank of earth. Plowing of this windrow into place will not be permitted.

All tears or holes appearing in the paper during the curing period shall be immediately repaired by cementing patches over such defects. It shall be the Contractor's responsibility to prevent damage to paper blankets, which would affect their serviceability and effectiveness as a concrete curing method. Blankets may be rejected by the Engineer or designated representative at any time if it appears they do not provide an airtight covering.

Paper blankets rejected on account of pinholes or minor tears may be continued in service by folding the blanket over lengthwise, first thoroughly spraying 1/2 of the blanket with the asphalt cement used for seams. The two thicknesses shall be firmly pressed together and well cemented. Blankets shall be of a width sufficient to cover the pavement surface and both edges. Doubled blankets may be rejected for the same cause as provided for single blankets. All paper

blankets rejected by the Engineer shall be immediately marked by the Contractor for identification and then destroyed or stored entirely separate from approved blankets.

No walking on paper shall be permitted at any time and, in locations where pedestrian traffic cannot be entirely controlled, the Contractor shall provide walkways and barricades or shall substitute other permissible curing methods on such sections of pavement.

## 2. Polyethylene Film Curing

Immediately after the finishing of the surface has been completed and the concrete has taken its initial set, it shall be wetted with water applied in the form of a fine spray and covered with the polyethylene film so placed and weighted as to cause it to remain in intimate contact with the surface. The polyethylene film covering shall be maintained in place continuously for not less than the specified curing period.

The film shall be prepared to form blankets of sufficient width to cover the entire surface and both edges of the pavement slab. All joints in the blankets occasioned by joining film sheets shall lap not less than 12 inches. All joints shall be sealed in a manner acceptable to the Engineer or designated representative to provide a moisture-proof lap.

The polyethylene film blankets shall be adequately weighted to prevent displacement or billowing due to wind and the film folded down over the side of the pavement shall be secured by a continuous bank of earth. Plowing of this windrow into place not to be permitted.

All tears or holes appearing in the polyethylene film during the curing period shall be immediately repaired by placing acceptable moisture proof patches over such defects or by replacing the blankets. It shall be the Contractor's responsibility to prevent damage to the film blankets, which would affect their serviceability and effectiveness as a concrete curing method. Blankets may be rejected by the Engineer at any time if it appears they do not provide an airtight covering.

Polyethylene film blankets rejected on account of pinholes or minor tears may be continued in service when repaired to an airtight condition. All polyethylene film blankets rejected by the Engineer or designated representative shall be immediately marked by the Contractor for identification and then destroyed or stored entirely separate from approved blankets.

Should the film blanket be damaged or torn for any cause during the first 72 hours of the curing period such damage shall be repaired immediately.

## 3. Membrane Curing

Immediately after the finishing of pavement has been completed and after the free surface moisture has disappeared, the pavement shall be sprayed uniformly with a curing compound. Membrane curing shall conform to Standard Specification Item No. 409S, "Membrane Curing," Type 2 white pigmented. Should the film of compound be damaged from any cause before the expiration of 72 hours after original application, the damaged portions shall be repaired with additional compound. Unless otherwise indicated on the drawings, membrane curing shall be used when the concrete (except that concrete to be used as a base) is placed with a slip form paver.

#### 4. Asphalt Curing

Where emulsified asphalt is used for curing concrete base, the material shall conform to Item No. 301S, "Asphalts, Oils and Emulsions," for the type and grade shown on the drawings. The rate of application may vary between the limits of 1 gallon per 180 square feet and 1 gallon per 90 square feet. The rate of application will be determined by the Engineer or designated representative, after observation of sections where amounts varying between the above limits have been applied. If it is found necessary to add water to the emulsion for the proper distribution through the spray, this may be done upon approval of the Engineer or designated representative. When the emulsion is diluted with water the amount of the applied mixture shall be increased to give a coverage of the original emulsion between the limits as set out herein. Care shall be taken to properly mix the emulsion and water and to keep the mixture well agitated during application.

#### M. Protection of Pavement

The Contractor shall erect and maintain the barricades indicated on the drawings and such other standard and approved devices as will exclude public traffic and traffic of the Contractor's employees and agents from the newly placed pavement for a minimum of 14 days. Portions of the roadway or crossings of the roadbed required to be maintained open for use by traffic shall not be obstructed by above required barricades. Crossings of the pavement indicated on the drawings or by construction sequence, during the period prior to opening to traffic as herein indicated, shall be provided with an adequate and substantial bridge approved by the Engineer or designated representative.

Curb shall be backfilled to the full height of the concrete, tamped and sloped as indicated on the drawings or as directed by the Engineer. The top 4 inches of backfill shall be of clean, friable soil capable of supporting plant life. This material shall also be free of stones and all other debris.

#### N. Opening Pavement to Traffic

The pavement shall be closed to traffic, including vehicles of the Contractor, until the concrete is at least 14 days old and has attained an average compressive strength acceptable to the Engineer or designated representative. This period of closure to traffic may be extended if, in the opinion of the Engineer or designated representative, weather or other conditions make it advisable to provide an extension of the time of protection.

At the end of the 14 day period and as long thereafter as ordered by the Engineer or designated representative and if so desired by the Contractor, the pavement may be opened for use by vehicles of the Contractor provided the gross weight (vehicle plus load) of such vehicles does not exceed 14,000 pounds. Such opening, however, shall in no manner relieve the Contractor from responsibility for the Contractor's work. On those sections of the pavement thus opened to traffic, all joints shall first be sealed, the pavement cleaned and topsoil placed against the pavement edges or behind the curb where turf or vegetation is to be established before permitting vehicles thereon.

After the concrete in any section is 14 days old or as long thereafter as ordered by the Engineer, such section of pavement may be opened to all traffic indicated on the drawings or when so directed by the Engineer or designated representative. On those sections of the pavement thus opened to traffic, all joints shall first be sealed, the pavement cleaned and 4 inches of top soil placed against the pavement edges and all other work performed as required for the safety of traffic. Such opening, however, shall in no manner relieve the Contractor from responsibility for the Contractor's work performed.

When High Early Strength Concrete, resulting from the use of Type III cement as indicated on the drawings is used, the pavement may be opened to all traffic after the concrete is 7 days old or as long thereafter as ordered by the Engineer or designated representative, subject to the same provisions governing the opening after 14 days as above indicated.

Where the Contractor desires to move any equipment not licensed for operation on public streets, on or across any pavement opened to traffic, the Contractor shall protect the pavement from damage by means of 2-ply timber mats of 2 inch stock or runways of heavier material laid on a layer of earth, all as approved by the Engineer or designated representative.

#### 1. Emergency Opening to Traffic

The Engineer or designated representative may require the opening of pavement to traffic prior to the minimum time specified above under conditions of emergency, which in the Engineer's or designated representative's opinion require such action in the interest of the public. In no case will the Engineer or designated representative order opening of the pavement to traffic within less than 72 hours after the last concrete in the section is placed. The Contractor shall remove all obstructing materials, place earth against pavement edges and perform other work involved in providing for the safety of traffic as required by the Engineer or designated representative in ordering emergency opening. Orders for emergency opening of the pavement to traffic will be issued by the Engineer or designated representative in writing.

#### 360S.8 - Penalty for Deficient Pavement Thickness or Strength

At the discretion of the City Engineer, the City may consider adjusting contract unit prices in lieu of remove/replace for paving mixtures that fail to meet acceptance criteria for gradation, asphalt content, density and mat thickness in accordance with the following:

The adjustment in unit prices provided for in this item will apply only when measurement for payment is by the square yard.

It is the intent of this specification that the pavement be constructed in strict conformity with the thickness, strength and typical sections indicated on the drawings. Where any pavement is found not so constructed, the following rules relative to adjustment of payment for acceptable pavement and to replacement of faulty pavement shall govern. Consideration of contract price adjustments in lieu of remove/replace will be at the discretion of the City Engineer and will only be made with approval of the City Engineer.

#### A. Pavement

The pavement will be core drilled after any grinding operations have been completed for surface corrections prior to final acceptance. Locations of core tests may be selected by the Engineer or designated representative; however, spacing interval for core tests, as specified herein, shall be maintained. The thickness of the pavement will be determined by measurement of the cores in accordance with TxDOT Test Method Tex-424-A.

For the purpose of establishing an adjusted unit price for pavement, units to be considered separately are defined as 1,000 linear feet of pavement in each traffic lane starting at the end of the pavement bearing the smaller station number. The last unit in each lane shall be 1,000 feet plus the fractional part of 1,000 feet remaining. Traffic lane width will be as shown on typical sections and pavement design standards.

For the purpose of establishing an adjusted unit price for ramps, widening, acceleration and deceleration lanes that are machine placed, isolated pavements of traffic lane width but less than 1,000 feet in length and other areas designated by the Engineer or designated representative, units will be considered separately and are defined as 1,000 square yards of pavement or fraction thereof.

One core will be taken at the location selected by the Engineer or designated representative or at random in each unit. When the measurement of the core from any unit is not deficient more than 0.2 inches from the plan thickness, full payment will be made. When the measurement of the core from any unit is deficient more than 0.2 inch but not more than 0.75 inch from the plan thickness, 2 additional cores will be taken from the unit and the average of the 3 cores determined. The 2 additional cores from any 1,000-foot unit will be taken at intervals of not less than 300 feet. The 2 additional cores from any 1,000 square yard unit will be taken at locations such that the pavement in the unit will be well represented. If the average measurement of these 3 cores is not deficient more than 0.2 inches from the plan thickness, full payment will be made. If the average thickness of the 3 cores is deficient by more than 0.2 inch but not more than 0.75 inch from the indicated thickness, an adjusted unit price as provided below will be paid for the areas represented by these cores.

In calculating the average thickness of the pavement, measurements which are in excess of the specified thickness by more than 0.2 inch will be considered as the specified thickness plus 0.2 inch and measurements which are less than the specified thickness by more than 0.75 inch will be considered as the specified thickness less 0.75 inch.

When the measurement of any core is less than the specified thickness by more than 0.75 inch, the actual thickness of pavement in this area will be determined by taking additional cores at 10 foot intervals parallel to the center line in each direction from the deficient core until, in each direction, a core is taken which is not deficient by more than 0.75 inch. Exploratory cores for deficient thickness will not be used in averages for adjusted unit price. Exploratory cores are to be used only to determine the length of pavement in a unit that is to be left in place without pay and/or removed and replaced as provided herein.

For new Concrete Pavement roadways, and for Concrete Pavement rehabilitation and overlay projects, if cracks develop in the pavement surface within the one year warranty period, the Contractor shall seal the cracks in accordance with Standard Specification Item No. 313S, "Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)", or perform other corrective measures as directed by the Engineer. Payment for this work will be considered subsidiary to Concrete Pavement, unless included as a separate pay item in the Contract.

For new Concrete Pavement roadways, and for Concrete Pavement rehabilitation and overlay projects, if cracks develop in the pavement surface within the one year warranty period, the Contractor shall seal the cracks in accordance with Standard Specification Item No. 313S, "Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)", or perform other corrective measures as directed by the Engineer. Payment for this work will be included in the unit price bid for Concrete Pavement, unless included as a separate pay item in the Contract.

Irrespective of an acceptable overall project average for any or all of the Pay-Adjustment Acceptance Factors, limited substandard portions of the work, as determined by the Engineer or designated representative, shall be remedied or removed and replaced to the satisfaction thereof.

## B. Price Adjustments



After any grinding or milling operations have been completed to meet the surface-testing requirement of this specification, if average thickness of pavement is deficient in thickness by more than 0.2 inch, but not more than 0.75 inch, payment will be made at an adjusted price as specified in the following table:

<b>Concrete Pavement Deficiency</b>	
<b>Deficiency in Thickness Determined by Cores, Inches</b>	<b>Proportional Part of Contract Price Allowed</b>
0.00 to 0.20	100 percent
0.21 to 0.30	80 percent
0.31 to 0.40	72 percent
0.41 to 0.50	68 percent
0.51 to 0.75	57 percent

Any area of pavement found deficient in thickness by more than 0.75 inch but not more than 1 inch or 1/8 of the indicated thickness, whichever is greater, shall be evaluated by the Engineer. If, in the judgment of the Engineer, the area of such deficiency should not be removed and replaced, there will be no payment for the area retained. If, in the judgment of the Engineer, the area of such deficiency warrants removal, the area shall be removed and replaced at the Contractor's entire expense, with concrete of the thickness indicated on the drawings.

Any area of pavement found deficient in thickness by more than 1 inch or more than 1/8 of the indicated thickness, whichever is greater, shall be removed and replaced, at the Contractor's entire expense, with concrete of the thickness indicated on the drawings.

No additional payment over the Contract unit price will be made for any pavement of a thickness exceeding that indicated on the drawings.

If the average compressive strength based on concrete test cylinders at 28 days is less than the specified minimum strength of the concrete, then payment will be made at an adjusted price as specified in the following table.

<b>Pay Adjustment Factor for Deficient Compressive Strength</b>	
<b>Ratio of Average Strength from Test Cylinders to Specified Minimum Compressive Strength both at 28 Days</b>	<b>Proportional Part of Contract Price Allowed</b>
More than 0.95	100 percent
0.90 to 0.95	85 percent

0.85 to 0.90	70 percent
0.80 to 0.85	60 percent
Less than 0.80	0 percent (Remove & Replace)

When, in the opinion of the Engineer or designated representative, the compressive strength test results appear unrepresentative, additional testing of field cores may be authorized. To be considered acceptable for consideration the field cores shall be acquired, properly handled and tested in accordance with ASTM C 42/C 42M, "Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete" within 45 days of the original concrete placement date. The retesting will be at the expense of the Contractor and the results of the retesting shall be averaged with the results of the original testing. If the results of retesting indicate that the original test results were erroneous in the opinion of the Engineer or designated representative, the original test results will be discarded. In the instance of erroneous original test results the subsequent first set of retests will be at the expense of the City of Pflugerville.

When, in the opinion of the Engineer or designated representative, the concrete compressive strength is deemed unacceptable for the intended use of the pavement, the concrete shall be removed and replaced to the limits indicated by test results.

#### 360S.9 - Measurement

- A. When indicated, concrete pavement will be measured by the square yard of surface area of completed and accepted work. The surface area shall be so measured to also include that portion of pavement slab extending beneath the curb. When concrete pavement is to be measured by the square yard and monolithic curb is required, measurements for "Monolithic Curb" will be by the linear foot complete in place.
- B. When indicated on the drawings, concrete pavement, including monolithic curb when required, will be measured by the cubic yard of absolute volume of materials entering the mixture.

#### 360S.10 - Payment

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit price bid for "Concrete Pavement," of the depth indicated on the drawings, "Concrete Pavement (High Early Strength)" of the depth indicated on the drawings and "Monolithic Curb" of the type indicated on the drawings (when pavement is measured by the square yard), as required or adjusted unit price for pavement of deficient thickness as provided under "Deficient Pavement Thickness", which price shall be full compensation for shaping and fine grading the roadbed, including furnishing and applying all water required; for furnishing, loading and unloading, storing, hauling and handling all concrete ingredients, including all freight and royalty involved; for placing and adjusting forms, including supporting material or preparing track grade; for mixing, placing, finishing, sawing, cleaning and sealing joints and curing all concrete; for furnishing and installing all reinforcing steel; for furnishing all materials for sealing joints and placing longitudinal, expansion and weakened plane joints, including all steel dowel caps and load transmission devices required and wire and devices for placing,

holding and supporting steel bars, load transmission devices and joint filler material in proper position, for coating steel bars where complete the work.

Excavation required by this item in the preparation of the subgrade and for completion of the parkway will be measured and paid for in accordance with provisions governing the Item Nos. 110S, "Street Excavation" and 130S, "Borrow," respectively, with provision that yardage to be measured and paid for once only, regardless of manipulations involved. Measurement of subgrade excavation for payment shall be limited to a total width of that of pavement plus 1 foot on each side.

Sprinkling and rolling required for the compaction of the rough subgrade in advance of fine grading will be measured and paid for as indicated in the governing items of excavation. Maintenance of a moist condition of the subgrade in advance of fine grading and concrete placing will not be paid for directly but shall be included in the unit price bid, as provided above.

Payment will be made under one of the following:

<b>Pay Item No. 360S-A:</b>	In. Concrete Pavement	Per Square Yard.
<b>Pay Item No. 360S-AH:</b>	In. Concrete Pavement (High Early Strength)	Per Square Yard.
<b>Pay Item No. 360S-AS:</b>	In. Concrete Pavement (High Range Water Reducing Admixture)	Per Square Yard.
<b>Pay Item No. 360S-B:</b>	Monolithic Curb	Per Linear Foot.
<b>Pay Item No. 360S-C:</b>	Concrete Pavement Including Monolithic Curb	Per Cubic Yard.

**END**

## ITEM NO. 401S - STRUCTURAL EXCAVATION AND BACKFILL

### 401S.1 - Description

This item shall govern the excavation for placement of structures, except pipe sewers, the disposal of such excavated material and the backfill around completed structures to the level of the original ground or grade indicated on the Drawings. The work shall include all necessary pumping or bailing, sheathing, drainage, and the construction and removal of any required cofferdams. Unless otherwise indicated on the Drawings, the work included hereunder shall provide for the removal of old structures or portions thereof (abutments, buildings, foundations, wingwalls, piers, etc.), trees and all other obstructions necessary to the proposed construction.

Where excavation is not classified, it will be grouped under "Unclassified Structural Excavation", which shall include the removal of all materials encountered regardless of their nature or the manner in which they are removed.

Where excavation is classified, it shall be classed as "Common Structural Excavation" or "Rock Structural Excavation" in accordance with the following criteria:

"Common Structural Excavation" shall include the removal of all materials other than rock.

"Rock Structural Excavation" shall include the removal of firm and compact materials that cannot be excavated with power equipment, without first being loosened or broken by blasting, sledging or drilling.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

### 401S.2 - Submittals

Within 14 days prior to the commencement of related work, the Contractor shall submit electronically the following submittal requirements as applicable:

- a. Supplier and certified test results for fine aggregate/sand material
- b. Supplier and certified test results for flexible base material
- c. Mix design and test results for lime stabilized subgrade material
- d. Mix design and test results for Class J Concrete Base
- e. Supplier and certified test results for granular material (coarse aggregate, foundation rock and pea gravel)
- f. Mix design and test results for cement-stabilized backfill
- g. Mix design and test results for controlled low strength material (CLSM)
- h. Excavation Safety System Plan for proposed cofferdams, trench excavation and special shoring installations

#### 401S.3 - Materials

##### A. Flexible Base

Flexible base shall conform to the requirements of Standard Specification Item No. 210S, "Flexible Base".

##### B. Lime Stabilized Base

Lime stabilized base shall conform to the requirements of Standard Specification Item No. 202S, "Lime" and Item No. 203S, "Lime Treatment for Materials in Place".

##### C. Concrete Base

Concrete base shall conform to a Class J Concrete as defined in Standard Specification Item No. 403S, "Concrete for Structures".

##### D. Granular Material

1. Coarse aggregate shall conform to the requirements of section 403S.3.C of Standard Specification Item No. 403S "Concrete for Structures".

2. Foundation Rock

Foundation rock shall be well graded, hard, durable coarse aggregate ranging in size from 2 to 6 inches.

##### E. Cement Stabilized Backfill

Cement stabilized backfill shall contain aggregate, water and a minimum of 7% hydraulic cement based on the dry weight of the aggregate in accordance with TxDOT Test Method Tex-120-E, "Soil-Cement Testing." Unless directed otherwise on the Drawings, the aggregate shall be clean sand approved by the City Engineer or designated representative.

##### F. Controlled Low Strength Material

Controlled low strength material (CLSM) shall conform to Standard Specification Item No. 402S, "Controlled Low Strength Material" and shall be approved by the City Engineer or designated representative.

## 401S.4 - Construction Methods

### A. Erosion Control and Tree Protection

Prior to commencement of this work, all required erosion control and tree protection measures indicated in the City of Pflugerville Tree Technical Manual: Standards & Specifications and/or on the Drawings shall be in place. The existing utilities shall be located and protected as specified in the City of Pflugerville Engineering Design Manual and Construction Standards and/or indicated on the Drawings. A permit shall be required when utility adjustments are to be made in preparation for construction in the right-of-way.

Areas within the construction limits indicated on the Drawings shall be cleared of all trees, stumps, brush, etc., except trees or shrubs scheduled for preservation which shall be carefully trimmed as directed by the City Engineer or designated representative, in accordance with the City of Pflugerville Tree Technical Manual: Standards and Specifications and shall be protected from scarring, barking or other injuries during construction operations. All exposed cuts over 2 inches in diameter, exposed ends of pruned limbs or scarred bark shall be treated with an approved asphalt material within 24 hours of the pruning or injury.

Construction equipment shall not be operated, nor construction materials stockpiled under the canopies of trees, unless otherwise indicated on the Drawings and/or specified in the Contract Documents. Excavation or embankment materials shall not be placed within the drip line of trees until tree wells are constructed.

Within the construction limits or areas indicated, all obstructions, stumps, roots, vegetation, abandoned structures, rubbish and objectionable material shall be removed to the following depths:

1. In areas to receive 6 inches or more embankment, a minimum of 12 inches below natural ground.
2. In areas to receive embankment less than 6 inches, a minimum of 18 inches below the lower elevation of embankment, structure or excavation.
3. In areas to be excavated a minimum of 18 inches below the lower elevation of the embankment, structure or excavation.
4. In all other areas a minimum of 12 inches below natural ground.

When abandoned storm drains, sewers or other drainage systems are encountered they shall be removed as required to clear the new structure and plugged in a manner approved by the City Engineer or designated representative.

Holes remaining after removal of all obstructions, objectionable material, trees, stumps, etc. shall be backfilled with select embankment material and compacted by approved methods. All cleared and grubbed material shall be disposed of in a manner satisfactory to the City Engineer or designated representative. Unless otherwise provided, all materials as described above shall become the property of the Contractor and removed from the site and disposed of at a permitted disposal site.

Burning materials at the site shall conform to City of Pflugerville Engineering Design Manual & Construction Standards.

### B. Excavation

1. Excavation shall be done in accordance with the lines and depths indicated on the Drawings or as established by the City Engineer or designated representative. Unless otherwise indicated on the Drawings or permitted by the City Engineer or designated representative no excavation shall be made outside a vertical plane 3 feet from the footing lines and parallel thereto. When caissons are provided, no excavation will be permitted outside the outer faces of the caissons.

When structures are installed in streets, highways or other paved areas, the pavement and base shall be cut to neat lines. After completion of the excavation and backfilling, the pavement structure shall be restored to the satisfaction of the City Engineer or designated representative.

2. Slopes, benching, sheeting, bracing, pumping and bailing shall be provided as necessary to maintain the stability and safety of excavations up to 5 feet deep. Excavation protection for excavations deeper than 5 feet shall be governed by Standard Specification Item No. 509S, "Excavation Safety Systems".
3. Excavation shall conform to elevations indicated on the Drawing or raised or lowered by written order of the City Engineer or designated representative, when such alterations are judged proper. When it is deemed necessary to increase or decrease the plan depth of footings, the alterations in the details of the structure shall be as directed by the City Engineer or designated representative. The City Engineer or designated representative shall have the right to substitute revised details resulting from consideration of changes in the design conditions.
4. When a structure is to rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation and the final excavation to grade shall not be performed until just before the footing is placed. Equipment selected and used by the Contractor for excavation which results in disturbance of what was otherwise stable subgrade material, as shown by laboratory tests, will not be used as a justification for payment for excavating to extra depth or for payment for stabilizing materials which may be ordered by the City Engineer or designated representative.
5. Excavated material required to be used for backfill may be deposited by the Contractor in storage piles as indicated on the Drawing or at points convenient for its rehandling during the backfilling operations, subject to the approval of the City Engineer or designated representative, who may require that the survey center line of the structure and the transverse or hub line of any unit of the structure be kept free of any obstruction. The Contractor shall adjust any stockpiles, to facilitate surveying and the work of other Contractors working in the immediate proximity, as directed by the City Engineer or designated representative.
6. Excavated material required to be wasted shall be disposed of as directed by the City Engineer or designated representative, in a manner which will not obstruct the stream or otherwise impair the efficiency or appearance of the structure or other part of the work.
7. For all single and multiple box culverts, pipe culverts, pipe arch culverts and box sewers of all types, where the soil encountered at established footing grade is a quicksand, muck or similar unstable material, the following procedure shall be used unless other methods are indicated:

- a. The depth to which unstable material is removed will be determined by the City Engineer or designated representative. It will not exceed 2 feet below the footing of culverts that are 2 feet or more in height and will not exceed the height of culverts for those less than 2 feet high. Excavation shall be carried at least 1 foot horizontally beyond the limits of the structure on all sides. All unstable soil removed shall be replaced with suitable stable material, in uniform layers of suitable depth for compaction as directed by the City Engineer or designated representative. Each layer shall be wetted, if necessary and compacted by rolling or tamping as required to provide a stable foundation for the structure. Soil, which has sufficient stability to properly sustain the adjacent sections of the roadway embankment, will be considered a suitable foundation material.
  - b. When, in the opinion of the City Engineer or designated representative, it is not feasible to construct a stable footing as outlined above, the Contractor shall construct it by the use of special materials, such as flexible base, cement stabilized base, cement stabilized rockfill or other material, as directed by the City Engineer or designated representative. This work will be paid for as provided in Section 401S.9, "Payment".
8. When the material encountered at footing grade of a culvert is found to be partially rock or incompressible material and partially a compressible soil which is satisfactory for the foundation, the incompressible material shall be removed for a depth of 6 inches below the footing grade and backfilled with a compressible material similar to that used for the rest of the structure.

#### 401S.5 - Cofferdams

The term cofferdams, whenever used in this specification, designates any temporary or removable structure constructed to hold the surrounding earth, water or both, out of the excavation, whether the structure is formed of earth, timber, steel, concrete or a combination of these. It includes earthen dikes, timber cribs, any type of sheet piling, removable steel shells and the like and all necessary bracing and it shall be understood also to include the use of pumping wells or well points for de-watering. The cost of cofferdams, when required, shall be included as a part of the bid price for excavation.

It is the intent of this specification to require that a suitable cofferdam be provided, when necessary, to ensure that the foundation may be placed in a dry condition, as to preclude sliding and caving of the walls of the excavation. The cofferdam shall conform with the requirements of Standard Specification Item No. 509S, "Excavation Safety Systems" and shall provide a safe work area with sufficient clearance for the construction, inspection and removal of required forms and, if necessary, sufficient room to allow pumping outside the forms. Where no ground or surface water is encountered, the cofferdam need be sufficient only to protect the workers and to avoid cave-ins or slides beyond the excavation limits.

Unless otherwise indicated on the Drawings, cofferdams shall be removed by the Contractor after the completion of the substructure without disturbing or marring the structure.

#### 401S.6 - De-Watering

Structures shall not be constructed or placed in the presence of water unless otherwise approved by the City Engineer or designated representative. Precast members, pipe and concrete shall only be placed on a dry, firm surface. Water shall be removed by bailing, pumping, well-point installation, deep wells, underdrains or other approved method.



When structures are approved for placement in the presence of water, standing water shall be removed in a manner that shall preclude the possibility of the movement of water through or alongside any concrete being placed. Pumping or bailing will not be permitted during the placing of concrete or for a period of at least 36 hours thereafter, unless from a suitable sump separated from the concrete work by a water-tight wall.

Pumping or bailing during placement of seal concrete shall only be allowed to the extent necessary to maintain a static head of water within the cofferdam. De-watering inside a sealed cofferdam shall not commence until the seal has aged a minimum of 36 hours.

When the bottom of an excavation cannot be de-watered to the point that the subgrade is free of mud or it is difficult to keep the reinforcing steel clean a stabilizing material (e.g. flexible base, cement-stabilized-backfill or lean concrete) shall be placed in the bottom of the excavation. When a lean concrete is used, the concrete shall include a minimum of 275 pounds of cement per cubic yard and be placed to a minimum depth of 3 inches. Stabilizing material that is placed for the convenience of the Contractor will be at the Contractor's own expense.

#### 401S.7 - Backfilling

##### A. General

As soon as practicable, all portions of excavation not occupied by the permanent structure shall be backfilled. Back-fill material shall be free from stones large enough to interfere with compaction, large or frozen lumps that will not break down readily under compaction, wood or other extraneous material. Backfill material shall be approved by the City Engineer or designated representative.

1. That portion of the backfill which will support any portion of the roadbed or embankment or is within 2 feet of the roadbed or embankment shall be placed in uniform layers not to exceed 6 inches in depth (loose measurement) and each layer compacted to the density specified for the appropriate material. Each layer of backfill material, if dry, shall be wetted uniformly to the moisture content required to obtain the specified density and shall be compacted to that density by means of mechanical tamps, except that the use of rolling equipment of the type generally used in compacting embankments will be permitted on portions which are accessible to such equipment. All portions of embankment too close to any portion of a structure to permit compaction by the use of the blading and rolling equipment used on adjoining sections of embankment, shall be placed and compacted in the same manner as specified above for backfill material. These provisions require the mechanical compaction, by means of either rolling equipment or mechanical tamps, of all backfill and embankment adjoining the exterior walls and wingwalls of culverts. Unless otherwise provided by the Plans or Special Conditions, hand tamping will not be accepted as an alternate for mechanical compaction. As a general rule, material used in filling or backfilling the portions described in this paragraph shall be an earth free of any appreciable amount of gravel or stone particles more than four (4) inches in greatest dimension and of a gradation that permits thorough compaction. The percentage of fines shall be sufficient to fill all voids and insure a uniform and thoroughly compacted mass of proper density. When required by the Plans or by written order of the City, cement stabilized material shall be used for backfilling.
2. All portions of fill and backfill described in the preceding paragraph shall be compacted to the same density requirements specified for the adjoining sections of embankment in accordance with the governing specifications. Where no embankment is involved on the

Project and no specifications therefor are included in the Contract, all backfill shall be compacted to a density comparable with the adjacent undisturbed material.

3. That portion of backfill which will not support any portion of completed roadbed or embankment shall be placed in layers not more than 10 inches in depth (loose measurement) and shall be compacted to a density comparable with the adjacent undisturbed material.
4. If the excavation has been made through a hard material resistant to erosion, the backfill around piers and in front of abutments and wings may be ordered by the City Engineer or designated representative to be of stone or lean concrete. Unless otherwise indicated on the Drawings, such backfill shall be paid for as extra work.
5. All portions of embankment too close to any portion of a structure to permit compaction by the use of the blading and rolling equipment used on adjoining sections of embankment, shall be placed and compacted with mechanical tamps and rammers to avoid damage to the structure.

These provisions require mechanical compaction by means of either rolling equipment or mechanical tampers or rammers, of all backfill and embankment adjoining the barrels and wingwalls or culverts and adjoining all sides of bridge abutments and retaining walls, regardless of whether or not such embankment or backfill is above or below the original surface of the ground and regardless of whether the excavation at structure site was performed conforming to Standard Specification Item No.111S, "Excavation", this Item No. 401S, "Structural Excavation and Backfill", Standard Specification Item No. 110S, "Street Excavation" or Standard Specification Item No. 120S, "Channel Excavation". Unless otherwise indicated on the Drawings, hand tamping will not be accepted as an alternate for mechanical compaction.

As a general rule, material used in filling or backfilling the portions described in this paragraph shall be an earth, free of any appreciable amount of gravel or stone particles larger than 4 inches in greater dimension and of a gradation that permits thorough compaction. When, in the opinion of the City Engineer or designated representative, such material is not readily available, the use of rock or gravel mixed with earth will be permitted, provided that no particles larger than 12 inches or smaller than 6 inches may be used. The percentage of fines shall be sufficient to fill all voids and insure a uniform and thoroughly compacted mass of proper density. When required by the Drawings or by written order of the City Engineer or designated representative, cement-stabilized-backfill material shall be used for backfilling.

All portions of fill and backfill described in the preceding paragraph shall be compacted to the same density requirements specified for the adjoining sections of embankment in accordance with the governing specifications. Where no embankment is involved on the project and no relevant specifications are included in the contract, all backfill shall be compacted to a density comparable with the adjacent undisturbed material.

No backfill shall be placed against any abutment or retaining wall until such structure has been in place at least 7 days. No backfill shall be placed adjacent to or over single and multiple boxes until the top slab has attained 500 psi flexural strength. Backfill placed around abutments and piers shall be deposited on both sides to approximately the same elevation at the same time.

Care shall be taken to prevent any wedging action of backfill against the structure and the slopes bounding the excavation shall be stepped or serrated to prevent such action. Backfill shall be uniformly placed around bridge foundations.

Backfilling shall not proceed prior to inspection and approval of the inspector.

#### B. Pipe Culverts

The following requirements shall apply to the backfilling of pipe culverts in addition to the pertinent portions of the general requirements given in the preceding section and in pipe bedding standards.

Selected materials from excavation, borrow or other approved material shall be wetted, if required and placed along both sides of the pipe equally, in uniform layers not exceeding 10 inches in depth (loose measurement) and thoroughly compacted so that there shall be a berm of thoroughly compacted material on each side of the pipe. The method and degree of compaction shall be the same as specified above for portions of backfill within the limits of embankment or roadbed.

Filling and/or backfilling shall be continued in this manner to the elevation of the top of the pipe. Special care shall be taken to secure thorough compaction of the material placed under the haunches of the pipe to prevent damage or displacement of the pipe. All fill or backfill below the top of pipe shall be compacted mechanically in the manner and to the density prescribed above, regardless of whether or not such material is placed within the limits of the embankment or roadbed. In the case of pipe placed in trenches, that portion of the backfill above the top of the pipe which supports embankment or the roadbed shall receive mechanical compaction as specified above and the portion which will not support any portion of embankment or roadbed shall be placed in layers not more than 10 inches in depth (loose measurement) and shall be compacted by whatever means the Contractor chooses, to a density comparable with the adjacent, undisturbed material. Embankments above the top of pipe shall be placed conforming to Item No. 132S, "Embankment". During construction adequate cover must be provided to protect the structure from damage.

The City Engineer or designated representative may reject backfill material that contains more than 20% by weight of material retained on a 3-in sieve, with large lumps not easily broken down, or that cannot be spread in loose layers. Material excavated by a trenching machine will generally meet the requirements of this Section as long as large stones are not present.

Where pipe extends beyond the toe of slope of the embankment and the depth of cover provided by backfill to the original ground level is less than the minimum required by the specifications for the type of pipe involved, additional material shall be placed and compacted until the minimum cover has been provided.

Whenever excavation is made for installing pipe culverts or box sewers across private property or beyond the limits of the embankment, the top soil removed in excavating the trench shall be kept separate and replaced as nearly as feasible in its original position and the entire area involved in the construction operations shall be restored to a presentable condition.

#### C. Cement Stabilized Backfill

When indicated on the Drawings, trenches shall be backfilled to the elevations shown with cement stabilized backfill. The cement-stabilized backfill shall be placed equally along the sides of structures to prevent strain on or displacement of the structure.

Cement stabilized backfill below the spring line of pipe culverts shall be sufficiently plastic to completely fill all voids in the trench. Hand operated tampers may be used if necessary to fill the voids. The pipe shall be held in alignment by jacks or other suitable means to prevent the mortared joints from cracking due to displacement caused by placing the backfill material.

Cement stabilized backfill above the spring line of pipe culverts may be dry enough to be transported without special mixing equipment.

On structures other than pipe culverts, special mixing equipment will not be required to transport the cement stabilized backfill unless otherwise indicated on the Drawings.

D. Controlled Low Strength Material (CLSM)

When indicated on the Drawings the excavation shall be backfilled with CLSM to the elevations shown. The structure shall be prevented from being displaced or "floated out" during the placement of CLSM. The CLSM shall be prevented from entering culverts and drainage structures.

401S.8 - Measurement

Unless otherwise indicated on the Drawings, structural excavation for pipe headwalls, inlets, manholes, culvert widening (extensions), bridge abutments and side road and private entrance pipe culverts will not be measured in the field but shall be included in the Plan Quantity unit price bid by the cubic yard. Determination of plan quantities for structural excavation shall be made by the method of average end-areas using the following limits to establish templates for measurement.

- A. For all structures requiring measurement, except the barrels of pipe culverts, no material outside of vertical planes 1 foot beyond the edges of the footings and parallel thereto will be included.
- B. For the barrels of pipe culverts of 42 inches or less nominal or equivalent diameter, no material outside of vertical planes 1 foot beyond the horizontal projection of the outside surfaces of the pipe and parallel thereto will be included. For the barrels of pipe culverts more than 42 inches in nominal or equivalent diameter, no material outside of vertical planes located 2 feet beyond the horizontal projection of the outside surfaces of the pipe and parallel thereto will be included.
- C. If a cofferdam, as herein defined, is used, the limitations indicated above shall apply just as if no cofferdams were used.
- D. Where excavation in addition to that allowed for the footings is required for other portions of the structure, such as for the cap, cross strut or tie beam of a pier or bent or for the superstructure, measurements for such additional excavation will be limited laterally by vertical planes 1 foot beyond the face of the member and parallel thereto and vertically to a depth of 1 foot below the bottom of such member.
- E. Except as allowed by the above conditions, no account will be taken of any excavation necessary for placing forms or falsework.
- F. Except at side road culverts, all street excavation called for on the contract drawings at all structure sites shall be assumed to be completed before starting the structural excavation and the measurement of structural excavation will include only material below or outside the limits of the completed street excavation. Excavation for side road and private entrance pipe culverts will not be measured for payment but shall be included in the unit price bid for this specification item.

- G. On all structures of bridge classification where the contract drawings call for channel excavation at the structure site, it shall be assumed to have been completed before starting the structural excavation and the measurement of structural excavation will include only material below or outside the limits of the completed channel section. The method of measurement for payment will be in accordance with this procedure regardless of the actual construction methods followed.
- H. Where excavation diagrams are indicated on the Drawings, they shall take precedence over these provisions.
- I. Measurement will not include materials removed below footing grades to compensate for anticipated swellage due to pile driving and it will not include material required to be removed due to swellage beyond the specified limits during pile driving operations.
- J. Measurement will not include additional yardage caused by slips, slides, cave-ins, siltings or fillings due to the action of the elements or the carelessness of the Contractor. Water will not be classed as excavated material.
- K. Where rock, other incompressible or unstable material is undercut to provide suitable foundation for pipe or box culverts, such material below grade, ordered by the City Engineer or designated representative to be removed, will be measured for payment.
- L. Except for any required undercut, quantities for "Structural Excavation", as indicated on the Drawings, shall be considered as final quantities and no further measurement will be required, unless the alignment, grades or structure locations are revised by the City Engineer or designated representative during construction. Final determination of quantities for individual structures will be made, if in the opinion of the City Engineer or designated representative or upon evidence furnished by the Contractor, substantial variations exist between quantities indicated on the Drawings and actual quantities due to changes in cross sections or apparent errors. Excavation quantities for foundations indicated on the Drawings where cofferdams are required shall be considered as final quantities and no further measurement will be made.
- M. For any footing, foundation or other structure unit within the scope of this specification, additional measurement will be made of the volume of excavation involved in the lowering or raising of the elevation of a footing, foundation or structure unit, when such grade change is authorized by the City Engineer or designated representative. Measurement will be made by the addition to or the deduction from, the original quantities for the volume of excavation involved in the authorized grade change.
- N. Cement stabilized backfill shall be measured by the backfill diagram as indicated on the Drawings. The quantity of "Cement Stabilized Backfill" as indicated on the Drawings shall be considered as final quantities and no further measurement will be required, unless alignment or grade elevations as indicated are revised by the City Engineer or designated representative. If such revisions result in an increase or decrease in this quantity, the final quantity will be revised by the amount represented by the changes in alignment or grade elevations.

#### 401S.9 - Payment

Payment for all work prescribed under this item and measured as provided above will be made at the unit bid price per cubic yard for the particular class of excavation specified on the Drawings in the amount shown on the Drawings and in the proposal. Payment for revised quantities will be made as specified above and for the removal of unstable and incompressible material as noted below.

Payment for removal and replacement of unstable or incompressible material below the footing grades of culverts and box sewers as indicated above will be made as follows:

When indicated on the Drawings or the City Engineer or designated representative directs the use of special materials such as flexible base, concrete base, cement stabilized backfill, controlled low strength material or other special material, payment for excavation below the footing grades shall be made at the unit bid price for "Unclassified Structural Excavation", "Common Structural Excavation" or "Rock Structural Excavation", as the case may be. Payment for furnishing, hauling, placing and compacting the flexible base, concrete base, cement stabilized backfill, controlled low strength material or other special material will be made at the unit bid price for these items in the bid or in accordance with pertinent provisions for extra work.

Where special materials are not required or specified, the removal and replacement of the unstable material will be performed as described above. Payment therefore will be made at a price equal to 200 percent of the unit bid price per cubic yard for "Unclassified Structural Excavation", "Common Structural Excavation" or "Rock Structural Excavation", as the case may be. The unit bid price shall include full compensation for removing the unstable or incompressible material, for furnishing, hauling, placing and compacting suitable material required to replace it and for all labor, equipment, tools and incidentals necessary to complete the work.

Payment for "Concrete Base", "Cement Stabilized Backfill" and "Controlled Low Strength Material" measured as prescribed above shall be made at the unit bid price per cubic yard. The unit bid price shall include full compensation for furnishing all materials, tools, labor, equipment, sheathing and incidentals required to perform the applicable work prescribed herein.

When the City Engineer or designated representative judges it necessary to lower the structure footings to an elevation below the grade indicated on the Drawings, payment for the "Unclassified Structural Excavation", "Common Structural Excavation" or "Rock Structural Excavation" as the case may be, required below plan grade down to and including an elevation 5 feet below drawing grade for any individual footing will be made at a unit price equal to 115 percent of the contract unit bid price. Payment for the excavation from an elevation over 5 feet below plan grade down to and including an elevation 10 feet below plan grade will be made at a unit price equal to 125 percent of the contract unit bid price for "Unclassified Structural Excavation", "Common Structural Excavation" or "Rock Structural Excavation" as the case may be. No increase in unit price will be allowed for other bid items of the contract and no additional compensation will be allowed for any required cofferdam adjustments made necessary by such lowering of footings. These provisions shall not apply to the lowering of culverts, except when the flow line grade is lowered 1 foot or more below plan grade.

In cases where the extra depths required for any footing or footings exceeds 10 feet, a supplemental agreement shall be made covering the quantities removed from depths in excess of 10 feet below plan grade.

No direct payment will be made for filling or backfilling around structures. Payment for the backfilling and compacting of areas, which were removed as structural excavation shall be included in the unit bid prices for the various classes of structural excavation.

At the end of each estimate period, the City Engineer or designated representative shall determine the completed portion of the total work under Standard Specification Item No. 401S "Structural Excavation and Backfill" and payment shall be made accordingly.

Filling or backfilling of areas above the natural ground level or above the limits of street excavation or channel excavation sections shall be considered as Standard Specification Item No. 132S, "Embankment" and payment therefore shall be included in the unit prices bid for the various classes of Standard Specification Item No. 110S, "Street Excavation", Standard Specification Item No. 120S, "Channel Excavation" or Standard Specification Item No. 130S, "Borrow".

Where no channel excavation is provided for at culvert sites and where it is necessary to excavate beyond the limits of structural excavation, as herein described in order that the culvert may function properly, such excavation shall be included with structural excavation as may be indicated on the Drawings.

Payment for all work prescribed under this item shall include full compensation for all excavation and backfill including compaction, all soundings, construction of all cofferdams, all dewatering and for furnishing all materials, labor, equipment, tools, sheathing, bracing, cofferdams, pumps, drills, explosives and incidentals necessary to complete the work, except for specific allowances stated above.

Special materials used or additional excavation made for the Contractor's convenience to expedite the work will not be paid for directly but shall be included in the unit price bid for this specification item. In addition, if the Contractor's construction methods and equipment creates conditions necessitating usage of special materials or additional excavation, the work and materials will not be paid for directly but shall be included in the unit price bid for this specification item.

When specified in the contract bid form as a separate pay item(s), the item(s) will be paid for at the contract unit price(s) for "Flexible Base", "Lime Stabilized Base" and "Controlled Low Strength Material". The bid prices shall include full compensation for all Work herein, specified, including the disposal of all material not required in the Work, the furnishing of all material, equipment, tools, labor and incidentals necessary to complete the Work.

Payment will be made under one of the following:

<b>Pay Item No. 401S-A:</b>	Unclassified Structural Excavation, Plan Quantity	Per Cubic Yard.
<b>Pay Item No. 401S-B:</b>	Common Structural Excavation	Per Cubic Yard.
<b>Pay Item No. 401S-C:</b>	Rock Structural Excavation	Per Cubic Yard.
<b>Pay Item No. 401S-D:</b>	Concrete Base	Per Cubic Yard.
<b>Pay Item No. 401S-E:</b>	Cement Stabilized Backfill	Per Cubic Yard.
<b>Pay Item No. 401S-F:</b>	Flexible Base	Per Cubic Yard.
<b>Pay Item No. 401S-G:</b>	Lime Stabilized Base	Per Square Yard.
<b>Pay Item No. 401S-H:</b>	Controlled Low Strength Material	Per Cubic Yard.
<b>Pay Item No. 401S-I:</b>	Cofferdams, type	Per Cubic Yard.

Pay Item No. 401S-J:	Dewatering	Per Cubic Yard.
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## ITEM NO. 402S - CONTROLLED LOW STRENGTH MATERIAL

### 402S.1 - Description

This item governs Controlled Low Strength Material (CLSM) used for trench backfill and for filling abandoned culverts, pipes, other enclosures, and for other uses as indicated on the drawings, Standard Details or as approved by the Engineer or designated representative. CLSM is a low strength, self-compacting, flowable, cementitious material used in lieu of soil backfill. It is intentionally prepared at low strength to allow for future removal using conventional excavation equipment.

The CLSM shall be composed of Portland Cement (PC) or fly ash, or both, filler aggregate and water. The CLSM, specified for use in filling abandoned culverts, pipes, or other enclosures, shall contain a settlement compensator, in addition to the other ingredients, to minimize settlement of the CLSM within the enclosure.

Normal Set CLSM shall be specified whenever the material will remain uncovered or will not be subjected to traffic or other loads within 24 hours after placement. Fast Set CLSM shall be specified whenever the material will be covered, subjected to traffic or other loads within 24 hours, or needed to expedite construction.

CLSM can be used for permanent subgrade repairs below the base layer but shall not be used for permanent pavement repairs. For temporary traffic applications, a minimum 2-inch cap composed of Hot Mix-Cold Laid Asphaltic Concrete Pavement (TxDOT Standard Specification Item 334) shall be placed on the CLSM.

### 402S.2 - Submittals

The submittal requirements of this specification item include:

1. A mix design submittal including the results of unconfined compressive strength tests, air entrainment (if applicable), flow consistency, hardened unit weight, and timed Ball Drop and corresponding Penetrometer tests.
2. Certifications and test results for the cement fly ash, and admixtures.
3. Particle-size gradation and specific gravity tests on the filler aggregate.

### 402S.3 - Materials

#### A. Cement.

PC shall conform to ASTM C 150, Type I (General Purpose).

PC manufactured in a cement kiln fueled by hazardous waste shall be considered as an approved product if the production facility is authorized to operate under regulation of the Texas Commission on Environmental Quality (TCEQ) and the U.S. Environmental Protection Agency (EPA). Supplier shall provide current TCEQ and EPA authorizations to operate the facility.

#### B. Fly Ash

Fly ash shall conform to the requirements of Standard Specification Item No. 405, "Concrete Admixtures" and TxDOT Specification Item 437.

C. Filler Aggregate.

Filler aggregate shall consist of sand, stone screenings, pavement milling cuttings or other granular material that is compatible with the other mixture components. The filler aggregate shall be fine enough to stay in suspension to the extent required for proper flow without segregation, and, in the case of filling of enclosures, for minimal settlement. Filler aggregate shall have a Plasticity Index (TxDOT Test Method Tex-106-E) less than 15 and shall conform to the following gradation:

Sieve Designation	US	Percent Passing
	No. 200	0—10

D. Mixing Water.

Mixing water shall conform to the requirements of Standard Specification Item No. 403, "Concrete for Structures".

E. Settlement Compensator

An air entraining admixture with a higher than usual dosage, which meets the requirements of Standard Specification Item No. 405, "Concrete Admixtures", shall be used as a settlement compensator. The settlement compensator may be introduced to the CLSM at the job site by placement of prepackaged admixture in capsules or bags in the mixing drum in accordance with the admixture manufacturer's recommendations.

402S.4 - Mix Design

The proportioning of CLSM shall be the responsibility of the Contractor. The Contractor shall furnish a mix design conforming to the requirements herein, for review and approval by the Engineer or designated representative. The mix design shall be prepared by a qualified commercial laboratory and then reviewed and signed by a registered Professional Engineer licensed in the State of Texas.

The Mix Design submittal must include:

- A. Test results for unconfined compressive strength, air entrainment (if applicable), flow consistency, hardened unit weight, and timed Ball Drop (ASTM C-360) and corresponding Penetrometer tests (with a concrete pocket penetrometer),
- B. Certifications and test results for the cement, fly ash, and admixtures, and
- C. Results of particle-size gradation and specific gravity tests on the filler aggregate. The submittal shall include Penetrometer tests performed every thirty minutes until the Ball Drop test shows a 2-inch indentation, as well as the predicted Penetrometer reading that corresponds to a 3-inch Ball Drop indentation. Particle-size gradation shall be determined using a series of sieves that gives no fewer than five uniformly spaced points for graphing the entire range of particle sizes larger than a No. 200 sieve.

The Contractor shall perform the work required to substantiate the design at no cost to the City, including all testing. Approved mix designs shall be valid for one year, provided there are no changes in the type, source, or characteristics of the materials during that year.

At the end of one year, the mix design may be submitted for renewal, provided that:

1. field tests of the CLSM during the year have been satisfactory,
2. there have been no changes in type or source of the materials of the mix, and
3. the characteristics of the materials have not changed significantly since the original submittal.

The Contractor shall also submit certifications and test results for the cement, fly ash and admixtures, and particle-size gradation and specific gravity test results for the filler aggregate. The Contractor shall compare results of tests made on the filler aggregate at the end of the year to the results of tests reported in the original submittal. Gradation changes less than ten percent in percent passing any sieve and specific gravity changes less than five percent shall not be considered significant.

#### 402S.5 - Strength

The CLSM mix designs shall meet the unconfined compressive strength requirements outlined in the table below. The compression tests shall be conducted in accordance with TxDOT Method Tex-418-A, using approved unbonded caps on specimens with 4-inch diameter and 8-inch height [or 3-inch diameter by 6-inch high specimens if a smaller capacity loading device gives more accurate results].

<b>Unconfined Compressive Strength, psi</b>		
Age	Normal Set CLSM	Fast Set CLSM
3 hours	—	35 minimum
24 hours	35 minimum	—
28 days	300 maximum	300 maximum

#### 402S.6 - Flow Consistency

Flow consistency shall be established in tests involving the use of a 6-inch length by 3-inch diameter open-ended straight tubing made of steel, plastic or other non-absorbent material that is non-reactive with cement or fly ash. The tube shall be placed with one end on a horizontal flat surface and held in a vertical position. The tube shall then be filled to the top with CLSM. The top surface shall be struck off with a suitable straight edge and any spillage shall be removed from the base of the tube. Within five seconds thereafter the tube shall be raised carefully, using a steady upward lift with no lateral or torsional motion. The entire test, from the start of filling until removal of the tube, shall be completed within 1½ minutes without interruption.

After removal of the tube, the spread of the CLSM shall be measured immediately along two diameters that are perpendicular to one another. The average of those two measurements is defined as the flow

consistency of the mix. The flow consistency of the CLSM shall be considered satisfactory if a circular-type spread of the mix occurs without segregation and a flow consistency (average diameter of spread) of 8 inches or more is achieved.

#### 402S.7 - Air Entrainment

Air entraining admixture shall be added as a settlement compensator, whenever the CLSM will be used to fill an enclosure (Section 402S.1). The dosage shall be sufficient to result in an air content of 15 to 25 percent (as determined by TxDOT Method Tex-416-A) at the time of placement of the CLSM.

#### 402S.8 - Field Strength Tests

Ball Drop or Penetrometer tests shall be used to determine, when the CLSM has developed sufficient strength to be covered or subjected to traffic or other loads as approved by the Engineer or designated representative.

The Ball Drop test shall be performed according to the latest version of ASTM C-360. An indentation diameter of 3 inches or less, and the absence of a sheen or any visible surface water in the indentation area shall indicate that the CLSM has achieved the desired strength. Because trench width and depth may affect the test results, the Contractor may perform this test on a control sample of CLSM in a 2-foot square by 6-inch deep container.

Penetrometer tests using a hand-held, spring reaction-type device commonly called a concrete pocket penetrometer, shall be performed on the surface of the CLSM. A Penetrometer reading, equal to or greater than the value established in the mix design (Section 402S.4) for a Ball Drop test indentation of 3-inches, shall indicate that the CLSM has achieved the desired strength.

#### 402S.9 - Construction Methods

##### A. General

The height of free fall placement of the CLSM shall not exceed 4 feet. Since CLSM is considered to be self-compacting, a vibrator shall not be allowed. The CLSM shall not be covered with any overlying materials or subjected to traffic or other loads until the Ball Drop test or the Penetrometer test shows acceptable results (Section 402S.8) or until the CLSM has been in place a minimum of 24 hours for Normal Set CLSM and a minimum of 3 hours for Fast Set CLSM. Curing of the CLSM will not be required.

##### B. Utility Line Backfill

After the utility pipe has been placed and the proper bedding material placed in accordance with the details on the drawings, the trench may be immediately backfilled with the CLSM to the subgrade level shown on the drawings, Standard Details 1100S-6B & D, 430S-4 "Concrete Backfill Under Curb and Gutter" or as directed by the Engineer or designated representative.

##### C. Culvert Backfill

Care shall be taken to prevent movement of the structure. If the pipe or structure moves either horizontally or vertically, the CLSM and the structure shall be immediately removed, and the pipe or structure re-laid to proper line and grade.

D. Other Backfill

CLSM may be used for backfill material in lieu of soil as shown on the drawings, Standard Details or as approved by the Engineer or designated representative.

E. Filling Abandoned Culverts, Pipe, or other Enclosures

The CLSM shall be placed in a manner that allows all air or water, or both, to be displaced readily as the CLSM fills the enclosure.

402S.10 - Acceptance Testing During Construction

The Engineer or designated representative may perform flow consistency, air entrainment, and unconfined compressive strength tests to determine if the CLSM meets the specification requirements. The number and frequency of acceptance tests will be determined by the Engineer or designated representative.

402S.11 - Measurement and Payment

The work and materials presented herein will generally not be paid for directly but shall be included in the unit price bid for the item of construction in which this item is used.

When specified in the contract bid form as a separate pay item, the item will be paid for at the contract unit bid price(s) for "Controlled Low Strength Material". The bid prices shall include full compensation for all Work herein specified, including the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the Work.

Payment will be made under the following:

<b>Pay Item No. 402S-A:</b>	Controlled Low Strength Material	Per Cubic Yard
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**END**

## ITEM NO. 403S - CONCRETE FOR STRUCTURES

### 403S.1 - Description

This item shall govern quality, storage, handling, proportioning and mixing of materials for hydraulic cement concrete construction of buildings, bridges, culverts, slabs, prestressed concrete and incidental appurtenances.

### 403S.2 - Submittals

Within 14 days prior to the commencement of related work, the Contractor shall submit electronically the following submittal requirements as applicable:

- a. Technical literature including type of concrete and mix design option(s) of the class of concrete required on the project,
- b. The supplier of the concrete mix design(s) and type of mixing equipment,
- c. Type of admixtures to be used with the concrete mixes,
- d. Description of curing method used, and
- e. Manufacturer of precast structures

### 403S.3 - Materials

Concrete shall be composed of Portland cement, water, aggregates (fine and coarse), and admixtures if desired or required, proportioned and mixed as hereinafter to achieve specified results.

#### A. Cementitious Materials

Hydraulic cement shall conform to ASTM C 150, Type I (General Purpose), Type II (General Purpose with Moderate Sulfate Resistance) and Type III (High Early Strength). Type I shall be used when none is specified or indicated on the drawings. Type I and Type III cements shall not be used when Type II cement is specified or indicated on the drawings. Type III cement may be used in lieu of a Type I cement, when the anticipated air temperature for the succeeding 12 hours will not exceed 60°F (15.6°C). A Type III cement shall only be used in precast concrete or when otherwise specified or allowed. All cement shall be of the same type and from the same source for a monolithic placement.

Unless otherwise specified, the cementitious material content shall be limited to no more than 700 lbs. per cubic yard. When supplementary cementing materials are used, cement is defined as "cement plus supplementary cementing material." Supplementary cementing materials include fly ash (DMS-4610), ultra-fine fly ash (DMS-4610), ground granulated blast furnace slag grade 100 or 120 (DMS-4620), silica fume (DMS-4630) and metakaolin (DMS-4635).

Class C flyash shall not be used in sulfate-resistant concrete.

Hydraulic cement manufactured in a cement kiln fueled by hazardous waste shall be considered as an approved equivalent product if the production facility is authorized to operate under regulation of the Texas Commission on Environmental Quality (TCEQ) and the U.S. Environmental Protection Agency (EPA). Supplier shall provide current TCEQ and EPA authorizations to operate the facility.

When sulfate-resistant concrete is required for a project, mix design options 1, 2, 3 or 4 presented in Section 403S.8, "Mix Design Options" shall be used to develop appropriate mix design utilizing Type I/II, II, V, IP or IS cement.

**B. Mixing Water**

Water for use in concrete and for curing shall be potable water free of oils, acids, organic matter or other deleterious substances and shall not contain more than 1,000 parts per million of chlorides as Cl or sulfates as SO<sub>4</sub>.

Water from the City of Pflugerville will not require testing. Contractor may request approval of water from other sources. Contractor shall arrange for samples to be taken from the source and tested at the Contractor's expense. When water from other sources is proposed, test reports shall be provided that indicates compliance with Table 1 before use.

<b>Table 1: Chemical Limits for Mix Water</b>		
<b>Contaminant</b>	<b>Test Method</b>	<b>Maximum Concentration (ppm)</b>
Chloride (CL) Prestressed concrete Bridge decks & superstructure All other concrete	ASTM D-512	500 500 1,000
Sulfate (SO <sub>4</sub> )	ASTM D-516	1,000
Alkalies (NA <sub>2</sub> O + 0.658 K <sub>2</sub> O)	ASTM D-4191 & D-4192	600
Total Solids	AASHTO T-26	50,000

Water that has an adverse effect on the air-entraining agent or any other chemical admixture or on strength or time of set of the concrete shall not be used. Water used in white Portland Cement (PC) concrete shall be free from iron and other impurities, which may cause staining, or discoloration.

**C. Coarse Aggregate**

Coarse aggregate shall consist of durable particles of crushed or uncrushed gravel, crushed blast furnace slag, crushed stone or combinations thereof; free from frozen material or injurious amounts of salt, alkali, vegetable matter or other objectionable material either free or as an adherent coating. When white hydraulic cement is specified, the coarse aggregates used in the concrete shall be light colored. Quality shall be reasonably uniform throughout.

The coarse aggregate from each source shall not contain more than 0.25 percent by weight of clay lumps, nor more than 1.0 percent by weight of shale nor more than 5 percent by weight of laminated and/or friable particles when tested in accordance with TxDOT Test Method Tex-413-A. The coarse aggregate from each source shall have a wear of not more than 40 percent when tested in accordance with TxDOT Test Method Tex-410-A.

Unless otherwise indicated on the drawings, the coarse aggregate from each source shall be subjected to 5 cycles of the soundness test conforming to TxDOT Test Method Tex-411-A. The loss shall not be greater than 12 percent when sodium sulfate is used or 18 percent when magnesium sulfate is used. A satisfactory record under similar conditions of service and exposure will be considered in the evaluation of material failing to meet these requirements.

Coarse aggregate shall be washed. The Loss by Decantation (TxDOT Test Method Tex-406-A), plus allowable weight of clay lumps, shall not exceed 1 percent or the value indicated on the drawings or in the project manual, whichever is less. If material finer than the # 200 sieve is definitely established to be dust of fracture of aggregates made primarily from crushing of stone, essentially free from clay or shale as established by Part III of TxDOT Test Method Tex-406-A, the percent may be increased to 1.5. When crushed limestone coarse aggregate is used in concrete pavements, the decant may exceed 1% but not more than 3% if the material finer than the #200 sieve is determined to be at least 67% calcium carbonate in accordance with TxDOT Test Method Tex-406-A, Part III.

The coarse aggregate factor may not be more than 0.82; however, when voids in the coarse aggregate exceed 48 percent of the total rodded volume, the coarse aggregate factor shall not exceed 0.85. The coarse aggregate factor may not be less than 0.68 except for a Class I machine extruded mix that shall not have a coarse aggregate factor lower than 0.61.

When exposed aggregate surfaces are required, the coarse aggregate shall consist of particles with at least 40 percent crushed faces. Uncrushed gravel, polished aggregates and clear resilient coatings are not acceptable for exposed aggregate finishes.

When tested by approved methods, the coarse aggregate including combinations of aggregates when used, shall conform to the grading requirements shown in Table 2.

<b>Grade</b>	<b>Nom. Size</b>	<b>2½"</b>	<b>2"</b>	<b>1½"</b>	<b>1"</b>	<b>¾"</b>	<b>½"</b>	<b>⅜"</b>	<b>No. 4</b>	<b>No. 8</b>
1	2"	100	80-100	50-85		20-40			0-5	
2 (467)*	1½"		100	95-100		35-70		10-30	0-5	
3	1"		100	95-100		60-90	25-60		0-5	
4 (57)*	1"			100	95-100		25-60		0-10	0-5
5 (67)*	¾"				100	90-100		20-55	0-10	0-5
6 (7)*	½"					100	90-100	40-70	0-15	0-5
7	⅜"						100	70-95	0-25	
8	⅜"						100	95-100	20-65	0-10



Notes:

1. Recycled crushed concrete fine aggregate shall be limited to a maximum of 20% of the fine aggregate.
2. The use of recycled crushed hydraulic cement concrete as a coarse aggregate shall be limited to Concrete Classes A, B and D (see Table 5).

D. Fine Aggregate

Fine aggregate shall be washed and consist of clean, hard, durable and uncoated particles of natural or manufactured sand or a combination thereof, with or without a mineral filler. When white hydraulic cement is specified, the fine aggregates used in the concrete shall be light colored. Quality shall be reasonably uniform throughout. It shall be free from frozen material or injurious amounts of salt, alkali, vegetable matter or other objectionable material and it shall not contain more than 0.5 percent by weight of clay lumps in accordance with Tex-413-A. When subjected to color test for organic impurities per TxDOT Test Method Tex-408-A, it shall not show a color darker than standard.

Unless indicated otherwise on the drawings the acid insoluble residue of fine aggregate used in slab concrete subject to direct traffic shall not be less than 60 percent by weight (mass) when tested conforming to TxDOT Test Method Tex-612-J.

Unless indicated otherwise on the Drawings, fine aggregate shall be blended, when necessary, to meet the acid insoluble residue requirement.

When blending the following equation shall be used:

$$\text{Acid Insoluble (\%)} = \{(A1)(P1)+(A2)(P2)\}/100$$

Where:

A1 = acid insoluble (%) of aggregate 1,

A2 = acid insoluble (%) of aggregate 2,

P1 = % by weight of A1 of the fine aggregate blend, and

P2 = % by weight of A2 of the fine aggregate blend.

When tested in accordance with TxDOT Test Method Tex-401-A, the fine aggregate, including mineral filler and combinations of aggregates, when used, shall conform to the grading requirements shown in Table 3.

<b>3/8</b>	<b>No. 4</b>	<b>No. 8</b>	<b>No. 16</b>	<b>No. 30</b>	<b>No. 50</b>	<b>No. 100</b>	<b>No. 200</b>
100	95-100	80-100	50-85	25-65	10-35	0-10	0-32

Notes:

1. Recycled crushed concrete fine aggregate shall be limited to a maximum of 20% of the fine aggregate.
2. The use of recycled crushed hydraulic cement concrete as a fine aggregate shall be limited to Concrete Classes A, B and D (see Table 5).
3. 6 to 35 when sand equivalent value is greater than 85.
4. 0 to 6 for manufactured sand.

Fine aggregate will be subjected to Sand Equivalent Test per TxDOT Test Method Tex-203-F. Sand Equivalent shall not be less than 80 nor less than otherwise indicated on the drawings, whichever is greater.

The fineness modulus will be determined by adding the percentages by weight retained on sieve Nos. 4, 8, 16, 30, 50 and 100 and dividing the sum of the six sieves by 100. For all classes of concrete except K (see Table 5), the fineness modulus shall be between 2.30 and 3.10. For Class K concrete, the fineness modulus shall be between 2.6 and 2.8, unless indicated otherwise on the Drawings.

E. Mineral Filler

Mineral filler shall consist of stone dust, clean crushed sand or other approved inert material. When tested in accordance with TxDOT Test Method Tex-401-A, it shall conform to the following gradation:

Passing the No. 30 Sieve	100 percent
Passing the No. 200 Sieve	65 to 100 percent

F. Mortar and Grout

Unless otherwise specified, indicated on the drawings or approved by the City Engineer or designated representative mortar and grout shall consist of 1 part cement, 2 parts finely graded sand and enough water to make the mixture plastic. When required to prevent color difference, white cement shall be added to produce color required. When required by the City Engineer or designated representative, approved latex adhesive may be added to the mortar. Mortar shall be provided with a consistency such that the mortar can be easily handled and spread by trowel. Grout shall be provided of a consistency that will flow into and completely fill all voids.

G. Admixtures

All chemical admixtures including water reducing, plasticizers and air entrainment shall conform to TxDOT DMS-4640, "Chemical Admixtures for Concrete". Calcium chloride-based admixtures shall not be approved. Unless otherwise noted, air-entraining, retarding and water reducing admixtures may be used in all concrete. Admixtures shall be included in the prequalified concrete admixtures list maintained by TxDOT's Construction Division (latest edition). High-range water-reducing admixtures

(TxDOT Type F or G) and accelerating admixtures (TxDOT Type C or E) shall not be used in bridge deck concrete.

#### H. Air Entrainment

Unless indicated otherwise on the drawings, all concrete classes with the exception of Class B shall be air entrained in accordance with Table 8. If the air content is more than 1½ percentage points below or 3 percentage points above the required air, the load of concrete will be rejected. If the air content is more than 1½ but less than 3 percentage points above the required air, the concrete may be accepted based on strength test results.

#### 403S.4 - Storage of Materials

##### A. Cement, Supplementary Cementing Materials and Mineral Filler

All cement, supplementary cementing materials and mineral filler shall be stored in separate and well ventilated, weatherproof buildings or approved bins, which will protect the material from dampness or absorption of moisture. Storage facilities shall be easily accessible, and each shipment of packaged cement shall be kept separated to provide for identification and inspection. The City Engineer or designated representative may permit small quantities of sacked cement to be stored in the open for a maximum of 48 hours on a raised platform and under waterproof covering.

##### B. Aggregates

The method of handling and storing concrete aggregates shall prevent contamination with foreign materials. If the aggregates are stored on the ground, the sites for the stockpiles shall be clear of all vegetation and shall be level. Aggregates shall be stockpiled in sizes to facilitate blending. If the aggregate is not stockpiled on a hard, non-contaminant base, the bottom 6-inch layer of the stockpile shall not be used without recleaning the aggregate.

When conditions require the use of 2 or more grades of coarse aggregates, separate stockpiles shall be maintained to prevent intermixing. Where space is limited, stockpiles shall be separated by walls or other appropriate barriers.

Aggregate shall be stockpiled and protected from the weather a minimum of 24 hours prior to use to minimize free moisture content. When stockpiles are too large to protect from the weather, accurate and continuous means acceptable to the City Engineer or designated representative shall be provided to monitor aggregate temperature and moisture. Aggregates shall be stockpiled and handled such that segregation and contamination are minimized.

The stockpiles shall be sprinkled to control moisture and temperature as necessary. A reasonably uniform moisture content shall be maintained in aggregate stockpiles.

##### C. Admixtures

Admixtures shall be stored in accordance with manufacturer's recommendations and shall be protected against freezing.

##### D. Hot Weather Concrete Mixes

Ice may be used during hot weather concrete placement (Section 13 of Standard Specification Item No. 410S, "Concrete Structures") to lower the concrete temperature; however, the Contractor shall

furnish a mix design acceptable to the City Engineer or designated representative for class of concrete specified. The addition of ice shall not exceed 50% of the total mix water weight.

#### 403S.5 - Measurement of Materials

Water shall be accurately metered. Fine and coarse aggregates, mineral filler, bulk cement and fly ash shall be weighed separately. Allowances shall be made in the water volume and aggregate weights during batching for moisture content of aggregates and admixtures. Volumetric and weight measuring devices shall be acceptable to the City Engineer or designated representative. Measurement of materials in non-volumetric and volumetric mixers shall conform TxDOT Specification Item 421, "Hydraulic Cement Concrete".

Batch weighing of sacked cement is not required; however, bags, individually and entire shipments, may not vary by more than 3 percent from the specified weight of 94 pounds per bag. The average bag weight of a shipment shall be determined by weighing 50 bags taken at random.

#### 403S.6 - Mix Design

The Contractor shall furnish a mix design acceptable to the City Engineer or designated representative for the class of concrete required in accordance with Table 5. The mix shall be designed by a qualified commercial laboratory and/or concrete technician and signed/sealed by a registered Professional Engineer, licensed in the state of Texas to conform with requirements contained herein, to ACI 211.1 or TxDOT Bulletin C-11 (and supplements thereto). The maximum water-to-cementitious material ratio identified in Table 5 for specific classes of concrete shall not be exceeded.

A higher-strength class of concrete with equal or lower water-to-cementitious-material ratio may be substituted for the specified class of concrete.

The mix design shall be over-designed in accordance with Table 5 in order to account for production variability and to ensure minimum compressive strength requirements are met.

Allowable mix design options are presented in Section 403S.8.

The Contractor shall perform, at the Contractor's expense, the work required to substantiate the design, including testing of strength specimens. Complete concrete design data shall be submitted to the City Engineer or designated representative for approval. The mix design will be valid for a period of one (1) year provided that there are no changes to the component materials. In lieu of the above mix design, the Contractor may accept a design furnished by the City. However, this will not relieve him of providing concrete meeting the requirements of these specifications.

It shall also be the responsibility of the contractor to determine and measure the batch quantity of each ingredient, including all water, so that the mix conforms to these specifications and any other requirements shown on the Drawings.

When there are changes in aggregates or in type, brand or source of cement, supplementary cementing material or chemical admixtures, the mix shall be evaluated as a new mix design. A change in vendor does not necessarily constitute a change in materials or source. When only the brand or source of cement is changed and there is a prior record of satisfactory performance of the cement with the ingredients, the submittal of new trial batches may be waived by the City Engineer or designated representative.

At the end of one (1) year, a previously approved mix may be resubmitted for approval if it can be shown that no substantial change in the component materials has occurred and that test results confirming the adequacy of the mix designs have been acquired during the previous year. The resubmittal analysis must be reviewed, signed and sealed by a registered Professional Engineer, licensed in the state of Texas. This resubmittal shall include a reanalysis of specific gravity, absorption, fineness modulus, sand equivalent, soundness, wear and unit weights of the aggregates. Provided that the fineness modulus did not deviate by more than 0.20 or that the re-proportioned total mixing water, aggregate and cement (or cement plus fly ash) are within 1, 2, and 3 percent, respectively, of pre-approved quantities, a one-year extension on the approval of the mix may be granted by the City Engineer or designated representative. Updated cement, fly ash, and admixture certifications shall accompany the resubmittal.

Approved admixtures that are included in the prequalified concrete admixtures list maintained by TxDOT's Construction Division may be used with all classes of concrete at the option of the Contractor provided that specific requirements of the governing concrete structure specification are met. Water reducing and retarding agents shall be required for hot weather, large mass, and continuous slab placements. Air entraining agents may be used in all mixes but must be used in the classes indicated on Table 5. Unless approved by the City Engineer or designated representative, mix designs shall not exceed air contents for extreme exposure conditions as recommended by ACI 211.1 for the various aggregate grades.

#### 403S.7 - Consistency and Quality of Concrete

Concrete shall be uniform, workable, cohesive, possess satisfactory finishing qualities and of stiffest consistency that can be placed and vibrated into a homogeneous mass within slump requirements specified in Table 4 without the development of segregation or honeycombing. No concrete will be permitted with a slump in excess of the maximums shown unless water-reducing admixtures have been previously approved. Concrete that exceeds the maximum acceptable placement slump at time of delivery will be rejected. Slump values shall be conducted in accordance with TxDOT Test Method Tex-415-A.

Consistency and quality of concrete should allow efficient placement and completion of finishing operations before initial set. Re-tempering (i.e. addition of water and reworking concrete after initial set) shall not be allowed. When field conditions are such that additional moisture is needed for final concrete surface finishing operation, the required water shall be applied to surface by fog spray only and shall be held to a minimum. Excessive bleeding shall be avoided and in no case will it be permissible to expedite finishing and drying by sprinkling the surface with cement powder.

<b>Table 4: Slump Requirements</b>		
<b>Type of Construction</b>	<b>Slump <sup>1</sup>, inches</b>	
	<b>Maximum</b>	<b>Minimum</b>
Cased Drilled Shafts	4	3
Reinforced Foundation Caissons and Footings	3	1
Reinforced Footings and Substructure Walls	3	1
Uncased Drilled Shafts	6	5
Thin-walled Sections; 9 inches or less	6½	4
Prestressed Concrete Members	6½	4
Precast Drainage Structures	6	4

Wall Sections over 9 inches	5	3
Reinforced Building Slabs, Beams, Columns and Walls	4	1
Bridge Decks	4	2
Pavements, Fixed-form	6½	4
<b>Table 4 (continued): Slump Requirements</b>		
	<b>Slump <sup>1</sup>, inches</b>	
<b>Type of Construction</b>	<b>Maximum</b>	<b>Minimum</b>
Pavements, Slip-form	3	1½
Sidewalks, Driveways and Slabs on Ground	4	2
Curb & Gutter, Hand-vibrated	3	1
Curb & Gutter, Hand-tamped or spaded	4	2
Curb & Gutter, Slip-form/extrusion machine	2	1/2
Heavy Mass Construction	2	1
High Strength Concrete	4	3
Riprap and Other Miscellaneous Concrete	6	1
Under Water or Seal Concrete	8½	6

Notes:

1. Slump values when a high range water reducer (HRWR) is not used.
2. When a high range water reducer (HRWR) is used, maximum acceptable placement slump will be 9 in.

During progress of the work, the City Engineer or designated representative shall cast test cylinders as a check on compressive strength of concrete actually placed. The City Engineer or designated representative may also perform slump tests, entrained air tests and temperature checks to ensure compliance with specifications.

Proportioning of all material components shall be checked prior to discharging. Excluding mortar material for pre-coating of the mixer drum [see section 403S.8.B] and adjustment for moisture content of admixtures and aggregates, material components shall fall within the range of + 1% for water, + 2% for aggregates, + 3% for cement, + 2% for fly ash and within manufacturer recommended dosage rates for admixtures except that air entrainment shall be within + 1½ percentage points of the mix design requirements.

Unless otherwise specified or indicated on the drawings, concrete mix temperature shall not exceed 90°F except in mixes with high range water reducers where a maximum mix temperature of 100°F will be allowed. Cooling an otherwise acceptable mix by addition of water or ice during agitation will not be allowed.

Test cylinders will be required for small placements such as manholes, inlets, culverts, wing walls, etc. The City Engineer or designated representative may vary the number of tests to a minimum of 1 for each 25 cubic yards placed over a several-day period.

Test cylinders shall be required for each monolithic placement of bridge decks or superstructures, top slabs of direct traffic culverts, cased drilled shafts, structural beams and as otherwise directed by the City Engineer or designated representative for design strength confirmation or early form removal. Test cylinders made for early form removal or for consideration of use of structure will be at Contractor's expense, except when required by the City Engineer or designated representative.

A strength test shall be defined as the average breaking strength of 2 cylinders. A minimum of four test cylinders shall be prepared; two each to be tested at 7 and 28 days. Specimens will be tested conforming to TxDOT Test Method Tex-418-A. If required strength or consistency of class of concrete being produced cannot be secured with minimum cementitious material specified or without exceeding maximum water/cementitious material ratio, Contractor will be required to furnish different aggregates, use a water reducing agent, an air entraining agent or increase the cement content in order to provide concrete meeting these specifications.

Slump tests will be performed in accordance with TxDOT Test Method Tex-415-A. Entrained air tests will be performed in accordance with TxDOT Test Method Tex-416-A.

Test specimens shall be cured using the same methods and under the same conditions as the concrete represented. Design strength cylinders shall be cured conforming to TxDOT Bulletin C-11 (and supplements thereto).

When control of concrete quality is by 28-day compressive tests, job control testing will be by 7-day compressive strength tests. The minimum strength requirement for seven (7) day test will be 70 percent of the specified minimum 28-day compressive strength. If the required 7-day strength is not secured with the quantity of cement specified in Table 4, changes in the mix design shall be made and resubmitted for approval. For an occasional failure of the seven-day compressive test, the concrete may be tested at 28 days for final evaluation.

<b>Concrete Classification</b>	<b>Sacks of Cement per CY</b>	<b>Min. Compressive Strength (28f' c) 28 Day (psi)</b>	<b>Min. Beam Strength 7 Day</b>	<b>Max. Water/Cement Ratio (gal/sack)</b>	<b>Coarse Aggregate No.<sup>5</sup></b>
A <sup>7</sup>	5.0	3000	425 390 <sup>3</sup>	6.5	1-2-3-4-8 <sup>1,4</sup>
B	4.5	2500	300	8	2-3-4-5-6-7
C <sup>6,7</sup>	6.0	3600	510	6	1-2-3-4-5
D	3.0	1500	215	11	2-3-4-5-6-7
E	6.0	3000	425	6	2-3-4-5
S <sup>7</sup>	6.5	4000	570 525 <sup>3</sup>	5	2-3-4-5
P	5.0	N/A	555 <sup>2</sup>	6.25	2-3
DC	8.75	5500	720	3.6	6

CO	7.0	4600	640	4.5	6
SS	7.0	3600	510	5.5	3-4-5

Notes:

1. Grade 8 aggregate for use in extended coarse and extruded curbs, unless a larger size is approved by the City Engineer or designated representative.
2. Minimum running average of concrete pavement.
3. When Type II or Type I / II cement is used.
4. Unless otherwise permitted by the City Engineer, Grade I coarse aggregate may only be used in massive foundations with 4-inch minimum clear spacing between reinforcing steel bars
5. Grade 1 coarse aggregate grading shall not be used in drilled shafts.
6. Structural concrete classes.
7. When Type II cement is used in Class C, S or A concrete, the 7-day compressive strength requirement will be 2310 psi for Class C, 2570 psi for Class S and 1925 psi for Class A minimum.

<b>Number Of Tests <sup>2,3</sup></b>	<b>Standard Deviation, psi</b>				
	300	400	500	600	700
15	470	620	850	1,120	1,390
20	430	580	760	1,010	1,260
30 or more	400	530	670	900	1,130

Notes:

1. When designing the mix, add the tabulated amounts to the minimum design strength in Table 5. Maximum water-cement or water-cementitious ratio by weight
2. Number of tests of a concrete mixture used to estimate the standard deviation of a concrete production facility. Test of another mix within 1,000 psi of the specified strength may be used.
3. If less than 15 prior tests are available, the overdesign should be 1,000 psi for specified strength less than 3,000 psi, 1,200 psi for specified strengths from 3,000 to 5,000 psi and 1,400 psi for specified strengths greater than 5,000 psi.



<b>Class</b>	<b>General Usage</b>
A	Drilled shafts, culverts (except top of slab of direct traffic culverts), inlets, manholes, headwalls, approach slabs, curb, gutter, curb & gutter, concrete retards, sidewalks, driveways, backup walls and anchors
B	Riprap, small roadside signs and anchors
C <sup>5</sup>	Drilled shafts, bridge substructure, bridge railing, culverts (except top slab of direct traffic culverts), headwalls, wing walls, approach slabs, and cast-in-place concrete traffic barrier

<b>Class</b>	<b>General Usage</b>
D	Riprap
E	Seal concrete
S	Bridge slab, top slab of direct traffic culvert, bridge sub-structure
P	Concrete pavement
DC	Dense concrete overlay
CO	Concrete overlay
SS	Slurry displacement shafts, underwater drill shafts

<b>Nominal Maximum Aggregate Size, In.</b>	<b>% Air Entrainment<sup>2</sup></b>	
	<b>Moderate Exposure</b>	<b>Severe Exposure</b>
3/8 - Grades 7 & 8	6	7½
1/2 - Grades 6	5½	7
3/4 - Grades 5	5	6
1 - Grades 4	4½	6
1½ - Grades 2 & 3	4½	5½
2 - Grades 2	4	5

Notes:

1. For specified concrete strengths above 5,000 psi a reduction of 1 percentage point is allowed.
2. Grade 8 aggregate for use in extended course and extruded curbs, unless a larger size is approved by the City Engineer or designated representative.

#### 403S.8 - Mix Design Options

For the structural concretes identified in Table 5 (Class C) and any other class of concrete designed using more than 520 lbs. of cementitious material per cubic yard, one of the mix design options presented below shall be used.

For the non-structural concretes identified in Table 5 (Classes A, B, D, E, S, P, DC, CO and SS) and any other class of concrete designed using less than 520 lbs. of cementitious material per cubic yard, one of the mix design options presented below will be used, except that Class C fly ash may be used instead of Class F fly ash for Options 1, 3 and 4 unless a sulfate-resistant concrete is required.

- A. Option 1: Twenty (20) to thirty-five (35) percent of the cement may be replaced with Class F fly ash.
- B. Option 2: Thirty-five (35) to fifty (50) percent of the cement may be replaced with ground granulated blast-furnace slag.
- C. Option 3: Thirty-five (35) to fifty (50) percent of the cement may be replaced with a combination of Class F fly ash, ground granulated blast-furnace slag or silica fume. The combination may not include more than thirty-five (35) percent fly ash and no more than ten (10) percent silica fume.
- D. Option 4: Type IP or Type IS will be used and up to ten (10) percent of the cement may be replaced with Class F fly ash, ground granulated blast-furnace slag or silica fume.
- E. Option 5: Thirty-five (35) to fifty (50) percent of the cement may be replaced with a combination of Class C fly ash and at least six (6) percent of silica fume, ultra-fine fly ash or metakaolin. The combination may not include more than thirty-five (35) percent fly ash and no more than ten (10) percent silica fume.
- F. Option 6: A lithium nitrate admixture will be added at a minimum dosage of 0.55 gal. of thirty (30) percent lithium nitrate solution per pound of alkalis present in the hydraulic cement.
- G. Option 7: When hydraulic cement only is used in the design, the total alkali contribution from the cement in the concrete does not exceed 4.0 lbs. per cubic yard, when calculated as follows:  
  
alkali (lbs. per CY) = .01 (lbs cement/CY) (% Na<sub>2</sub>O equivalent in cement)  
  
where (% Na<sub>2</sub>O equivalent in cement) is assumed to be the maximum cement alkali content reported on the cement mill certificate.
- H. Option 8: When there are deviations from Options 1 through 7, the following shall be performed:
  1. Conduct tests on both coarse and fine aggregate separately in accordance with ASTM C-1260, using 440 g of the proposed cementitious in the same proportions of hydraulic cement to supplementary cementing material to be used in the mix.

2. Prior to use of the mix, a certified test report signed and sealed by a Professional Engineer, licensed in the state of Texas shall be submitted that demonstrates that ASTM C 1260 test results for each aggregate do not exceed 0.10 percent expansion.

#### 403S.9 - Mixing and Mixing Equipment

All equipment, tools and machinery used for hauling materials and performing any part of the work shall be maintained in such condition to insure completion of the work without excessive delays for repairs and replacement. Mixing shall be done in a mixer of approved type and size that will produce uniform distribution of material throughout the mass and shall be capable of producing concrete meeting requirements of ASTM C 94, Ready-mixed concrete and these specifications. Mixing equipment shall be capable of producing sufficient concrete to provide required quantities. Entire contents of the drum shall be discharged before any materials are placed therein for a succeeding batch. Improperly mixed concrete shall not be placed in a structure. For all mixers an adequate water supply and an accurate method of measuring the water shall be provided.

The concrete shall be mixed in quantities required for immediate use. Re-tempering of concrete will not be permitted unless concrete is delivered in a truck-mixer.

In threatening weather, which may result in conditions that will adversely affect quality of the concrete to be placed, the City Engineer or designated representative may order postponement of the work. Where work has been started and changes in weather conditions require protective measures, the Contractor shall furnish adequate shelter to protect the concrete against damage from rainfall, or freezing temperatures. If necessary to continue operations during rainfall, the Contractor shall also provide protective coverings for the material stock piles. Aggregate stockpiles need to be covered only to the extent necessary to control the moisture conditions in the aggregates to adequately control the consistency of the concrete.

The mixer may be batched by either volumetric or weight sensing equipment and shall be equipped with a suitable timing device that will lock the discharging mechanism and signal when specified time of mixing has elapsed.

##### A. Proportioning and Mixing Equipment

For all miscellaneous concrete placements, a mobile, continuous, volumetric mixer or a volumetric or weight batch mixer of the rotating paddle type may be used.

When approved by the City Engineer or designated representative in writing or when specified for use in other items, these mixers may be used for other types of concrete construction, including structural concrete, if the number of mixers furnished will supply the amount of concrete required for the particular operation in question.

These mixers shall be designed to receive all the concrete ingredients, including admixtures, required by the mix design in a continuous uniform rate and mix them to the required consistency before discharging.

For continuous volumetric mixers, the materials delivered during a revolution of the driving mechanism or in a selected interval, will be considered a batch and the proportion of each ingredient will be calculated in the same manner as for a batch type plant.

Mixing time shall conform to recommendations of manufacturer of mixer unless otherwise directed by the City Engineer or designated representative.

#### B. Ready-mixed Concrete

Use of ready-mixed concrete will be permitted provided the batching plant and mixer trucks meet quality requirements specified herein. When ready-mixed concrete is used, additional mortar (1 sack cement, 3 parts sand and sufficient water) shall be added to each batch to coat the mixer drum. Ready-mixed concrete, batching plant and mixer truck operation shall include the following:

1. A ticket system will be used that includes a copy for the Inspector. Ticket will have machine stamped time/date of concrete batch, a mix design designation, weight of cement, fly ash, sand and aggregates; exact nomenclature and written quantities of admixtures and water. Any item missing or incomplete on ticket may be cause for rejection of concrete.
2. Sufficient trucks will be available to support continuous placements. The Contractor will satisfy the City Engineer or designated representative that adequate standby trucks are available to support monolithic concrete placement requirements.
3. A portion of mixing water required by the mix design to produce the specified slump may be withheld and added at the job site, but only with permission of the City Engineer or designated representative and under the Inspector's observation. When water is added under these conditions, the concrete batch will be thoroughly mixed before any slump or strength samples are taken. Additional cement shall not be added at the job site to otherwise unacceptable mixes.
4. A metal plate(s) shall be attached in a prominent place on each truck mixer plainly showing the various uses for which it was designed. The data shall include the drum's speed of rotation for mixing and for agitating and the capacity for complete mixing and/or agitating only. A copy of the manufacturer's design, showing dimensions of blades, shall be available for inspection at the plant at all times. Accumulations of hardened concrete shall be removed to the satisfaction of the City Engineer or designated representative.
5. The loading of the transit mixers shall not exceed capacity as shown on the manufacturer's plate attached to the mixer or 63 percent of the drum volume, whichever is the lesser volume. The loading of transit mixers to the extent of causing spill-out en route to delivery will not be acceptable. Consistent spillage will be cause for disqualification of a supplier.
6. Excess concrete remaining in the drum after delivery and wash water after delivery shall not be dumped on the project site unless approval of the dump location is first secured from the City Engineer or designated representative.

#### C. Volumetric Batching

Use of volumetric batched concrete will be permitted provided the batching and continuous mixing operations conform to ASTM C 685, "Concrete Made By Volumetric Batching and Continuous Mixing." This type concrete shall be made from materials continuously batched by volume, mixed in a continuous mixer and delivered to the site in a freshly mixed and unhardened state. Tests and criteria for batching accuracy and mixing efficiency shall be as specified in ASTM C 685.

1. A ticket system will be used that includes a copy for the Inspector. The ticket will have machine stamped time/date of concrete batch, a mix design designation, weight of cement, fly ash, sand and aggregates; exact nomenclature and written quantities of admixtures and water. Any item missing or incomplete on ticket may be cause for rejection of concrete.
2. Each batching or mixing unit, or both, shall carry in a prominent place a metal plate or plates on which are plainly marked the gross volume of the unit in terms of mixed concrete, discharge speed and the weight-calibrated constant of the machine in terms of a revolution counter or other output indicator. The mixer shall produce a thoroughly mixed and uniform concrete.
3. The batcher-mixer unit shall contain in separate compartments all the necessary ingredients needed for the manufacture of concrete. The unit shall be equipped with calibrated proportioning devices to vary the mix proportions and it shall produce concrete as required by the Work and ASTM C 685.

#### D. Truck-mixed Concrete

The concrete shall be mixed in a truck mixer from 70 to 100 revolutions at the mixing speed designated by the manufacturer that will produce a uniform concrete mix. The concrete shall be delivered to the project in a thoroughly mixed and uniform mass and shall be discharged with a satisfactory degree of uniformity. Additional mixing at the job site, at the mixing speed designated by the manufacturer, may be allowed by the City Engineer or designated representative as long as the concrete is discharged before the drum has revolved a total of 300 revolutions after the introduction of the mixing water to the cement and the aggregates.

Re-tempering or adding concrete chemical admixtures is only permitted at the job site when concrete is delivered in a truck mixer. Water shall not be added after introduction of mixing water at the batch plant except on arrival at the job site with approval of the City Engineer or designated representative, in order to adjust the slump of the concrete. When this water is added, the mix design water-cementitious-material ratio shall not be exceeded. The drum or blades shall be turned at least 30 additional revolutions at mixing speed to ensure thorough and uniform mixing of the concrete. Water or chemical admixtures shall not be added to the batch after any concrete has been discharged.

When the concrete contains silica fume, mixing times and batching operations shall be adjusted as necessary to ensure that the material is completely and uniformly dispersed in the mix. The dispersion of the silica fume within the mix shall be verified in trial batches.

#### E. Hand-mixed Concrete

Hand mixing of concrete may be permitted for small placements or in case of an emergency and then only on authorization of the City Engineer or designated representative. Hand-mixed batches shall not exceed a 4 cubic foot batch in volume. Material volume ratios shall not be leaner than 1 part cement, 2 parts large aggregate, 1 part fine aggregate and enough water to produce a consistent mix with a slump not to exceed 4 inches. Admixtures shall not be used unless specifically approved by the City Engineer or designated representative.

#### 403S.10 - Excavation, Placing of Concrete, Finishing, Curing and Backfill

Excavation, placing of concrete, finishing, curing and backfill shall conform to Standard Specification Item No. 401S, "Structural Excavation and Backfill", Standard Specification Item No. 410S, "Concrete Structures" and Standard Specification Item No. 411S, "Surface Finishes for Concrete".

##### A. Placing Concrete in Cold Weather

Concrete may be placed when the atmospheric temperature is not less than 35°F. Concrete shall not be placed in contact with any material coated with frost or having a temperature less than 32°F.

#### 403S.11 - Measurement

Where measurement of concrete for a structure is not provided by another governing pay item, measurement shall be made under this specification in accordance with the following.

The quantities of concrete of the various classifications which constitute the completed and accepted structure or structures in place will be measured by the cubic yard, each, square yard, or linear foot as indicated in the Contract Documents. Measurement will be as follows:

##### A. General

1. Measurement based on dimensions shall be for the completed structure as measured in place. However, field-measured dimensions shall not exceed those indicated on the drawings or as may have been directed by the City Engineer or designated representative in writing.
2. No deductions shall be made for chamfers less than 2 inches in depth, embedded portions of structural steel, reinforcing steel, nuts, bolts, conduits less than 5 inches in diameter, pre/post tensioning tendons, keys, water stops, weep holes and expansion joints 2 inches or less in width.
3. No measurement shall be made for concrete keys between adjoining beams or prestressed concrete planks.
4. No measurement shall be made for fill concrete between the ends or adjoining prestressed concrete planks/box beams at bent caps or between the ends of prestressed concrete planks/box beams and abutment end walls.
5. No measurement shall be made for inlet and junction box invert concrete.
6. No measurement shall be made for any additional concrete required above the normal slab thickness for camber or crown.

B. Plan Quantity. For those items measured for plan quantity payment, adequate calculations have been made. If no adjustment is required by Article 403S.11, additional measurements or calculations will not be required or made.

C. Measured in Place. For those items not measured for Plan Quantity payment, measurement will be made in place, subject to the requirements of Article 403S.10.A.1 above.

403S.12 - Payment

The work performed and materials furnished as prescribed by this item and measured in accordance with the applicable provisions of "Measurement" above will be paid for as follows.

The quantity to be paid for will be that quantity indicated in the contract documents and/or shown on the drawings, regardless of errors in calculations, except as may be modified by the following.

Plan Quantities will be adjusted:

- A. When a complete structure element has been erroneously included or omitted from the drawings, the quantity shown on the drawings for that element will be added to or deducted from the plan quantity and included for payment. A complete structure element will be the smallest portion of a total structure for which a quantity is included on the drawings. Quantities revised in this manner will not be subject to the provisions of the "General Conditions", Article 11.
- B. When the plan quantity for a complete structure element is in error by 5 percent or more, a recalculation will be made, and the corrected quantity included for payment. Quantities revised in this manner will not be subject to the provisions of the "General Conditions", Article 11.
- C. When quantities are revised by a change in design, the "plan quantity" will be increased or decreased by the amount involved in the design change. Quantities revised in this manner will be subject to the provisions of the "General Conditions", Article 11.

The party to the contract requesting the adjustment shall present to the other, a copy of the description and location, together with calculations of the quantity for the structure element involved. When this quantity is certified correct by the City Engineer or designated representative, it will become the revised plan quantity.

Payment for increased or decreased costs due to a change in design on those items measured as "Cubic Yard", "Each", "Square Foot", "Square Yard" or "Linear Foot" will be determined by Change Order. Quantities revised in this manner will be subject to the provisions of the "General Conditions", Article 11.

The unit prices bid for the various classes of concrete shown shall include full compensation for furnishing, hauling, and mixing all concrete material; placing, finishing and curing all concrete; all grouting, pointing and finishing; furnishing and placing drains; furnishing and placing metal flashing strips; furnishing and placing expansion joint material required by this item; and for all forms and false work, labor, tools, equipment and incidentals necessary to complete the work.

<b>Pay Item No. 403S-CY:</b>	(Structure or Structural Component)	Per Cubic Yard.
<b>Pay Item No. 403S-EA:</b>	(Structure or Structural Component)	Per Each.
<b>Pay Item No. 403S-SY:</b>	(Structure or Structural Component)	Per Square Yard.
<b>Pay Item No. 403S-LF:</b>	(Structure or Structural Component)	Per Lineal Foot.

END

## ITEM NO. 404S - PNEUMATICALLY PLACED CONCRETE

### 404S.1 - Description

This item shall govern furnishing and placing of "Pneumatically Placed Concrete" for riprap, concrete channel, canal lining, tunnel lining, encasement of designated structural steel members, covering of designated portions of concrete structures, repair of deteriorated or damaged concrete and other miscellaneous construction as indicated on the drawings.

### 404S.2 - Submittals

The submittal requirements of this specification item may include:

- A. Mix design of the class (Type I or Type II) of concrete required on the project (encasement, repair, rip-rap, ditch lining),
- B. Application process (wet or dry),
- C. Work experience of the superintendent and workers performing specialized tasks to be employed on the project, and
- D. Type of Expansion joint material to be used on the project.

### 404S.3 - Materials

Unless indicated otherwise on the drawings, Class II Portland cement concrete shall be used for encasement and Class I Portland cement concrete shall be used for repair.

Cement, water and sand shall conform to the requirements of Standard Specification Item No. 403S, "Concrete for Structures." Specifically, the fine aggregate shall conform to the requirements of Table 2 and the coarse aggregate shall conform to the requirements of Table 1, Grade 7, unless otherwise indicated on the drawings.

Air entraining admixtures, retarders and water reducing admixtures, if used, shall comply with Standard Specification Item No. 405S, "Concrete Admixtures."

Bar reinforcement and wire fabric reinforcement shall conform to Standard Specification Item No. 406S, "Reinforcing Steel."

Expansion joint material shall conform to the requirements of Standard Specification Item No. 410S, "Concrete Structures."

Steel drive pins, studs or expansion bolts used for the attachment of reinforcing when covering designated portions of concrete structures with pneumatically placed concrete shall be capable of being driven to the specified depth without deforming or otherwise becoming unsuitable for the purpose intended. The pins shall have a minimum diameter of 1/8 inch and a minimum length of 2 inches. Size and location of drive pins or studs and method of attachment of reinforcing shall be as indicated on the drawings.

The equipment used for driving the pins or studs shall be of the type, which uses an explosive for the driving force, and shall be capable of inserting the stud or pin to the required depth without damage to the surrounding concrete. The Engineer or designated representative may require that a test be made of the equipment prior to approving it for use.



Expansion hook bolts, 1/4-inch diameter, shall be placed in a drilled hole of the size and depth recommended by the manufacturer. The Engineer or designated representative may require that a test be made of the driving equipment for steel drive pins and check the pull-out quality of the expansion bolts, prior to approving their use.

#### 404S.4 - Proportioning and Mixing

The Contractor shall submit a mix design for approval by the Engineer or designated representative. The basic mix design shall conform to the following table:

**TABLE I**

	<b>*Minimum of 1</b>	<b>Minimum 7 Day Compressive</b>
<b>Type</b>	<b>Part Cement to</b>	<b>Strength Cores</b>
I	4 Parts Aggregate	2520 psi
II	5 Parts Aggregate	2100 psi
III	7 Parts Aggregate	1400 psi

\* The Contractor may use a design containing more cement than required by this specification, when approved by the Engineer or designated representative.

The cement and aggregates shall be measured by volume with enough water added to bring the materials to the desired consistency. Test panels will be required prior to approval of the mix design. The concrete will be applied to a plywood panel and shall be a minimum size of 18 inches x 18 inches x 3 inches in depth. The panel will be shot with the same air pressure and nozzle tip to be used for the production work. The panel will be cured in the same manner required for the particular usage required by the contract.

Three 2-inch diameter cores will be taken from each panel and tested in compression at 7 days. The average strength of the cores shall be the strengths required in Table I. Testing of cores shall conform to TxDOT Test Method Tex-424-A.

The Engineer or designated representative may require additional test panels during the progress of the work if there is any change in materials, equipment or nozzle operator.

If, in the opinion of the Engineer, the cylinder strengths are indicating undesirable variation in the concrete, the Contractor may be required to change the mix design and/or method of placement so as to correct this condition.

Mixing and application may be done by either the dry mix or wet mix process. The materials shall be thoroughly and uniformly mixed using a mixer designed for pneumatic concrete application. It may be either a paddle type or drum type mixer. Transit mix concrete may be used for the wet process. No water shall be added to the mix after mixing and before application. Mixed material that has not been used within 45 minutes shall be rejected and no remixing or tempering will be permitted.

All mixing and placing equipment shall be cleaned at regular intervals and be kept in acceptable working condition. The nozzle liner water and air injection system should be inspected daily and replaced when the parts are worn.

#### 404S.5 - Construction Methods

##### A. Surface Preparation

All surfaces on which pneumatically placed concrete is to be placed shall be cleaned thoroughly of all paint, rust, loose mill, scales, grease and such other foreign materials which are likely to prevent adequate bond. Structural steel to be encased with pneumatically placed concrete shall not be painted. Concrete and reinforcing steel surfaces to be covered with pneumatically placed concrete shall be abrasion blasted clean and then the surface cleaned of loose material with filtered compressed air.

Concrete surfaces on which pneumatically placed Portland Cement (PC) concrete is to be applied shall be thoroughly moistened by wetting prior to placement. Excess water shall be allowed to drain or shall be removed by filtered air blasting.

Where standing or running water is encountered it shall be removed before applying the PC concrete.

The periphery of repair areas shall be saw cut 1 inch deep and existing concrete removed as necessary to prevent feathered edges.

Concrete adjacent to a crack shall be removed in such a manner as to leave the existing reinforcing steel throughout the repair area as intact as possible.

##### B. Reinforcement

All reinforcement to be embedded in pneumatically placed concrete shall be clean and free from loose mill scale, rust, oil or other coatings which might prevent adequate bond.

Reinforcement shall be secured rigidly in the position indicated. The clear distance between reinforcing bars shall be at least 2 ½ inches.

Minimum clear distance between forms and reinforcement and for cover shall be as indicated on the drawings. Space shall be provided for splicing bars in the approved manner.

For the covering of designated portions of concrete structures, welded wire fabric shall be held securely about ¾ inch out from the surface to be covered. Adjacent sheets shall lap at least 6 inches and sheets shall be fastened together securely by tying at intervals not to exceed 18 inches. In attaching the wire fabric, steel drive pins spaced at 2 feet on centers each way shall be driven to a penetration of not less than 1 inch or ¼-inch hook bolts installed conforming to manufacturer's recommendation into the face of the designated portion to be covered or repaired. The wire fabric shall be fastened securely to each pin or bolt. Any pin that does not reach the desired depth or hook bolt that does not anchor properly in its hole may remain in place but must be supplemented by an additional pin or bolt installation meeting specification requirements. The welded wire fabric shall have a minimum of 1 inch cover to the finished concrete surface.

For the encasement of designated portions of steel structures, the welded wire fabric shall be bent to a template to conform as nearly as possible to the outlines of the steel members to be encased. Drilled holes not less than 1/2 inch nor more than 1 inch in diameter shall be provided in the webs of the members as near as practicable to the flanges for the purpose of attaching the reinforcing fabric. These holes shall be spaced approximately 3 feet on center. The welded wire fabric shall be held securely about 3/4 inch out from the surfaces of the members to be encased. Adjacent sheets shall lap at least 6 inches and sheets shall be fastened together securely by tying at intervals not to exceed 18 inches. In placing the wire fabric, 3/8 inch round rods shall be fastened to the structural steel through the holes provided in the webs of the members to be encased and the fabric shall be tied securely outside to rods. Ties shall be spaced approximately 12 inches on centers. The formed fabric shall conform, insofar as possible, to the shape of the structural member with a space of 3/4 inch between the fabric and the faces of the members to be encased.

#### C. Placing of Pneumatically Placed Concrete

Proper consistency shall be controlled at the nozzle valve by the operator for the dry mix process and a low water-cement ratio must be maintained. The consistency of the mix and the water shall be controlled by the mixer pump or by the transit mix truck when used for the wet mix process. The mix shall be sufficiently wet to adhere properly and sufficiently dry so that it will not sag or fall from vertical or inclined surfaces or separate in horizontal work.

No work shall be done without the permission of the Engineer or designated representative when the temperature is lower than 35°F. Concrete shall not be applied to a surface containing frost or ice. After placing, the concrete shall be protected from freezing and/or quick drying. Except by specific written authorization of the Engineer or designated representative, concrete shall not be placed when the temperature is below 40°F and falling but may be placed when the temperature is above 35°F and rising, the temperature being taken in the shade and away from artificial heat.

When encasing structural steel members or covering portions of structures the concrete may be applied in 1 coat; however, if the concrete, after being placed, shows any tendency to sag, it shall be applied in 2 or more coats. Pneumatically placed concrete for overhead work shall be placed in 2 or more coats as may be necessary to ensure proper bond and to eliminate sag. In covering vertical surfaces, placing of the concrete shall begin at the bottom and be completed at the top.

Any sag or other defects shall be corrected to proper section by the Contractor at the Contractor's own expense and as directed by the Engineer or designated representative.

The nozzle shall be held at an approximate distance of 2 to 4 feet and positioned so that the stream of flowing concrete shall impinge as nearly as possible at right angles to the surface being covered. Any deposit of loose sand shall be removed prior to placing any initial or succeeding layers of pneumatically placed concrete. When any deposit of loose sand is covered with pneumatically placed concrete, the concrete shall be removed and replaced with a new coat of pneumatically placed concrete after the receiving surface has been properly cleaned.

Before channel or canal lining or riprap is placed, the earth canal or channel slopes shall have been compacted uniformly and thoroughly and brought to a uniform moist condition. The subgrade for lining shall be excavated and fine graded to the required section. The use of forms for lining will not be required. The surfaces of pneumatically placed concrete for both channel lining and riprap shall be finished accurately by hand floating methods before the concrete has attained its initial set.

The original surface and the surface of each layer, which is permitted to harden before applying succeeding layers, shall be washed with water and filtered air blast or a stiff hose stream and loosened material removed. Any material which rebounds and does not fall clear of the work or which collects on horizontal surfaces shall be blown off from time to time to avoid leaving sand pockets.

D. Curing

Encasements shall be water cured for four curing days.

For curing, the repair area shall have a piece of wet cotton mat taped into place over the repaired area followed with a covering of 4 mil minimum sheet plastic also taped into place. The sheet plastic shall be larger than the mat and shall be continuously taped at the edges with 3-inch Reinforcement minimum width tape (air duct tape or better) to completely enclose the mat and hold in the moisture. After 4 days or longer the mat and cover may be removed.

After the curing period the patches will be tested by striking with a hammer to check for soundness and bond to existing concrete.

E. Riprap and Ditch Lining

Pneumatically placed concrete for riprap and for channel or canal linings shall be the type indicated on the drawings. The concrete shall be placed to the limits indicated on the drawings or as designated by the Engineer or designated representative. The surface shall be given a wood float finish or a gun finish as directed by the Engineer or designated representative. Curing of riprap and/or ditch lining shall be by either Type I or II membrane conforming to Standard Specification Item No. 409S, "Membrane Curing."

F. Operating Requirements for the Dry Mix Process

The compressor or blower used to supply air shall be capable of delivering a sufficient volume of oil free air at a pressure range of 40 to 85 psi as required by the size of the nozzle employed. Required capacity of compressor and operating pressures are shown in Table 2 for the various nozzle sizes. Steady pressure must be maintained throughout the placing process. The water pump shall be of sufficient size and capacity to deliver the water to the nozzle at a pressure of not less than 15 psi in excess of the required air pressure.

G. Operating Requirements for the Wet Mix Process

The pump shall operate so that the line pressure is between 100 psi and 300 psi for delivery hoses with 1½-inch to 3-inch diameters. The mixing equipment shall be capable of thoroughly mixing the materials in sufficient quantity to maintain continuous placement. When transit mix concrete is used, this equipment shall conform to Standard Specification Item No. 403S, "Concrete for Structures."

**Table 2 COMPRESSOR CAPACITIES**

<b>Compressor Capacity Cubic Feet per Minute</b>	<b>Hose Diameter inches</b>	<b>Maximum Size of Nozzle Tip, Inches</b>	<b>Operating Air Pressure Available, Psi</b>
250	1	3/4	40

<b>Compressor Capacity Cubic Feet per Minute</b>	<b>Hose Diameter inches</b>	<b>Maximum Size of Nozzle Tip, Inches</b>	<b>Operating Air Pressure Available, Psi</b>
315	1¼	1¼	45
365	1½	1¼	55
500	1 5/8	1½	65
600	1¾	1 5/8	75
750	2	1¾	85

The values shown in Table 2 are based on a hose length of 150 feet with the nozzle not more than 25 feet above the delivery equipment. Operating pressures shall be increased approximately 5 psi for each additional 50 feet of hose and approximately 5 psi for each 25 feet the nozzle is raised.

H. Rebound

Accumulation of loose particles of concrete, which do not adhere to the surface being covered, shall be removed and discarded. Concrete shall not be placed over such material.

I. Construction Joints

Particular care shall be given to the formation of construction joints. Unless otherwise indicated on the drawings, all joints subject to compressive stress or over existing construction joints shall be square butt joints. Tapered joints will be permitted at other locations except the outside 1 inch shall be perpendicular to the surface.

J. Workers

Only experienced superintendents and workers performing specialized tasks shall be employed. Satisfactory written evidence of such experience shall be furnished to the Engineer or designated representative upon demand.

404S.6 - Measurement

Measurement of pneumatically placed concrete for encasement of structural steel members, will be by the square foot, in place, of the actual contact area.

Measurement of pneumatically placed concrete for repair and restoration of concrete structures, tunnel linings and miscellaneous structures will be by the cubic yard in place using the surface area times the average depth of the patch.

Measurement of pneumatically placed concrete for riprap and ditch lining, shall conform to Standard Specification Item No. 591S, "Riprap for Slope Protection."

404S.7 - Payment

Pneumatically placed concrete, measured as provided above, will be paid for at the unit price bid per square foot or cubic yard for "Pneumatically Placed Concrete" of the type specified.

The unit price bid per square foot shall be full compensation for all cement, aggregate, water, reinforcement, furnishing and driving all steel drive pins, for mixing, placing and curing pneumatically placed concrete and for all labor, tools, equipment and incidentals necessary to complete the work. Excavation for channel and canal lining will be paid for conforming to Standard Specification Item No. 120S, "Channel Excavation." Shaping and fine grading of channel or canal slopes and floors and excavation required for shaping slopes for headerbanks will not be paid for directly but shall be included in the unit price bid for "Pneumatically Placed Concrete." When headerbanks upon which "Pneumatically Placed Concrete" is to be placed have been built by prior contract, excavation for shaping or slopes will be paid for conforming to Item No. 401S, "Structural Excavation and Backfill."

Payment will be made under:

<b>Pay Item No. 404S-A:</b>	_____ Inch Pneumatically Placed Concrete	Per Square Foot.
<b>Pay Item No. 404 S-B:</b>	Pneumatically Placed concrete	Per Cubic Yard.

END

## ITEM NO. 405S - CONCRETE ADMIXTURES

### 405S.1 - Description

This item shall govern material requirements of admixtures for Portland Cement (PC) concrete.

### 405S.2 - Submittals

The submittal requirements of this specification item include:

- A. Type and manufacturer of any proposed admixture.
- B. Certification that proposed admixture meet the requirements of this specification, ASTM C260 and ASTM C494.
- C. For a specific mix design, a statement of compatibility of products shall be submitted when admixtures from multiple manufacturers are proposed.

### 405S.3 - Materials

All admixture submittals must be approved by the Engineer or designated representative. No admixture shall be chloride-based or have chloride(s) added in the manufacturing process. Admixtures must be pretested by the Texas Department of Transportation (TxDOT) Materials and Tests Engineer and be included in the State's current approved admixture list. All admixtures must retain an approved status through the duration of a mix design's one-year approval period.

#### (1) Air Entraining Admixture:

An "Air Entraining Admixture" is defined as a material which, when added to a concrete mixture in the proper quantity, will entrain uniformly dispersed microscopic air bubbles in the concrete mix. The admixture shall meet the requirements of ASTM Designation: C 260 modified as follows:

- (a) The cement used in any series of test shall be either the cement proposed for the specific work or a "reference" Type I cement from one mill.
- (b) The air entraining admixture used in the reference concrete shall be Neutralized Vinsol Resin.

#### (2) Water-reducing Admixture:

A "Water-reducing Admixture" is defined as a material which, when added to a concrete mixture in the correct quantity, will reduce the quantity of mixing water required to produce concrete of a given consistency and required strength. This admixture shall conform to ASTM C 494, Type A.

#### (3) Accelerating Admixture:

An "Accelerating Admixture" is defined as an admixture that accelerates the setting time and the early strength development of concrete. This admixture shall conform to ASTM C 494, Type C. The accelerating admixture will contain no chlorides.

#### (4) Water-reducing, Retarding Admixture:

A "Water-reducing, Retarding Admixture" is defined as a material which, when added to a concrete mixture in the correct quantity, will reduce the quantity of mixing water required to produce concrete

of a given consistency and retard the initial set of the concrete. This admixture shall conform to ASTM C 494, Type D.

(5) High-range Water Reducing Admixtures:

A "High-range Water Reducing Admixture", referred to as a superplasticizer, is defined as a synthetic polymer material which, when added to a low slump concrete mixture increases the slump without adversely affecting segregation, impermeability or durability of the mix. This admixture shall conform to ASTM C 494, Type F or G.

(6) Fly Ash:

Fly ash used in PC concrete as a substitute for Portland cement or as a mineral filler shall comply with TxDOT Materials Specification D-9-8900 and be listed on TxDOT's current list of approved fly ash sources. Fly ash obtained from a source using a process fueled by hazardous waste (30 Texas Administrative Code, Section 335.1) shall be prohibited. This applies to any other specification concerning the use of fly ash. Contractor shall maintain a record of source for each batch. Supplier shall certify that no hazardous waste is used in the fuel mix or raw materials.

#### 405S.4 - Certification and Product Information

The Contractor shall submit the name of the admixture proposed and manufacturer's certification that the selected admixtures meet the requirements of this item and of ASTM C 260 and C 494 as applicable. Admixtures for a mix design shall be of the same brand. If more than one admixture is proposed in the concrete mix, a statement of compatibility of components shall accompany certification. Manufacturer's product literature shall specify when in the batching/mixing operation the admixture must be added.

The Engineer or designated representative may request additional information such as infrared spectrophotometry scan, solids content, pH value, etc., for further consideration. Any unreported changes in formulation discovered by any of the tests prescribed herein may be cause to permanently bar the manufacturer from furnishing admixtures for Owner's work.

#### 405S.5 - Construction Use of Admixtures

All admixtures used shall be liquid except high-range water reducers which may be a powder. Liquid admixtures shall be agitated as needed to prevent separation or sedimentation of solids; however, air agitation of Neutralized Vinsol Resin will not be allowed.

No admixture shall be dispensed on dry aggregates. Admixtures shall be dispensed at the batching site separately, but at the same time as the mixing water. Only high range water reducers may be introduced into the mix at the job site.

When other admixtures are used with fly ash, the amount of the other admixture to be used shall be based on the amount of Portland cement only and not the amount of Portland cement and fly ash.

When high-range water reducers are to be added at the job site, transit mixers shall be used. Admixture manufacturer literature shall indicate recommended mixing methods and time for the specific equipment and mix design used. The transit mix equipment shall not be loaded in excess of 63 percent of its rated capacity to ensure proper mixing of the admixture at the site. If during discharging of concrete a change in slump in excess of 30% is noted, the remaining concrete shall be rejected unless prior approval was given by the Engineer or designated representative to retemper a load with a second charge of admixture. Retempering with water shall not be allowed.



Accelerating admixtures will not be permitted in combination with Type II cement.

All mixes with air entrainment shall have a minimum relative durability factor of 80 in accordance with ASTM C 260. Dosage of air entrainment admixtures may be adjusted by the Contractor to stay within the specified tolerances for air entrainment of Standard Specification Item No. 403S, "Concrete for Structures".

#### 405S.6 - Measurement and Payment

The requirements of these specifications shall not be measured and paid for directly, but shall be included in the unit price bid for the item of construction in which this item is used.

**END**

## ITEM NO. 406S - REINFORCING STEEL

### 406S.1 - Description

This item shall govern furnishing and placement of reinforcing steel, deformed and smooth, of the size and quantity indicated on the drawings and in accordance with these specifications.

### 406S.2 - Submittals

Within 14 days prior to the commencement of related work, the Contractor shall electronically submit the following submittal requirements:

- A. Evidence that the steel reinforcement producer is included on the TxDOT list of approved producing mills
- B. Listing of the size, grade, type and quantity of reinforcing steel proposed for the project.
- C. If welding of reinforcing steel is proposed, evidence that carbon equivalent (CE) of the proposed steel is at least 0.55% with a report of chemical analysis showing the percentages of elements necessary to establish CE
- D. If epoxy coated steel is proposed, evidence that the steel reinforcement producer is included on the TxDOT list of approved epoxy coating applicators
- E. If epoxy coated steel is proposed, written certification that the epoxy-coated reinforcing steel meets the requirements of this Item with a copy of the manufacturer's control tests.
- F. When mechanical splices are proposed, the types of couplers proposed for use.

### 406S.3 - Materials

#### A. Approved Mills

Prior to furnishing reinforcing steel, the producing mills must be included on the list of approved producing mills that is maintained by the Construction Division of the State of Texas Department of Transportation

#### B. Deformed Bars and Wire Reinforcement

Unless indicated otherwise on the drawings, Bar reinforcement shall be Grade 60 and deformed. Reinforcing steel must conform to one of the following:

ASTM A615/615M, Grades 40 or 60 (300 or 420)

ASTM A996/996M, Type A, Grades 40 or 60 (300 or 420)

ASTM A996/996M, Type R, Grade 60 (420), permitted in concrete pavement only (furnished as straight bars only without bends. Bend tests are not required.)

ASTM A706/706M

In cases where the provisions of this item are in conflict with the provisions of the ASTM Designation to which reference is made, the provisions of this item shall govern.

The nominal size, area and weight of reinforcing steel bars covered by these specifications are as follows:

Bar Size Number 1/8 ins	Nominal Diameter, inches	Nominal Area, Sq. ins.	Weight/Linear Foot Lbs.
2	0.250	0.05	0.167
3	0.375	0.11	0.376
4	0.500	0.20	0.668
5	0.625	0.31	1.043
6	0.750	0.44	1.502
7	0.875	0.60	2.044
8	1.000	0.79	2.670
9	1.128	1.00	3.400
10	1.270	1.27	4.303
11	1.410	1.56	5.313
14	1.693	2.25	7.65
18	2.257	4.00	13.60

Smooth, round bars shall be designated by size number through a No. 4. Smooth bars above No. 4 shall be designated by diameter in inches.

C. Smooth Bar and Spiral Reinforcement

Smooth bars and dowels for concrete pavement must have a minimum yield strength of 60 ksi and meet ASTM A615/615M. Smooth bars that are greater in diameter than a No. 4 designation shall conform to ASTM A615 or meet the physical requirements of ASTM A36.

Spiral reinforcement shall be either smooth or deformed bars or wire of the minimum size or gauge indicated on the drawings. Bars for spiral reinforcement shall comply with ASTM A615 Grade 40(300), ASTM A996, Type A, Grade 40 (300); or ASTM A675, Grade 80(550), meeting dimensional requirements of ASTM A615. Smooth wire shall comply with ASTM A82, and deformed wire shall comply with ASTM A496.

D. Weldable Reinforcing Steel

Reinforcing steel to be welded must comply with ASTM A706 or have a carbon equivalent (CE) of at most 0.55%. A report of chemical analysis showing the percentages of elements necessary to establish CE is required for reinforcing steel that does not meet ASTM A706 to be structurally welded. No tack welding will be allowed. All welding shall conform to the requirements of AWS D1.1/D1.1M.

Carbon Equivalent (CE) shall be calculated as follows:

$$CE = \%C + 1.67*(\% Mn) + .025*(\% Cu) + .05*(\% Ni) + .01*(\%Cr) - .02*(\%Mo) - .1*(\%V)$$

Where C is carbon,

Mn is manganese

Cu is copper

Ni is nickel

Cr is chromium

Mo is molybdenum, and

V is vanadium.

The requirements above do not apply to the following miscellaneous welding applications:

Splicing reinforcing steel to extend bars in the bottom of a drilled shaft;

Attaching chairs to the reinforcing steel cage of a drilled shaft;

Armor joints and their supports;

Screed rail and form hanger supports where permitted on steel units;

Reinforcing steel to R-bars for lateral stability between prestressed beams, spirals, or bands of reinforcing bars in drilled shaft cages;

Permanent bridge deck forms;

Steel added in railing when slip-form construction is used; and

Other similar miscellaneous members that have no load carrying capacity in the completed structure.

#### E. Welded Wire Fabric

Wire shall conform to the requirements of the Standard Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement, ASTM A82 or A 496. Wire fabric, when used as reinforcement, shall conform to ASTM A185 or A497.

When wire is ordered by size numbers, the following relation between size number, diameter in inches and area shall apply unless otherwise indicated on the drawings:

<b>Size, W Number 1/100 in <sup>2</sup></b>	<b>Nominal Diameter inch</b>	<b>Nominal Area, sq. inches</b>
31	0.628	0.310
30	0.618	0.300
28	0.597	0.280
26	0.575	0.260
24	0.553	0.240
22	0.529	0.220
20	0.505	0.200
18	0.479	0.180
16	0.451	0.160
14	0.422	0.140
12	0.391	0.120
10	0.357	0.100
8	0.319	0.080
7	0.299	0.070
6	0.276	0.060
5.5	0.265	0.055
5	0.252	0.050
4.5	0.239	0.045
4	0.226	0.040
3.5	0.211	0.035

Size, W Number 1/100 in <sup>2</sup>	Nominal Diameter inch	Nominal Area, sq. inches
3	0.195	0.030
2.5	0.178	0.025
2	0.160	0.020
1.5	0.138	0.015
1.2	0.124	0.012
1	0.113	0.010
0.5	0.080	0.005

Where deformed wire is required, the size number shall be preceded by D and for smooth wire the prefix W shall be shown.

Welded wire fabric shall be designated as follows: 6 x 12 - W16 x W8, which indicates a 6 in longitudinal wire spacing and 12-in transverse wire spacing with smooth No. 16 (103) wire longitudinally and smooth no. 8 (52) wire transversely.

F. Epoxy Coating

Epoxy coating shall be required as indicated on the drawings. Prior to furnishing epoxy-coated reinforcing steel, the epoxy applicator must be included on the list of approved applicators that is maintained by the Construction Division of the State of Texas Department of Transportation.

The reinforcing steel shall be epoxy coated in accordance with the following.

**Epoxy Coating Requirements for Reinforcing Steel**

Material	Specification
Bar	ASTM A775 or A934
Wire or Fabric	ASTM A884 Class A or B
Mechanical Coupler	As indicated on the drawings
Hardware	As indicated on the drawings

The epoxy coating material and coating repair material shall comply with TxDOT's DMS-8130, "Epoxy Powder Coating for Reinforcing Steel". The applicator shall not patch more than 1/4 inch total length in any foot at the applicator's plant.

The epoxy-coated reinforcing steel shall be sampled and tested in accordance with TxDOT Test Method Tex-739-I, "Sampling and Testing Epoxy Coated Reinforcing Steel".

The identification of all reinforcing steel shall be maintained throughout the epoxy coating and fabrication and until delivery to the project site.

Written certification that the epoxy-coated reinforcing steel meets the requirements of this Item shall be provided along with a copy of the manufacturer's control tests.

**G. Mechanical Couplers**

When mechanical splices in reinforcing steel bars are indicated on the drawings, the following types of couplers may be used:

Sleeve-filler

Sleeve-threaded

Sleeve-swaged, or

Sleeve-wedge.

**H. Chairs and Supports**

Chairs and Supports shall be steel, precast mortar or concrete blocks cast in molds meeting the approval of the Engineer or designated representative of sufficient strength to position the reinforcement as indicated on the drawings when supporting the dead load of the reinforcement, the weight of the workers placing concrete and the weight of the concrete bearing on the steel. Chairs shall be plastic coated when indicated on the drawings.

<b>Chair Types and Applicable Uses</b>	
Structural or Architectural Elements (columns, beams, walls, slabs) exposed to weather, not subjected to sand blasting, water blasting or grinding.	Galvanized steel or steel chairs with plastic coated feet.
Structural or Architectural Elements exposed to weather and subject to sand blasting, water blasting or grinding.	Stainless steel chairs.
Structural or Architectural Elements not exposed to weather or corrosive conditions.	Uncoated steel chairs

<b>Chair Types and Applicable Uses</b>	
Slabs and grade beams cast on grade.	Steel chairs with a base with 9 inch <sup>2</sup> minimum area or sufficient area to prevent the chair from sinking into fill or subgrade. Precast mortar or concrete blocks meeting

406S.4 - Bending

The reinforcement shall be bent cold, true to the shapes indicated on the drawings. Bending shall preferably be done in the shop. Irregularities in bending shall be cause for rejection. Improperly fabricated, damaged or broken bars shall be replaced at no additional expense to the City. Damaged or broken bars embedded in a previous concrete placement shall be repaired using a method approved by the Engineer or designated representative.

Unless otherwise indicated on the drawings, the inside diameter of bar bends, in terms of the nominal bar diameter (d), shall be as follows:

Bends of 90 degrees and greater in stirrups, ties and other secondary bars that enclose another bar in the bend.

<b>Bar Number in 1/8 inches</b>	<b>Diameter</b>
3, 4, 5	4d
6, 7, 8	6d

All bends in main bars and in secondary bars not covered above.

<b>Bar Number in 1/8 inches</b>	<b>Diameter</b>
3 thru 8	6d
9, 10, 11	8d
14, 18	10d



#### 406S.5 - Tolerances

Fabricating tolerances for bars shall not be greater than shown on Standard (Detail) 406S-1 "Reinforced Steel Tolerances".

#### 406S.6 - Storing

Steel reinforcement shall be stored above the surface of the ground upon platforms, skids or other supports and shall be protected as far as practicable from mechanical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the work, reinforcement shall be free from dirt, paint, grease, oil or other foreign materials. Reinforcement shall be free from injurious defects such as cracks and laminations. Rust, surface seams, surface irregularities or mill scale will not be cause for rejection, provided the minimum dimensions, cross sectional area and tensile properties of a hand wire brushed specimen meets the physical requirements for the size and grade of steel indicated on the drawings.

#### 406S.7 - Splices

Splicing of bars, except when indicated on the drawings or specified herein, will not be permitted without written approval of the Engineer or designated representative. No substitution of bars will be allowed without the approval of the Engineer or designated representative. Any splicing of substituted bars shall conform to the requirements in the Table below.

Splices not indicated on the drawings will be permitted in slabs not more than 15 inches in thickness, columns, walls and parapets.

Splices will not be permitted in bars 30 feet or less in plan length unless otherwise approved. For bars exceeding 30 feet in plan length, the distance center to center of splices shall not be less than 30 feet minus 1 splice length, with no more than 1 individual bar length less than 10 feet. Splices not indicated on the drawings, but permitted hereby, shall conform to the Table below. The specified concrete cover shall be maintained at such splices and the bars placed in contact and securely tied together.

<b>Minimum Lap Requirements</b>		
<b>Bar Number in 1/8 inches</b>	<b>Uncoated Lap Length</b>	<b>Coated Lap Length</b>
3	1 foot 4 inches	2 foot 0 inches
4	1 foot 9 inches	2 foot 8 inches
5	2 foot 2 inches	3 feet 3 inches
6	2 foot 7 inches	3 feet 11 inches
7	3 feet 5 inches	5 feet 2 inches
No. 8	4 feet 6 inches	6 feet 9 inches

No. 9	5 feet 8 inches	8 feet 6 inches
No. 10	7 feet 3 inches	10 feet 11 inches
No. 11	8 feet 11 inches	13 feet 5 inches

Spiral steel shall be lapped a minimum of 1 turn. Bar No. 14 and No. 18 may not be lapped.

Welded wire fabric shall be spliced using a lap length that includes an overlap of at least 2 cross wires plus 2 inches on each sheet or roll.

Splices using bars that develop equivalent strength and are lapped in accordance with the table above are permitted.

Welding of reinforcing bars may be used only where indicated on the drawings or as permitted herein. All welding operations, processes, equipment, materials, quality of work and inspection shall conform to the requirements indicated on the drawings. All splices shall be of such dimension and character as to develop the full strength of the bar being spliced.

End preparation for butt-welding reinforcing bars shall be done in the field, except Bar No. 6 and larger shall be done in the shop. Delivered bars shall be of sufficient length to permit this practice.

For box culvert extensions with less than 1 foot of fill, the existing longitudinal bars shall have a lap with the new bars as shown in the table above. For box culvert extensions with more than 1 foot of fill, a minimum lap of 12 inches will be required.

Unless otherwise indicated on the drawings, dowel bars transferring tensile stresses shall have a minimum embedment equal to the minimum lap requirements shown in the table above. Shear transfer dowels shall have a minimum embedment of 12 inches.

#### 406S.8 - Placement

Reinforcement shall be placed as near as possible in the position indicated on the drawings. Unless otherwise indicated on the drawings, dimensions shown for reinforcement are to the centers of the bars. In the plane of the steel parallel to the nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of the spacing between bars. In the plane of the steel perpendicular to the nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch. Cover of concrete to the nearest surface of steel shall be as follows:

	Minimum Cover, Inches
(a) Concrete cast against and permanently exposed to earth	3
(b) Concrete exposed to earth or weather:	
Bar No. 6 (19) through No. 18 bars (57)	2
Bar No. 5 (16), W31 (W200) or D31 (D200) wire and smaller	1½

	<b>Minimum Cover, Inches</b>
(c) Concrete not exposed to weather or in contact with ground:	
Slabs, walls, joists:	
Bar No. 14 (43) and 18 (57)	1½
Bar No. 11 (36) and smaller	1
Beams, columns:	
Primary reinforcement, ties, stirrups, spirals	1 ½
Shells, folded plate members:	
Bar No. 6 (19) and larger	1
Bar No. 5 (16), W31 (W200) or D31 (D200) wire, and smaller	1

Vertical stirrups shall always pass around the main tension members and be attached securely thereto.

The reinforcing steel shall be located accurately in the forms and held firmly in place before and during concrete placement by means of bar supports that are adequate in strength and number to prevent displacement and to keep the steel at the required distance from the form surface. Bars shall be supported by means of approved galvanized metal spacers, metal spacers with plastic coated tips, stainless steel spacers, plastic spacers or approved precast mortar or concrete blocks when supports are in contact with removable or stay-in-place forms. Bright basic bar supports shall be used to support reinforcing steel placed in slab overlays on concrete panels or on existing concrete slabs. Bar supports in contact with soil or subgrade shall be approved.

For bar supports with plastic tips, the plastic protection must be at least 3/32 in thick and extend upward on the wire to a point at least 1/2 in above the formwork.

For approval of plastic spacers on a project, representative samples of the plastic shall show no visible indications of deterioration after immersion in a 5 percent solution of sodium hydroxide for 120 hours.

All accessories such as tie wires, bar chairs, supports, or clips used with epoxy-coated reinforcement shall be of steel, fully coated with epoxy or plastic. When approved by the Engineer or designated representative, plastic supports may also be used with epoxy-coated reinforcement.

All reinforcing steel shall be tied at all intersections, except that where spacing is less than 1 foot in each direction, alternate intersections only need be tied. For reinforcing steel cages for other structural members, the steel shall be tied at enough intersections to provide a rigid cage of steel. Mats of wire fabric shall overlap each other 1 full space as a minimum to maintain a uniform strength and shall be tied at the ends and edges.

Where prefabricated deformed wire mats are specified or if the Contractor requests, welded wire fabric may be substituted for a comparable area of steel reinforcing bar plan, subject to the approval of the Engineer or designated representative.

Mortar or concrete blocks shall be cast to uniform dimensions with adequate bearing area. A suitable tie wire shall be provided in each block, to be used for anchoring to the steel. Except in unusual cases and when specifically authorized by the Engineer, the size of the surface to be placed adjacent to the forms shall not exceed 2½ inches square or the equivalent thereof in cases where circular or rectangular areas are provided. Blocks shall be cast accurately to the thickness required and the surface to be placed adjacent to the forms shall be a true plane, free of surface imperfections. The blocks shall be cured by covering them with wet burlap or mats for a period of 72 hours. Mortar for blocks should contain approximately 1 part hydraulic cement to three parts sand. Concrete for blocks should contain 850 pounds of hydraulic cement per cubic yard of concrete.

Individual bar supports shall be placed in rows at 4-ft maximum spacing in each direction. Continuous type bar supports shall be placed at 4-ft maximum spacing. Continuous bar supports shall be used with permanent metal deck forms.

The exposure of the ends of longitudinals, stirrups and spacers used to position the reinforcement in concrete pipe and in precast box culverts or storm drains is not a cause for rejection.

Reinforcing steel for bridge slabs, top slabs of direct traffic culverts, and top slabs of prestressed box beams at all intersections, except tie only alternate intersections where spacing is less than 1 ft in each direction.

For steel reinforcing cages for other structural members, reinforcement shall be supported and tied in such a manner that a sufficiently rigid cage of steel is provided. Fasten mats of wire fabric securely at the ends and edges. If the cage is not adequately supported to resist settlement or floating upward of the steel, overturning of truss bars or movement in any direction during concrete placement, permission to continue concrete placement will be withheld until corrective measures are taken. Sufficient measurements shall be made during concrete placement to ensure compliance with the above.

No concrete shall be deposited until the Engineer or designated representative has reviewed the placement of the reinforcing steel and all mortar, mud, dirt, etc, shall be cleaned from the reinforcement, forms, workers' boots and tools. Do not place concrete until authorized by the Engineer or designated representative.

#### 406S.9 - Handling, Placement and Repair of Epoxy-coated Reinforcement Steel

##### A. Handling

Systems for handling coated reinforcement with padded contact areas shall be provided. Handling bands shall be padded to prevent damage to the coating. Bundles of coated reinforcement shall be lifted with a strongback, spreader bar, multiple supports or a platform bridge. The bundled reinforcement shall be carefully transported and stored on protective cribbing. The coated reinforcement should not be dropped or drug during handling.

##### B. Construction Methods

Coated reinforcement shall not be flame-cut but shall be sawn or shear-cut only when approved. Cut ends shall be coated as specified in Section C, "Repair of Coating".

Coated reinforcement steel shall not be welded or mechanically coupled except where specifically indicated on the drawings. When welding or coupling is indicated on the drawing, the epoxy coating shall be removed at least 6 in beyond the weld limits before welding and 2 in beyond the limits of the mechanical coupler before assembly. After the welding or coupling operation is completed the steel shall be cleaned of oil, grease, moisture, dirt, welding contamination (slag or acid residue) and rust to a near-white finish. The existing epoxy coating shall be examined for damage and any damaged or loose epoxy shall be removed to expose sound epoxy coating.

After cleaning the coated steel, the splice area shall be coated with epoxy repair material to a thickness of 7 to 17 mils after curing. A second application of the repair material shall be applied to the bar and coupler interface to ensure complete sealing of the joint.

#### C. Repair of Coating

The material used for coating repair shall comply with the requirements of this Item and ASTM D3963/D3963M, "Specification for Fabrication and Jobsite Handling of Epoxy-coated Reinforcing Steel Bars". Repairs shall be made in accordance with procedures recommended by the manufacturer of the epoxy coating powder. For areas to be patched, a minimum coating thickness as required for the original coating shall be applied. All visible damage to the coating shall be repaired.

Sawed and sheared ends, cuts, breaks and other damage shall be promptly repaired before additional oxidation occurs. The areas to be repaired shall be cleaned to ensure that they free from surface contaminants. Repairs shall be made in the shop or in the field as required.

#### 406S.10 - Measurement

The measurement of quantities of reinforcement furnished and placed will be based on the calculated weight of the steel actually placed as indicated on the drawings, with no allowance made for added bar lengths for splices requested by the Contractor nor for extra steel used when bars larger than those indicated on the drawings are used or for a higher grade of steel that is substituted with the permission of the Engineer or designated representative. Tie wires and supporting devices will not be included in the calculated weights. The calculated weight of bar reinforcement will be determined using the theoretical bar weight set forth in this item.

Measurement required by a change in design will be computed as described above for the actual steel required to complete the work.

#### 406S.11 - Payment

This item shall be paid for at the contract unit price bid per pound of "Reinforcing Steel". The unit bid price shall include full compensation for all work specified herein including furnishing, bending, fabricating, welding and placing reinforcement, for all clips, blocks, metal spacers, ties, chairs, wire or other materials used for fastening reinforcement in place and for all tools, labor, equipment and incidentals necessary to complete the work.

Reinforcing steel will generally not be paid for directly but shall be included in the unit price bid for the items of construction in which the reinforcing steel is used.

When specified in the contract bid form as a separate pay item, this item shall be paid for at the contract unit price bid per pound of "Reinforcing Steel". The unit bid price shall include full compensation for all work specified herein including furnishing, bending, fabricating, welding and placing reinforcement, for all

clips, blocks, metal spacers, ties, chairs, wire or other materials used for fastening reinforcement in place and for all tools, labor, equipment and incidentals necessary to complete the work.

Payment, when included as a contract pay item, will be made under:

<b>Pay Item No. 406S-RC:</b>	Reinforcing Steel	Per Pound.
<b>Pay Item No. 406S-ERC:</b>	Epoxy-Coated Reinforcing Steel	Per Pound.

**END**

## ITEM NO. 407S - FIBROUS CONCRETE

### 407S.1 - Description

This item shall govern furnishing and placing of concrete reinforced with fibers in accordance with this specification item and with details as shown on the Drawings.

Fibrous concrete shall only be used with permission of the City Engineer on City projects and within the City right-of-way.

### 407S.2 - Submittal Requirements

The submittal requirements of this specification item include:

- A. Concrete Type, Supplier and Design.
- B. Fiber Type, Supplier and product properties.
- C. Proposed proportioning of material, including adjustment for slump requirements.
- D. Fiber documentation of compliance with applicable building codes, this specification item, and ASTM C 1116/C 1116 M-08.

### 407S.3 - Materials

#### A. Concrete

All concrete shall conform to the requirements of Standard Specification Item Number 403S, "Concrete for Structures".

The concrete shall be Class A concrete unless otherwise shown on the drawings or indicated otherwise in the Pay item of this document.

Since the slump of a fiber-reinforced concrete is less than the slump of an otherwise identical concrete without fiber and since the magnitude of difference depends upon the amount and type of fibers, trial mixtures representing the amount and type of fibers to be used for the work shall be prepared and tested to insure that the specified slump requirements are met.

#### B. Reinforcement

Reinforcement shall be in accordance with ASTM C 1116/C 1116 M-08. Fibers shall conform to section 4.1.2 Type 2 Glass Fiber-Reinforced Concrete, or 4.1.3 Type 3 Synthetic Fiber-Reinforced Concrete, or 4.1.4 Natural Fiber-Reinforced Concrete. Unless otherwise shown on the drawings, each cubic yard of concrete shall contain no less than 1½ pounds of fibers. The fibers shall be added to the concrete mix at the time the mix is batched.

Reinforcement shall be 100% virgin polypropylene fibrillated fibers specially manufactured for use as concrete reinforcement and meeting the requirements of ASTM C-1116 (Fiber-Reinforced Concrete and Shotcrete). The fibrous material shall not contain reprocessed olefin. Each container of fibrous material shall bear the manufacturer's name and/or trademark and the net weight of fibrous material in the package.

The fiber manufacturer shall provide documentation of a minimum of 5 year performance history of the fiber and confirm compliance with applicable building codes, this specification item and ASTM C-1116.

The specific gravity of the fibrous material shall be 0.91 plus or minus .05. The tensile strength shall be 80 to 110 ksi. The lengths of the fibrous material shall be 1/2, 3/4, 1½ and 2 inches in length.

Unless otherwise shown on the drawings, each cubic yard of concrete shall contain no less than 1½ pounds of fibrous material. The fibrous material shall be added to the concrete mix at the time the mix is batched.

**407S.4 - Excavation, Placing of Concrete, Finishing, Curing and Backfill**

All excavation, placing of concrete, finishing, curing and backfilling shall be in accordance with Standard Specification Item Number 401S, "Structural Excavation and Backfill", and Standard Specification Item Number 410S, "Concrete Structures".

**407S.5 - Measurement**

The quantities of concrete of the various classes which constitute the completed and accepted work in place will be measured per cubic yard, square foot or linear foot as indicated in the Project Manual. Measurement will be as follows:

- A. Plan Quantity. For those items measured for plan quantity payment, adequate calculations have been made. No additional measurements or calculations will be made.
- B. Measured in Place. For those items not measured for Plan Quantity payment, measurement will be made in place. However, field measured dimensions shall not exceed those indicated on the drawings or as may have been directed by the Engineer or designated representative in writing.

**407S.6 - Payment**

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit bid price for Fibrous Concrete of the class specified. The unit bid price shall include full compensation for furnishing, hauling and mixing all materials; placing, finishing and curing all concrete; and for all forms, labor, tools, equipment and incidentals necessary to complete the work.

<b>Pay Item No. 407S-CY:</b>	Fibrous Concrete, (Class _____ )	Per Cubic Yard.
<b>Pay Item No. 407S-SF:</b>	Fibrous Concrete, (Class _____ )	Per Square Foot.
<b>Pay Item No. 407S-LF</b>	Fibrous Concrete, (Class _____ )	Per Lineal Foot

**END**



ITEM NO. 408S - CONCRETE JOINT MATERIALS

408S.1 - Description

This item shall govern the furnishing and placing of all longitudinal, transverse contraction and expansion joint material in concrete work as herein specified in the various items of these specifications as indicated or as directed by the Engineer or designated representative.

408S.2 - Submittals

The submittal requirements of this specification item include:

- A. Type and manufacturer of all joint materials proposed for use.
- B. Technical data indicating that proposed products meet the requirements specified herein.

408S.3 - Materials

(1) Preformed Asphalt Board

Preformed asphalt board formed from cane or other suitable fibers of a cellular nature securely bound together and uniformly impregnated with a suitable asphaltic binder and meeting the requirements of the Standard Specifications for Preformed Expansion Joint Filler for Concrete (Bituminous Type), ASTM D 994.

(2) Preformed Nonbituminous Fiber Material

Preformed nonbituminous fiber material shall meet the requirements of the Standard Specifications for the Preformed Expansion Joint Filler for Concrete Paving and Structural Construction, ASTM D 1751, except that the requirements pertaining to bitumen content, density and water absorption shall be voided.

(3) Joint Sealer (Concrete Pavement)

This material shall be a one part low modulus silicone especially designed to cure at ambient temperatures by reacting with moisture in the air and shall have the following properties:

<b>As Supplied</b>	
Color	Gray
Flow, MIL-2-8802D Sec. 4.8.4	0.2 maximum
Working Time, minutes	10Tack-Free Time at 77°F 2F Min.
MIL-2-8802D Sec.4.8.7	60
Cure time, at 77°F, days	7-14

<b>As Supplied</b>	
Full Adhesion, days	14-21
As Cured—after 7 days at 77°F and 40% RH	
Elongation, percent minimum	1200
Durometer Hardness, Shore A, points ASTM 2240	15
Joint Movement Capability, percent	+100/-50
Tensile Strength, maximum elongation, psi	100
Peel Strength, psi	25

The joint sealer shall adhere to the sides of the concrete joint or crack and shall be an effective seal against infiltration of water and incompressibles. The material shall not crack or break when exposed to low temperature.

(5) Backer Rod

Backer Rod shall be expanded closed cell polyethylene foam compatible with sealant. No bond or reaction shall occur between rod and sealant. Backer Rod shall be of sufficient width to be in compression after placement and shall be used with joint sealer.

(6) Joint Sealing Material

Joint Sealing Material for other than pavement use may be a two-component, synthetic polymer or cold-pourable, self-leveling type meeting the following requirements:

The material shall adhere to the sides of the concrete joint or crack and shall form an effective seal against infiltration of water and incompressibles. The material shall not crack or break when exposed to low temperatures. Curing is to be by polymerization and not by evaporation of solvent or fluxing of harder particles. It shall cure sufficiently at an average temperature of 77°F 3°F so as not to pick up under wheels of traffic in a maximum of 3 hours.

Performance Requirements:

When tested in accordance with Test Method Tex-525-C, the joint sealing material shall meet the above curing times and the requirements as follows:

It shall be of such consistency that it can be mixed and poured or mixed and extruded into joints at temperatures above 60°F.

Penetration 77°F, 150 gm. Cone, 5 sec., max.-cm	0.90
Bond and Extension 75%, 0F, 5 cycles:	
Dry Concrete Blocks	Pass
Wet Concrete Blocks	Pass
Steel Blocks (Primed if specified by manufacturer)	Pass
Flow at 200 °F	None
Water content % by weight, max.	5.0
Resilience:	
Original sample min. % (cured)	50
Oven-aged at 158°F min. %	50
For Class 1-a material only, Cold Flow (10 minute)	None

(7) Rebonded Recycled Tire Rubber

This material consists of granular particles of rubber, made by grinding automobile and truck tires, securely bound together by a synthetic resin or plastic binder. The filler must be molded into sheets of the required dimensions, which meet the testing requirements of both ASTM D 1751 and ASTM D 1752, except that the requirements for asphalt content and expansion are waived. The density of the material must be at least 30 lb/ft<sup>3</sup>.

408S.4 - Construction Methods

The Contractor shall install "Concrete Joint Materials" which will function as a compatible system. Joint sealer shall not be placed where a bond breaker is present.

Asphalt or other materials used shall extend the full depth of the concrete and shall be perpendicular to the exposed face. All joints shall be shaped to conform to the contour of the finished section in which they are installed. All material shall be a minimum of 1/2 inch thick or as indicated. Materials shall be anchored to the adjacent concrete to permanently hold them in place. Joint sealer shall be installed in accordance with the manufacturer's recommendations.

The material used for curb and gutter expansion joints filler shall conform to any of the above, except when placed adjacent to concrete pavement, the joint material shall match the pavement joint material.

408S.5 - Measurement and Payment

No additional compensation will be made for materials, equipment or labor required by this item, but shall be included in the unit price bid for the item of construction in which this item is used.

**END**

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## ITEM NO. 409S - MEMBRANE CURING

### 409S.1 - Description

This item shall govern curing concrete pavement, concrete base, pavement, curbs, gutters, retards, sidewalks, driveways, medians, islands, concrete riprap, cement stabilized riprap, concrete structures and other concrete as indicated by applying an impervious liquid membrane forming material.

### 409S.2 - Submittals

Within 14 days prior to the commencement of related work, the Contractor shall electronically submit the following submittal requirements:

- A. Type and manufacturer for all membrane curing materials proposed.
- B. Proposed curing procedures.

### 409S.3 - Material

The liquid forming membrane curing compound shall comply with the "Standard Specification for Liquid Membrane-forming Compounds for Curing Concrete", ASTM C 309, Type 1-D clear or translucent, with fugitive dye or Type 2 white pigmented. The material shall have a minimum flash point of 80°F when tested by the "Pensky-Martin Closed Cup Tester", ASTM D 93.

It shall be of such consistency that it can be satisfactorily applied as a fine mist through an atomizing nozzle by means of approved pressure spraying equipment at atmospheric temperatures above 40°F.

It shall be of such nature that it will not produce permanent discoloration of concrete surfaces nor react deleteriously with the concrete or its components. Type 1 compound shall contain a fugitive dye that will be distinctly visible not less than 4 hours nor more than 7 days after application.

Type 2 compound shall not settle out excessively or cake in the container and shall be capable of being mixed to a uniform consistency by moderate stirring and shall exhibit a daylight reflectance of not less than 60 percent of that of magnesium oxide when tested as indicated.

The compound shall produce a firm, continuous, uniform moisture impermeable film, free from pinholes and shall adhere satisfactorily to the surfaces of damp concrete. When applied to the damp concrete surface at the rate of coverage indicated, the compound shall dry to the touch in not more than 4 hours and shall not be tacky or track off concrete after 12 hours.

It shall adhere to horizontal and vertical surfaces in a tenacious film and shall not run off or show an appreciable sag, disintegrate, check, peel or crack during the required curing period.

Under traffic, the compound shall not pick up or peel and shall gradually disintegrate from the surface.

The compound shall be delivered to the job only in the manufacturer's original containers, which shall be clearly labeled with the manufacturer's name, the trade name of the material and a batch number or symbol with which test samples may be correlated.

The water retention test shall be in accordance with the following:

Percentage loss shall be defined as the water lost after the application of the curing material was applied. The permissible percentage moisture loss (at the rate of coverage specified herein) shall not exceed the following:

24 hours after application	2 percent
72 hours after application	4 percent

#### 409S.4 - Construction Methods

The membrane curing compound shall be applied after the surface finishing has been completed and immediately after the free surface moisture has disappeared. The surface shall be sealed with a single uniform coating of the specified type of curing compound applied at the rate of coverage recommended by the manufacturer and directed by the Engineer or designated representative, but not less than 1 gallon per 180 square feet of area. The Contractor shall provide satisfactory means and facilities to properly control and check the rate of application of the compound.

The compounds shall not be applied before the surface has become dry but shall be applied just after free moisture has disappeared.

The compound shall be thoroughly agitated during its use and shall be applied by means of approved mechanical power pressure sprayers for street and bridge applications. The sprayers used to apply the membrane to concrete exposed surfaces shall travel at a uniform speed along the forms and be mechanically driven. The equipment shall be of such design that it will insure uniform and even application of the membrane material. The sprayers shall be equipped with satisfactory atomizing nozzles. On small miscellaneous items or on interim bridge deck curing will the Contractor be permitted to use hand-powered spray equipment. For all spraying equipment, the Contractor shall provide facilities to prevent the loss of the compound between the nozzle and the concrete surface during the spraying operations.

At locations where the coating shows discontinuities, pinholes or other defects or if rain falls on the newly coated surface before the film has dried sufficiently to resist damage, an additional coat of the compound shall be applied immediately at the same rate of coverage specified herein.

To ensure proper coverage, the Engineer or designated representative shall inspect all treated areas after application of the compound for the period of time designated in the specification for curing, either for membrane curing or for other methods. Dry areas are identifiable because of the lighter color of dry concrete as compared to damp concrete. All suspected areas shall be tested by placing a few drops of water on the suspected areas. If the water stands in rounded beads or small pools which can be blown along the surface of the concrete without wetting the surface, the water impervious film is present. If the water wets the surface of the concrete as determined by obvious darkening of the surface or by visible soaking into the surface, no water-impervious film is present. Should the foregoing test indicate that any area during the curing period is not protected by the required water-impervious film an additional coat or coats of the compound shall be applied immediately and the rate of application of the membrane compound shall be increased until all areas are uniformly covered by the required water-impervious film.

The compounds shall not be applied to a dry surface and if the surface of the concrete has become dry, it shall be thoroughly moistened prior to the application of the membrane by fogging or mist application. Sprinkling or coarse spraying will not be allowed.

When temperatures are such as to warrant protection against freezing, curing by this method shall be supplemented with an approved insulating material capable of protecting the concrete for the specified curing period.

If at any time there is reason to believe that this method of curing is unsatisfactory or is detrimental to the work, the Contractor, when notified, shall immediately cease the use of this method and shall change to curing by one of the other methods specified under this contract.

Curing compounds shall be compatible with the adhesion of toppings or overlays where curing has been applied to the concrete base surface in order to assure adequate bond.

When forms are stripped before the 4 minimum curing days have passed, curing shall continue by an approved method.

#### 409S.5 - Measurement and Payment

Membrane curing will not be measured for payment. The work and materials prescribed herein will not be paid for directly but shall be included in the unit price bid for the item of construction in which these materials are used.

**END**

## ITEM NO. 410S - CONCRETE STRUCTURES

### 410S.1 - Description

This item shall govern the construction of all types of structures involving the use of structural concrete, except where the requirements are waived or revised by other governing specifications.

All concrete structures shall be constructed in accordance with the design requirements and details indicated on the drawings, in conformity with the pertinent provisions of the items contracted for, the incidental items referred to and in conformity with the requirements herein.

### 410S.2 - Submittals

Within 14 days prior to the commencement of related work, the Contractor shall submit electronically the following submittal requirements as applicable:

- a. Appropriate mix designs for class of concrete for each type of structure or unit;
- b. Appropriate mortar and grout mix designs;
- c. Product name, description, technical information and supplier of any acrylic-polymer latex admixture;
- d. Type, supplier and certified test results for expansion joint materials;
- e. Type of waterstop and confirmation that the product conforms to TxDOT DMS-6160;
- f. Type and manufacturer of proposed evaporation retardant and confirmation that it meets the requirements of test results for TxDOT DMS-4650;
- g. Type and manufacturer of proposed chemical admixtures and confirmation that it meets the requirements of test results for TxDOT DMS-4640;
- h. Type and manufacturer of proposed curing admixtures and confirmation that it meets the requirements of test results for TxDOT DMS-4640;
- i. Type and manufacturer of proposed chemical admixtures and confirmation that it meets the requirements of test results for TxDOT DMS-4640;
- j. Type and manufacturer of proposed epoxy and/or adhesives and confirmation that it meets the requirements of test results for TxDOT DMS-6100;
- k. Reinforcing steel shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".
- l. Contractors formwork plan for placing and consolidating concrete around wall penetrations and at locations designated as having congested reinforcing steel.

### 410S.3 - Materials

#### A. Concrete

Concrete shall conform to Item No. 403S, "Concrete for Structures".



The class of concrete for each type of structure or unit shall be as indicated on the drawings or by pertinent governing specifications.

B. Grout or Mortar

When required or shown on the drawings, mortar and grout consisting of 1 part hydraulic cement and 2 parts sand with sufficient water to provide the desired consistency shall be provided. Mortar shall be provided with a consistency that can be handled easily and spread by a trowel. Grout shall be provided with a consistency that will flow into and completely fill all voids.

C. Latex

When required an acrylic-polymer latex admixture (acrylic resin emulsion in accordance with TxDOT DMS-4640, "Chemical Admixtures for Concrete") suitable for producing polymer-modified concrete or mortar shall be provided. The latex shall not be allowed to freeze.

The following information shall be submitted for latex:

- a. Name and information of company contact personnel,
- b. Product name and polymer description, and

The latex shall meet the following requirements.

<b>Table 1: LATEX ADDITIVE REQUIREMENTS</b>	
Property	Value
Total Solids, minimum, percent	47
PH	9.0 to 11.0
Brookfield viscosity (# 1 spindle @ 10 rpm), mPas, maximum	60
Butadiene Content, percent	30 to 40
Freeze-thaw stability, 2 cycles. maximum	0.1

Specification targets and production tolerances shall also be provided for the following properties.

1. viscosity (including test method and temperature reference),
2. percent solids,
3. pH,
4. specific gravity, and
5. styrene/butadiene ratio.

#### D. Reinforcing Steel

Reinforcing steel shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

#### E. Expansion Joint Material

Joints and devices to provide for expansion and contraction shall be constructed as indicated herein or in the Drawings. The expansion joint material shall conform to the requirements of TxDOT DMS-6310, "Joint Sealants and Fillers".

##### 1. Preformed Fiber Sheets

Unless otherwise indicated on the drawings preformed bituminous fiber material shall be provided. The preformed fiber material shall be 1/2 inch or conform to the dimensions indicated on the drawings. Preformed fiber sheets shall be one of the following unless otherwise noted on the drawings:

- a. "Preformed Bituminous Fiber Material" shall meet the requirements of the Standard Specifications for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction, ASTM Designation: D1751.
- b. "Preformed Non-Bituminous Fiber Material": shall meet the requirements of the Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction ASTM Designation: D1751, except that the requirements pertaining to bitumen content, density and water absorption shall be voided.

##### 2. Joint Sealing Material

Unless otherwise indicated on the drawings, the sealer shall be synthetic polymer Sikaflex, iCSL or approved equivalent.

##### 3. Timber Boards

Timber boards shall be made from redwood or cypress and must be free from sapwood, knots, clustered bird's eye, checks and splits. When oven dried at 230°F to a constant weight, the density of the board shall be between 20 and 35 lbs. per cubic foot.

##### 4. Asphalt Board

Asphalt Board shall consist of two liners of 0.016 inches asphalt impregnated paper, filler with a mastic mixture of asphalt and vegetable fiber and/or mineral filler. Boards shall be smooth, flat and sufficiently rigid to permit installation. When tested in accordance with Test Method Tex-524-C, the asphalt board shall not deflect from the horizontal more than one (1) inch in three and one half (3 ½) inches.

##### 5. Rebonded Neoprene Filler Sheet

Rebonded neoprene filler shall consist of ground closed cell neoprene particles, rebonded and molded into sheets of uniform thickness of the dimensions indicated on the drawings. These sheets shall meet the requirements of ASTM D-1752, Type I.

The manufacturer shall furnish the City Engineer or designated representative with certified test results as to the compliance with the above requirements.

## F. Waterstop

Unless otherwise indicated on the drawings, rubber waterstops or Polyvinyl Chloride (PVC) waterstops that conform to TxDOT DMS-6160, "Waterstops, Nylon Reinforced Neoprene Sheet, and Elastomeric Pads" shall be provided.

## G. Evaporation Retardants

Evaporation retardants shall conform to the requirements of TxDOT DMS-4650, "Hydraulic Cement Concrete Curing Materials and Evaporation Retardants". The evaporation retardant must be a commercially available monomolecular film compound. The evaporation retardant shall have no adverse effect on the cement hydration process or the concrete and shall reduce surface moisture evaporation from the concrete when performing concrete operations in direct sun, wind, high temperatures, or low relative humidity. The producer of the evaporation retardant shall certify that it meets these specified requirements.

## H. Curing Materials

### 1. Liquid Membrane Forming compounds

Liquid Membrane Forming compounds shall conform to the requirements of TxDOT DMS-4650, "Hydraulic Cement Concrete Curing Materials and Evaporation Retardants". The compound shall be applied to damp concrete as a fine mist through atomizing nozzles at a wet film thickness of 8 to 9 mils. The liquid membrane-forming compound must not react deleteriously with concrete or its components. It must produce a firm, continuous, uniform moisture-impermeable film that is free of pinholes, cracks, or other film defects. It must also exhibit satisfactory adhesion.

The consistency must be such that the compound can be applied satisfactorily by conventional or airless spray at atmospheric and material temperatures above 40°F without thinning. When applied at the manufacturer's recommended thickness, not less than 8 mils wet, to vertical surfaces of damp concrete, the compound must not run off or appreciably sag. The liquid membrane-forming compound must not disintegrate, check, peel, or crack during the required curing period. It must not peel or pick up under traffic and must disappear from the surface of the cured concrete by gradual disintegration.

### 2. Cotton Mats

Cotton mats shall consist of a filling material of cotton "bat" or "bats" [at least 12 oz. Per square yard] completely covered with unsized cloth [at least 6 oz. Per square yard stitched longitudinally with continuous parallel rows of stitching spaced at less than 4 in., or tuft both longitudinally and transversely at intervals less than 3 in.

The cotton mats shall be free from tears and in good general condition. A flap at least 6 in. wide with two (2) thicknesses of the covering that extends along one side of the mat shall be provided.

### 3. Polyethylene Sheeting

The polyethylene sheeting shall be at least 4 mils thick and free from visible defects. Clear or opaque white sheeting shall be provided when the ambient temperature during curing exceeds 60°F or when applicable to control temperature during mass pours.

#### 4. Burlap-Polyethylene Mats

The burlap-polyethylene mats shall be made from burlap impregnated on 1 side with a film of opaque white-pigmented polyethylene, free from visible defects. The laminated mats shall have at least 1 layer of an impervious material such as polyethylene, vinyl plastic, or other acceptable material (either as a solid sheet or impregnated into another fabric) and shall be free of visible defects.

##### I. Chemical Admixtures

Chemical admixtures including water reducing, plasticizers and air entrainment shall conform to TxDOT DMS-4640, "Chemical Admixtures for Concrete" Calcium chloride shall not be used. Admixtures shall be included in the prequalified concrete admixtures list maintained by TxDOT's Construction Division.

##### J. City of Pflugerville Survey Monuments

The Public Works Department may furnish permanent survey monuments to be cast in concrete as indicated on the drawings or as directed by the City Engineer or designated representative.

##### K. Epoxy

Unless indicated otherwise on the drawings, epoxy materials shall conform to TxDOT DMS-6100, "Epoxy and Adhesives".

#### 410S.4 - General Requirements

Before starting work, the Contractor shall inform the City Engineer or designated representative fully of the construction methods the Contractor proposes to use, the adequacy of which shall be subject to the review by the City Engineer or designated representative. The Contractor shall notify the City Engineer or designated representative 2 days before placing concrete in any unit of the structure to permit for the inspection of forms, reinforcing steel placement, and other preparations. Concrete shall not be placed in any unit prior to the completion of formwork and placement of reinforcement therein. Drawings for forms and falsework for piers and superstructure spans over 20 feet long, bracing systems for girders when the overhang exceeds 3 ft. 6 in. and for all bridge widening details shall be submitted to the City Engineer or designated representative for review, if requested. Similar drawings shall be submitted for other units of the structure, if requested by the City Engineer or designated representative. The drawings shall be prepared on standard 22-inch by 36-inch sheets and shall show all essential details of the proposed forms, falsework and bracing to permit a structural analysis. Four sets of such drawings will be required.

Concrete mixing, placing and finishing shall be done in daylight hours unless adequate provisions are made to light the entire site of all operations.

Concurrence on the part of the City Engineer or designated representative in any proposed construction methods, approval of equipment or of form and falsework drawings does not relieve the Contractor of the responsibility for the safety or correctness of the Contractor's methods, adequacy of equipment or from carrying out the work in full accordance with the contract.

Unless otherwise indicated on the drawings, the requirements in the succeeding paragraphs shall govern the time sequence in which construction operations may be carried on and for the opening of completed structures to traffic:

- a. Superstructure members, forms, falsework or erection equipment shall not be placed on the substructure before the concrete therein has attained a 3000 psi compressive strength.
- b. Storage of materials on completed portions of a structure will not be permitted until all curing requirements for those particular portions have been met.
- c. No forms shall be erected on concrete footings supported by piling or drilled shafts until the concrete therein has attained a minimum compressive strength of 2500 psi. Such work may begin on spread footings after the therein has aged at least 2 curing days. Concrete may be placed as soon as the forms and reinforcing steel are approved by the City Engineer or designated representative.
- d. The support of tie beam and/or forms by falsework placed on previously placed tie beams is permissible provided such beams have attained 3000 psi compressive strength, curing requirements are completed and the beams are properly supported to eliminate stresses not provided for in the design.
- e. Bridges and direct traffic culverts shall not be opened to construction traffic or to the traveling public until authorized by the City Engineer or designated representative in accordance with the following:
- f. Authorization may be given after the last slab concrete has been in place at least 14 days for light construction traffic not to exceed a 3/4-ton vehicle. Authorization to place embankments to allow normal construction traffic and when necessary to the traveling public, may be given after the last slab concrete has been in place 30 days or when the minimum compressive strength ( $f_c'$ ) has reached the 28 day strength conforming to Item No. 403S, "Concrete for Structures" or as indicated on the drawings.

#### 410S.5 - Drains

Weep holes and roadway drains shall be installed and constructed as indicated on the drawings.

#### 410S.6 - Expansion Joints

Joints and devices shall be used to provide for expansion and contraction of concrete slabs and shall be constructed as indicated on the drawings.

The bearing area under the expansion ends of concrete slabs and slab and girder spans shall be given a steel trowel finish and finished to the exact grades required on the drawings. The material used to separate expansion surfaces shall be as indicated on the drawings and placed so that concrete or mortar cannot be subsequently worked around or under it. The bridging of concrete or mortar around expansion joint material in bearings and expansion joints shall be prevented.

Concrete adjacent to armor joints and finger joints shall be placed carefully to avoid defective anchorage and porous or honeycombed concrete in such areas.

All open joints and joints to be filled with expansion joint material shall be constructed using forms adaptable to loosening or early removal. To avoid expansion or contraction damage to the adjacent concrete, these forms shall be loosened as soon as possible after final concrete set to permit free movement of the span without requiring full form removal.

Preformed fiber joint material or other material indicated shall be used in the vertical joints of the roadway slab, curb, median or sidewalk. The top 1-inch thereof shall be filled with joint sealing material, as specified herein. The sealer shall be installed in accordance with Standard Specification Item No. 413S, "Cleaning and/or Sealing Joints and Cracks (PC Concrete)" and the manufacturer's recommendations.

Prior to placing the sealing material, the vertical faces of the joint shall be cleaned of all laitance by sandblasting or by mechanical routing. Cracked or spalled edges shall be repaired. The joint shall be blown clean of all foreign material and sealed.

Where preformed fiber joint material is used, it shall be anchored to the concrete on one side of the joint by light wire or nails to prevent the material from falling out.

Finished joints shall conform to the drawing details with the concrete sections completely separated by the specified opening or joint material.

Soon after form removal and where necessary after surface finishing, all projecting concrete shall be removed along exposed edges to secure full effectiveness of the expansion joints.

#### 410S.7 - Construction Joints

The joint formed by placing plastic concrete in direct contact with concrete that has attained its initial set shall be deemed a construction joint. The term monolithic placement shall be interpreted to mean that the manner and sequence of concrete placing shall not create construction joints.

Construction joints shall be of the type and at the locations indicated on the drawings. Additional joints will not be permitted without written authorization from the City Engineer or designated representative and when authorized, shall have details equivalent to those indicated for joints in similar locations.

Unless otherwise provided, construction joints shall be square and normal to the forms. Bulkheads shall be provided in the forms for all joints, except when horizontal. All vertical construction joints shall be chamfered. All horizontal construction joints shall be routed or grooved.

Construction joints requiring the use of joint sealing material shall be as indicated on the drawings or as directed by the City Engineer or designated representative. The material will be indicated on the drawings without reference to joint type.

A concrete placement terminating at a horizontal construction joint shall have the top surface roughened thoroughly as soon as practicable after initial set is attained. The surfaces at bulkheads shall be roughened as soon as the forms are removed.

The hardened concrete surface shall be thoroughly cleaned of all loose material, laitance, dirt or foreign matter and saturated with water so it is moist when placing fresh concrete against it. Remove all free water and moisten the surface before concrete or bonding grout is placed against it. Forms shall be drawn tight against the existing concrete and the joint surface flushed with grout just prior to placing the fresh concrete.

The joint surface shall be coated with bonding mortar, grout, epoxy or other material as indicated on the drawings or other items. A Type V epoxy shall be provided in accordance with TxDOT DMS-6100, "Epoxies and Adhesives" for bonding fresh concrete to hardened concrete. The epoxy shall be placed on a clean dry surface and the fresh concrete shall be placed while the epoxy is still tacky. Bonding mortar or grout shall be placed on a surface that is saturated surface dry and the concrete shall be placed before

the bonding mortar or grout dries. Other bonding agents shall be placed in accordance with the manufacturer's recommendations.

#### 410S.8 - Foundation and Substructure

Excavation for foundations and substructure shall conform to Standard Specification Item No. 401S, "Structural Excavation and Backfill".

Concrete for foundation seals, unless otherwise indicated on the drawings, shall be Class C Concrete with a coarse aggregate grade of 2, 3, 4 or 5 and placed in accordance with the requirements herein. The top of the completed seal shall not vary from plan grade or the grade established by the City Engineer or designated representative.

Where a concrete seal is indicated on the Drawings, the design will be based on the normal water elevation as indicated on the Drawings. If the foundation concrete can be placed in the dry at the time of construction, the seal will not be required. If additional seal is necessary for the conditions existing during the time of construction, its thickness shall be increased as deemed necessary by the Contractor and at the Contractor's expense. If the conditions existing at the time of construction require a seal for placing the foundation concrete in the dry and none is indicated on the Drawings, the Contractor shall place an adequate seal at the Contractor's expense.

The seal shall be allowed to set for at least 36 hours before the caisson or cofferdam is dewatered, after which the top of the seal shall be cleaned of all laitance or other soft material and all high spots exceeding the above limitation shall be cut off and removed.

#### 410S.9 - Falsework

The Contractor is totally responsible for all falsework. The Contractor shall design and construct it to safely carry the maximum anticipated loads and to provide the necessary rigidity. Details of falsework construction shall be subject to review by the City Engineer or designated representative, but City's review shall in no way relieve the Contractor of responsibility of the adequacy and safety of the falsework design.

All timber used in falsework centering shall be sound, in good condition and free from defects which will impair its strength. When wedges are used to adjust falsework to desired elevations, they shall be used in pairs to insure even bearing.

Sills or grillages shall be large enough to support the superimposed load without settlement and unless founded on solid rock, shale or other hard materials, precautions shall be taken to prevent yielding of the supporting material.

Falsework, which cannot be founded on a satisfactory spread footing, shall be placed on piling driven to a bearing capacity sufficient to support the superimposed load without settlement. The safe bearing capacity of piling shall be determined by test loads or by such other methods that may be required or acceptable to the City Engineer or designated representative.

In general, each falsework bent shall be capped transversely by a member of proper size. A short cap section forming a T-head may be substituted to permit the removal of portions of the forms without disturbing the falsework. Caps shall be securely fastened to each pile or column in the bent and set at the proper elevation to produce, in conjunction with the use of approved wedges or jacks, permanent camber indicated on the Drawings, plus a construction camber covering allowance for deformation of the forms

and falsework. The use of wedges to compensate for incorrectly cut bearing surfaces will not be permitted. Each falsework bent shall be securely braced to provide the stiffness required with the bracing securely fastened to each pile or column it crosses.

In setting falsework for arches, allowances shall be made for settlement of falsework, deflection of the arch and permanent camber. Provision shall be made by suitable wedges, sand jacks or other acceptable devices for the controlled lowering of falsework when the arch is swung. Falsework may be required to be placed on jacks to provide for settlement correction during concrete placement.

When the falsework is no longer required, it shall be removed. Falsework piling shall be pulled or cut off not less than 2 feet below finished ground level. Falsework and piling in a stream, lake or bay shall be completely removed to a point specified by the City Engineer or designated representative to prevent any obstruction to the waterway.

#### 410S.10 - Forms

Forms for precast prestressed concrete members and for prestressed piling shall be constructed conforming to Item No. 424S, "Pre-stressed Concrete Planks".

##### A. General

Except where otherwise indicated on the drawings, forms may be of either timber or metal.

Forms for round columns exposed to view shall be of steel, except that other materials will be allowed with written permission of the City Engineer or designated representative.

Forming plans shall be submitted for approval by the City Engineer or designated representative. Forms shall be designed for the pressure exerted by a liquid weighing 150 pounds per cubic foot. The rate of placing the concrete shall be taken into consideration in determining the depth of the equivalent liquid. For job-fabricated forms an additional live load of 50 pounds per square foot shall be allowed on horizontal surfaces. The maximum unit stresses shall not exceed 125 percent of the allowable stresses used by the City Engineer or designated representative for the design of structures.

Formwork for wall and/or column pours equal or exceeding 8 feet shall be designed in accordance with ACI 347, "Guide to Formwork for Concrete" and sealed by a Registered Civil Engineer Licensed in the State of Texas, who is experienced in formwork design.

Commercially produced structural units used in formwork shall not exceed the manufacturer's maximum allowable working load for moment, shear or end reaction. The maximum working load shall include a live load of 35 pounds per square foot of horizontal form surface and sufficient details and data shall be submitted for use in checking formwork details for approval.

Forms shall be practically mortar-tight, rigidly braced and strong enough to prevent bulging between supports and maintained to the proper line and grade during concrete placement. Forms shall be maintained in a manner that will prevent warping and shrinkage.

Deflections due to cast-in-place slab concrete and railing shown in the dead load deflection diagram shall be taken into account in the setting of slab forms.

All forms and footing areas shall be cleaned of any extraneous matter before placing concrete.



Permission to place concrete will not be given until all of such work is complete to the satisfaction of the City Engineer or designated representative.

If, at any stage of the work, the forms show signs of bulging or sagging, the portion of the concrete causing such condition shall be removed immediately, if necessary and the forms shall be reset and securely braced against further movement.

#### B. Timber Forms

Lumber for forms shall be properly seasoned, of good quality and free from imperfections, which would affect its strength or impair the finished surface of the concrete. The lumber used for facing or sheathing shall be finished on at least 1 side and 2 edges and shall be sized to uniform thickness.

Form or form lumber that will be reused shall be maintained clean and in good condition. Lumber that is split, warped, bulged, or marred or that has defects that will produce inferior forms shall not be used but shall be removed from the work.

Form lining will be required for all formed surfaces, except for the inside of culvert barrels, inlets, manholes and box girders, the bottom of bridge decks between beams or girders, surfaces that are subsequently covered by backfill material or are completely enclosed and any surface formed by a single finished board. Lining will not be required when plywood forms are used.

Form lining shall be of an approved type such as Masonite or plywood. Thin membrane sheeting such as polyethylene sheets shall not be used for form lining.

Forms may be constructed of plywood not less than 3/4 inch in thickness, with no form lining required. The grain of the face plies on plywood forms shall be placed parallel to the span between the supporting studs or joists.

Plywood used for forming surfaces, which remain exposed, shall be equal to that specified as B-B Plyform Class I or Class II Exterior of the U.S. Department of Commerce Voluntary Product Standard, PS 1.

Studs and joists shall be spaced so that the facing form material remains in true alignment under the imposed loads.

Wales shall be spaced close enough to hold forms securely to the designated lines and scabbed at least 4 feet on each side of joints to provide continuity. A row of wales shall be placed near the bottom of each placement.

Facing material shall be placed with parallel and square joints and securely fastened to supporting studs.

Forms for surfaces receiving only an ordinary finish and exposed to view shall be placed with the form panels symmetrical, i.e., long dimensions set in the same direction. Horizontal joints shall be continuous.

Molding specified for chamfer strips or other uses shall be made of materials of a grade that will not split when nailed and which can be maintained to a true line without warping. Wood molding shall be mill cut and dressed on all faces. Unless indicated otherwise on the drawings, forms shall be filleted at all sharp corners and edges with triangular chamfer strips measuring 3/4 inch on the sides.

Forms for railings and ornamental work shall be constructed to standards equivalent to first class millwork. All moldings, panel work and bevel strips shall be straight and true with neatly mitered joints designed so the finish work is true, sharp and clean cut. All forms shall be constructed to permit their removal without marring or damaging the concrete. The forms may be given a slight draft to permit ease of removal.

Metal form ties of an approved type or a satisfactory substitute shall be used to hold forms in place and shall be of a type that permits ease of removal of the metal as hereinafter specified.

All metal appliances used inside of forms for alignment purposes shall be removed to a depth of at least 1/2 inch from the concrete surface. They shall be made so the metal may be removed without undue chipping or spalling and when removed, shall leave a smooth opening in the concrete surface. Burning off of rods, bolts or ties will not be permitted.

Any wire ties used shall be cut back at least 1/2 inch from the face of the concrete and properly patched.

Devices holding metal ties in place shall be capable of developing the strength of the tie and adjustable to allow for proper alignment.

Metal and wooden spreaders, which are separate from the forms, shall be removed entirely as the concrete is being placed.

Adequate clean-out openings shall be provided for narrow walls and other locations where access to the bottom of the forms is not readily attainable.

Prior to placing concrete, the facing of all forms shall be treated with oil or other bond breaking coating of such composition that it will not discolor or otherwise injuriously affect the concrete surface. Care shall be exercised to prevent coating of the reinforcing steel.

#### C. Metal Forms

The foregoing requirements for timber forms as regards design, mortar-tightness, filleted corners, beveled projections, bracing, alignment, removal, reuse and wetting shall also apply to metal forms, except that these will not require lining, unless specifically indicated on the drawings.

The thickness of form metal shall be as required to maintain the true shape without warping or bulging. All bolt and rivet heads on the facing sides shall be countersunk. Clamps, pins or other connecting devices shall be designed to hold the forms rigidly together and to allow removal without injury to the concrete. Metal forms, which do not present a smooth surface or line up properly, shall not be used. Metal shall be kept free from rust, grease or other foreign materials.

#### D. Form Supports for Overhang Slabs

Form supports which transmit a horizontal force to a steel girder or beam or to a prestressed concrete beam will be permitted, but shall not be used unless a structural analysis has been made of the effect on the girder or beam and approval is granted by the City Engineer or designated representative.

In normal or skewed spans with standard overhangs not exceeding 3 feet, 1 ½ inches, beam bracing as shown in the drawings shall be used.

Spans in which the overhang width exceeds 3 feet, 1½ inches will require additional support for the outside beams to resist torsion. Details of the Contractor's proposed method of providing additional support shall be included with the slab forming plans submitted to the City Engineer or designated representative for review and approval.

Holes in steel members for support of overhang brackets may be punched or drilled full size or may be torch cut to 1/4 inch under size and reamed full size. In no case shall the holes be burned full size. The hole shall be left open unless indicated to be filled with a button head bolt. They shall never be filled by welding.

#### 410S.11 - Placing Reinforcement

Reinforcement in concrete structures shall be placed carefully and accurately and rigidly supported as provided in Standard Specification Item No. 406S, "Reinforcing Steel". Reinforcing steel supports shall not be welded to I-beams or girders or stirrups of prestressed concrete beams.

#### 410S.12 - Placing Concrete

##### A. General

Concrete shall not be placed when impending weather conditions would impair the quality of the finished work. If conditions of wind, humidity and temperature are such that concrete cannot be placed without the potential for shrinkage cracking, the concrete should be placed in early morning, at night or on a schedule with more favorable weather. When mixing, placing and finishing concrete is scheduled during non-daylight hours; the entire placement site should be illuminated to the satisfaction of the City Engineer or designated representative.

If changes in weather conditions require protective measures after work starts, adequate shelter shall be provided to protect the concrete against damage from rainfall or from freezing temperatures as outlined in this Item. Operations during rainfall shall only be continued if approved by the City Engineer or designated representative. Aggregate stockpiles shall be covered to the extent necessary to control the moisture conditions in the aggregates.

Slab concrete shall be mixed in a plant located off the structure. Carting or wheeling concrete batches over completed slabs will not be permitted until they have aged at least 4 full curing days or timber planking placed on top of the slab for the carts to traverse along. Carts shall be equipped with pneumatic tires. Curing operations shall not be interrupted for the purpose of wheeling concrete over finished slabs.

Exposed concrete surfaces, while still plastic, shall be stamped with an impression having the Contractor's name, the month and year. The stamp shall be of an approved design.

At least 1 day of curing shall be allowed after the concrete has achieved initial set before placing strain on projecting reinforcement to prevent damage to the concrete.

The storing of reinforcing or structural steel on completed roadway slabs generally shall be avoided and when permitted, shall be limited to quantities and distribution that will not induce excessive stresses.

**B. Preparation of Surfaces**

All forms, prestressed concrete panels, T-beams and concrete box beams on which concrete will be placed shall be thoroughly wetted before the placement of concrete. Puddles of excess water shall be removed before placing the concrete. The various surfaces shall be in a moist, saturated surface dry condition when concrete is placed on or against them.

The subgrade or foundation shall be moist before placing concrete for bridge approach slabs or other concrete placed on grade. If dry the subgrade shall be lightly sprinkled.

**C. Placing Temperature**

The minimum temperature of all concrete at the time of placement shall not be less than 50°F. The maximum temperature of any concrete, unless otherwise indicated on the drawings, shall not exceed 95°F when placed. The maximum temperature of cast-in-place concrete in bridge superstructures, diaphragms, parapets, concrete portions of railing, curbs and sidewalks and direct traffic box culverts shall not exceed 85°F when placed. Other portions of structures, when indicated on the drawings, shall require the temperature control specified.

For continuous placement of the deck on continuous steel units, the initial set of the concrete shall be retarded sufficiently to ensure that it remains plastic in not less than 3 spans immediately preceding the one being placed. For simple spans, retardation shall be required only if necessary to complete finishing operations.

The consistency of the concrete as placed should allow the completion of all finishing operations without the addition of water to the surface. When conditions are such that additional moisture is needed for finishing, the required water shall be applied to the surface by fog spray only and shall be held to a minimum amount. Fog spray for this purpose may be applied with hand operated fogging equipment.

The height of free fall of concrete shall be limited to 5 feet to prevent segregation.

**D. Transporting Time**

The maximum time interval between the addition of cement to the batch and the placing of concrete in the forms shall not exceed the following:

<b>Table 2: Allowable Transportation Times</b>			
Air or Concrete Temperature whichever is higher	Maximum Time w/o Retarder	Maximum Time with Retarder	
		*Specific Applications	All others
Non-agitated Concrete			
35°F to 79°F	45 minutes	45 minutes	45 minutes
Over 80°F	30 minutes	45 minutes	45 minutes
Agitated Concrete			

90°F or above	45 minutes	75 minutes	105 minutes
75°F to 89°F	60 minutes	90 minutes	120 minutes
35°F to 74°F	90 minutes	120 minutes	150 minutes

\* Specific applications include Bridge decks, cased drilled shafts and slabs of direct traffic culverts

The use of an approved retarding agent in the concrete will permit the extension of each of the above temperature-time maximums by 30 minutes for bridge decks, top slabs of direct traffic culverts and cased drilled shafts and 1 hour for all other concrete except that the maximum time shall not exceed 45 minutes for non-agitated concrete.

#### E. Handling and Placing

The Contractor shall give the City Engineer or designated representative 2 days' notice before placing concrete in any unit of the structure to permit the review of forms, reinforcing steel placement and other preparations. Concrete shall not be placed in any unit prior to the completion of formwork and placement of reinforcement therein.

The sequence for placing concrete shall be as indicated on the drawings or as required herein. The placing shall be regulated so the pressures caused by the plastic concrete shall not exceed the loads used in the form design.

The method of handling, placing and consolidation of concrete shall be capable of maintaining the rate of placement approved by the City Engineer, minimize segregation and displacement of the reinforcement and produce a uniformly dense and compact mass. Concrete shall not have a free fall of more than 5 feet, except in the case of drilled shafts, thin wall sections such as in culverts, or as allowed by other Items. Any hardened concrete spatter ahead of the plastic concrete shall be removed.

Each part of the forms shall be filled by depositing concrete as near its final position as possible. The coarse aggregate shall be worked back from the face and the concrete forced under and around the reinforcement bars without displacing them. Depositing large quantities at one point and running or working it along the forms will not be allowed.

Concrete shall be deposited in the forms in layers of suitable depth but not more than 36 inches in thickness, unless otherwise directed by the City Engineer or designated representative.

Cold joints in a monolithic placement shall be avoided. The sequence of successive layers or adjacent portions of concrete shall be such that they can be vibrated into a homogeneous mass with the previously placed concrete without a cold joint. Not more than 1 hour (1 ½ hours if a normal dosage of retarding admixture is used) shall elapse between adjacent or successive placements of concrete. Unauthorized construction joints shall be avoided by placing all concrete between the authorized joints in one continuous operation.

An approved retarding agent shall be used to control stress cracks and/or authorized cold joints in mass placements where differential settlement and/or setting time may induce stress cracking, such as on false work, in deep girder stems, etc.

Openings in forms shall be provided, if needed, for the removal of laitance or foreign matter of any kind.

All forms shall be wetted thoroughly before the concrete is placed therein.

#### F. Consolidation

All concrete shall be well consolidated, and the mortar flushed to the form surfaces by continuous working with immersion type vibrators. Vibrators which operate by attachment to forms or reinforcement will not be permitted, except on steel forms. At least 1 standby vibrator shall be provided for emergency use in addition to the ones required for placement. For lightweight concrete, vibrators of the high frequency type, which produce a minimum of 7000 impulses per minute, will be required.

The concrete shall be vibrated immediately after deposition. Prior to the beginning of work, a systematic spacing of the points of vibration shall be established to insure complete consolidation and thorough working of the concrete around the reinforcement, embedded fixtures and into the corners and angles of the forms. Immersion type vibrators shall be inserted vertically, at points 18 to 30 inches apart and slowly withdrawn. The vibrator may only be inserted in a sloping or horizontal position in shallow slabs. The entire depth of each lift shall be vibrated, allowing the vibrator to penetrate several inches into the preceding lift. The vibrator shall not be used to move the concrete to other locations. In addition, the vibrator shall not be dragged through the concrete. Concrete along construction joints shall be thoroughly consolidated by operating the vibrator along and close to but not against the joint surface. The vibration shall continue until thorough consolidation and complete embedment of reinforcement and fixtures is produced, but not long enough to cause segregation. Vibration may be supplemented by hand spading or rodding, if necessary, to insure the flushing of mortar to the surface of all forms.

#### G. Finishing

From the time of initial strike off until final finish is completed and required interim curing is in place, the unformed surfaces of slab concrete in bridge decks and top slab of direct traffic culverts and concrete slabs, shall be kept damp, not wet, to offset the effects of rapid evaporation of mixing water from the concrete due to wind, temperature, low humidity or combinations thereof. Fogging equipment capable of applying water in the form of a fine fog mist, not a spray, will be required. Fogging will be applied at the times and in the manner directed by the City Engineer or designated representative.

Fogging equipment may be either water pumped under high pressure or a combination of air and water, either system in combination with a proper atomizing nozzle. The equipment shall be sufficiently portable for use in the direction of any prevailing winds. The equipment shall be adapted for intermittent use to prevent excessive wetting of the surfaces.

Upon completion of the final finish, interim curing will be required for slab concrete in bridge decks and top slabs of direct traffic culverts as follows:

- a. Required water curing shall begin as soon as it can be done without damaging the concrete finish.
- b. Unless otherwise indicated on the Drawings, Type 1-D membrane curing compound (resin base only) shall be applied to the slab surface.

#### H. Installation of Dowels and Anchor Bolts

Dowels and anchor bolts shall be installed by casting them in place or by grouting with grout, epoxy, or epoxy mortar unless indicated otherwise on the drawings.

Holes for grouting shall be formed or drilled. Holes for anchor bolts shall be drilled to accommodate the bolt embedment required on the drawings. Holes for dowels shall be made at least 12 in. deep unless indicated otherwise on the drawings. When grout or epoxy mortar is specified the diameter of the hole shall be at least twice the dowel or bolt diameter but shall not exceed the dowel or bolt diameter plus 1 ½ in. When epoxy is specified the hole diameter should be 1/16 to 1/4 in. greater than the dowel or bolt diameter.

Holes for anchor bolts in piers, abutments, bents or pedestals may be drilled or formed by the insertion of oiled wooden plugs or metal sleeves in the plastic concrete. Formed holes shall be large enough to permit horizontal adjustments of the bolts. The bolts shall be carefully set in mortar. In lieu of the above, anchor bolts may be set to exact locations when the concrete is placed.

The holes shall be thoroughly cleaned of all loose material, oil, grease or other bond-breaking substance and blow them clean with filtered compressed air. When an epoxy type material is used the holes shall be in a surface dry condition. When hydraulic cement grout is used the holes shall be in a surface moist condition. The void space between the hole and the dowel or bolt shall be completely filled with grouting material. The requirements for cleaning outlined in the product specification for prepackaged systems shall be followed exactly.

The following should be used as a guide in selection of an appropriate grout, mortar, epoxy or epoxy grout.

<b>Material Type</b>	<b>Recommendation</b>
Epoxy, Epoxy Mortar or other prepackaged Mortar	As Approved
Cast-in-place or Grouted system	1 part hydraulic cement, 2 parts sand and sufficient water for desired consistency
Neat Epoxy	Type III epoxy per TxDOT DMS-6100, "Epoxies and Adhesives"
Epoxy Grout	Type III epoxy per TxDOT DMS-6100, "Epoxies and Adhesives" Provide grout, epoxy or epoxy mortar as the binding agent unless otherwise indicated on the drawings

#### 410S.13 - Placing Concrete in Cold Weather

##### A. General

The Contractor is responsible for the protection of concrete placed under any and all weather conditions and is responsible for producing concrete equal in quality to that placed under normal

conditions. Permission given by the City Engineer or designated representative to allow placement of the concrete during cold weather does not relieve the Contractor of the responsibility for producing concrete equal in quality to that placed under normal conditions. Concrete placed under adverse weather conditions that proves to be unsatisfactory shall be removed and replaced at Contractor' expense.

#### B. Cast-in-Place Concrete

Concrete may be placed when the ambient temperature is not less than 35°F in the shade and rising or above 40°F. Concrete shall not be placed when the ambient temperature in the shade is below 40°F and falling unless approved by the City Engineer or designated representative. Concrete shall not be placed in contact with any material coated with frost or having a temperature less than 32°F.

Aggregates shall be free from ice, frost and frozen lumps. When required, in order to produce the minimum specified concrete temperature; the aggregate and/or the water shall be heated uniformly, in accordance with the following:

The water temperature shall not exceed 180°F and/or the aggregate temperature shall not exceed 150°F. The heating apparatus shall heat the mass of aggregate uniformly. The temperature of the mixture of aggregates and water shall be between 50°F and 85°F before introduction of the cement.

All concrete shall be effectively protected as follows:

1. The temperature of slab concrete of all unformed surfaces shall be maintained at 50°F or above for a period of 72 hours from time of placement and above 40°F for an additional 72 hours.
2. The temperature at the surface of all concrete in bents, piers, culvert walls, retaining walls, parapets, wingwalls, bottom of slabs and other similar forms shall be maintained at 40°F or above for a period of 72 hours from time of placement.
3. The temperature of all concrete, including the bottom slabs of culverts placed on or in the ground, shall be maintained above 32°F for a period of 72 hours from time of placement.

Protection shall consist of providing additional covering, insulated forms or other means and if necessary, supplementing such covering with artificial heating. Avoid applying heat directly to concrete surfaces. Curing shall be provided during this period until all requirements for curing have been satisfied.

When impending weather conditions indicate the possibility of the need for such temperature protection, all necessary heating and covering material shall be on hand ready for use before permission is granted to begin placement.

Sufficient extra test specimens will be made and cured with the placement to ascertain the condition of the concrete as placed prior to form removal and acceptance.

#### C. Precast Concrete

A fabricating plant for precast products which has adequate protection from cold weather in the form of permanent or portable framework and covering, which protects the concrete when placed the forms and is equipped with approved steam curing facilities may place concrete under any low temperature conditions provided:



1. The framework and covering are placed, and heat is provided for the concrete and the forms within 1 hour after the concrete is placed. This shall not be construed to be 1 hour after the last concrete is placed, but that no concrete shall remain unprotected longer than 1 hour.
2. Steam heat shall keep the air surrounding the concrete between 50°F and 85°F for a minimum of 3 hours prior to beginning the temperature rise, which is required for steam curing.

#### 410S.14 - Placing Concrete in Hot Weather

When the temperature of the air is above 85°F, an approved retarding agent will be required in all exposed concrete, concrete used in superstructures, top slabs of direct traffic culverts and all cased drilled shafts regardless of temperatures. Concrete mix temperatures shall not exceed 90°F except for mixes that include high range water reducers where a maximum mix temperature of 100°F will be allowed.

If the concrete mix temperature is expected to exceed 90°F (or 100°F in mixes with high range water reducers) ice may be utilized to lower the concrete mix temperature. Ice may be added to the concrete mix as a portion by weight of the mix water. However, the addition of ice shall not exceed 50% of the total mix water weight.

When weather conditions are such that the addition of ice at 50% of the mix water is not sufficient to reduce the concrete mix temperature to an acceptable temperature, concrete work shall not be allowed.

When ice is to be used in hot weather concrete placement, the Contractor shall furnish a mix design (Section 4.4 of Standard Specification Item 360S, "Concrete Pavement" and Section 6 of Standard Specification Item No. 403S, "Concrete for Structures") acceptable to the City Engineer or designated representative for class of concrete specified on the drawings.

#### 410S.15 - Placing Concrete in Water

Concrete shall be deposited in water only when indicated on the drawings or with written permission of the City Engineer or designated representative. The forms, cofferdams or caissons shall be sufficiently tight to prevent any water current passing through the space in which the concrete is being deposited. Pumping will not be permitted during the concrete placing nor until it has set for at least 36 hours.

The concrete shall be placed with a tremie, pump or other approved method and shall not be permitted to fall freely through the water nor shall it be disturbed after it has been placed. Its surface shall be kept approximately level during placement.

The tremie shall be supported or the pump operated so that it can be easily moved horizontally to cover all the work area and vertically to control the concrete flow. The lower end of the tremie or pump hose shall be submerged in the concrete at all times.

The placing operations shall be continuous until the work is complete.

For concrete to be placed under water, the concrete mix shall be designed in accordance with Standard Specification Item No. 403S, "Concrete For Structures" with a minimum cement content of 650 lb. Per cubic yard. An anti-wash admixture may be included in the mix design as necessary to produce a satisfactory finished product.

#### 410S.16 - Placing Concrete in Box Culverts

In general, construction joints will be permitted only where indicated on the drawings.

Where the top slab and walls are placed monolithically in culverts more than 4 feet in clear height, an interval of not less than 1 nor more than 2 hours shall elapse before placing the top slab to allow for settlement and shrinkage in the concrete wall.

The base slab shall be trowel finished accurately at the proper time to provide a smooth uniform surface. Top slabs, which carry traffic, shall be finished as specified for roadway slabs in "Finish of Roadway Slabs", below. Top slabs of fill type culverts shall be given a reasonably smooth float finish.

#### 410S.17 - Placing Concrete in Foundations and Substructure

Concrete shall not be placed in footings until the depth and character of the foundation has been inspected by the City Engineer or designated representative and permission has been given to proceed.

Placing of concrete footings upon seal courses will be permitted after the caissons or cofferdams are free from water and the seal course cleaned. Any necessary pumping or bailing during the concrete placement shall be done from a suitable sump located outside the forms.

All temporary wales or braces inside cofferdams or caissons shall be constructed or adjusted as the work proceeds to prevent unauthorized construction joints in footings or shafts.

When footings can be placed in a dry excavation without the use of cofferdams or caissons, forms may be omitted if desired by the Contractor and approved by the City Engineer or designated representative and the entire excavation filled with concrete to the elevation of the top of footing.

Concrete in columns shall be placed monolithically unless otherwise indicated on the drawings. Columns and caps and/or tie beams supported thereon may be placed in the same operation or separately. To allow for settlement and shrinkage of the column concrete, it shall be placed on the lower level of the cap or tie beam and placement delayed for not less than 1 hour nor more than 2 before proceeding with the cap or tie beam placement.

#### 410S.18 - Treatment and Finishing of Horizontal Surfaces Except Bridge Slabs

All unformed upper surfaces shall be struck off to grade and finished. The use of mortar topping for surfaces under this classification will not be permitted.

After the concrete has been struck off, the surface shall be floated with a suitable float. Bridge sidewalks shall be given a wood float or broom finish or may be striped with a brush as specified by the City Engineer or designated representative.

The tops of caps and piers between bearing areas shall be sloped slightly from the center toward the edge and the tops of abutments and transition bents sloped from the back wall to the edge, as directed by the City Engineer or designated representative, so that water will drain from the surface. The concrete shall be given a smooth trowel finish. Bearing areas for steel units shall be constructed in such a manner to have a full and even bearing upon the concrete. When the concrete is placed below grade, bearing areas may be raised to grade on beds of Portland cement mortar consisting of 1 part cement, 2 parts sand and a minimum amount of water.

Bearing seat buildups or pedestals for concrete units shall be cast integrally with the cap or with a construction joint. The construction joint area under the bearing shall have the surface roughened thoroughly as soon as practical after initial set is obtained. The bearing seat buildups shall be placed using a latex based grout, an epoxy grout, or an approved proprietary bearing mortar, mixed in accordance with the manufacturer's recommendation. Pedestals shall be placed using Class C concrete, reinforced as indicated on the drawings.

The bearing area under the expansion end of concrete slabs and slab and girder spans shall be given a steel-trowel finish to the exact grades required on the drawings. Bearing areas under elastomeric bearing pads or nonreinforced bearing seat buildups shall be given a textured wood float finish. The bearing area shall not vary from a level plane more than 1/16 in. in all directions.

#### 410S.19 - Placing Survey Monuments

The Contractor shall obtain City Survey Monuments, for a fee of 10 dollars, from the Department of Public Works, Construction Inspection Division. Monuments shall be embedded in freshly poured concrete at locations indicated on the drawings and accessible to survey equipment at the completion of the project. The monuments shall be installed flush with the adjacent concrete.

#### 410S.20 - Curing Concrete

The Contractor shall inform the City Engineer or designated representative fully of the methods and procedures proposed for curing, shall provide the proper equipment and material in adequate amounts and shall have the proposed method, equipment and material approved by the City Engineer or designated representative prior to placing concrete.

Inadequate curing and/or facilities therefore shall be cause for the City Engineer or designated representative to notify the Contractor, in writing, that the work is unsatisfactory, and the concrete will have to be removed and replaced.

All concrete shall be cured for a period of 4 curing days except as noted herein. A curing day is a calendar day when the temperature, taken in the shade away from artificial heat is above 50°F for at least 19 hours or on colder days if the temperature of all surfaces of the concrete is maintained above 40°F for the entire 24 hours. The required curing shall begin when all concrete has attained its initial set. TxDOT's Tex-440-A, "Initial Time-of-Set of Fresh Concrete" may be used to establish when the concrete has attained its initial set.

<b>Description</b>	<b>Type of Cement</b>	<b>Required Curing Days</b>
Upper Surfaces of Bridge Slabs, Top Slabs of Direct Traffic Culverts and Concrete Overlays	I or II	8
	II or I/II	10
	All types with supplementary cementing materials	10
Concrete Piling buildups		6

For upper surfaces of bridge slabs, bridge support slabs, median and sidewalk slabs and culvert top slabs constructed using Class S Concrete (Standard Specification Item No. 403S, "Concrete for Structures") interim curing using a Type 1-D curing compound shall be applied as soon as possible after application of the evaporation retardant and after the water sheen has disappeared, but no more than 45 minutes after application of the evaporation retardant. Membrane interim curing shall be applied using a work bridge or other approved apparatus to ensure a uniform application. Final curing with water cure in accordance with this section shall start as soon as possible without damaging the surface finish. Water curing shall be maintained for the duration noted in the table above. Polyethylene sheeting, burlap-polyethylene blankets, laminated mats or insulating curing mats shall be placed in direct contact with the slab when the ambient temperature is expected to drop below 40°F during the first 72 hours of the curing period. The curing materials will be weighed down with dry mats to maintain direct contact with the concrete and to provide insulation against cold weather. Supplemental heating or insulation may be required in cold and wet weather if the insulating cotton mats become wet or if the concrete temperature drops below the specified curing temperature. Application of heat directly to concrete surfaces shall be avoided.

For the top surface of any concrete unit upon which concrete is to be placed and bonded at a later date (i.e. stub walls, risers, etc.), only water-cure in accordance with this Section shall be used.

All other concrete shall be cured as specified in pertinent Items.

The following methods are permitted for curing concrete subject to the restrictions of this Item:

A. Form Curing

When forms are left in intimate contact with the concrete, other curing methods will not be required except for exposed surfaces and for cold weather protection.

When forms are stripped before the 4-day minimum curing time has elapsed, curing shall continue by an approved method.

B. Water Curing

All exposed surfaces of the concrete shall be kept wet continuously for the required curing time. The water used for curing shall meet the requirements for concrete mixing water as indicated in Item No. 403S, "Concrete for Structures". Seawater will not be permitted. Water, which stains or leaves an unsightly residue, shall not be used.

1. Wet Mats

Wet cotton mats placed in direct contact with the slab shall be maintained for the required curing time. If needed damp burlap blankets made from 9-ounce stock may be placed on the damp concrete surface for temporary protection prior to the application of the cotton mats, which may be placed dry and wetted down after placement.

The mats shall be weighted down adequately to provide continuous contact with all concrete surfaces where possible. The surfaces of the concrete shall be kept wet for the required curing time. Surfaces, which cannot be cured by contact, shall be enclosed with mats, anchored positively to the forms or to the ground, so that outside air cannot enter the enclosure. Sufficient moisture shall be provided inside the enclosure to keep all surfaces of the concrete wet.

2. Water Spray

This method shall consist of overlapping sprays or sprinklers that keep all unformed surfaces continuously wet.

3. Ponding

This method requires the covering of the surfaces with a minimum of 2 inches of clean granular material, kept wet at all times or a minimum of 1 inch depth of water. Satisfactory provisions shall be made to provide a dam to retain the water or saturated granular material.

C. Membrane Curing

Unless otherwise indicated on the drawings, either Type 1-D or Type 2 membrane curing compound may be used where permitted except that Type 1-D (Resin Base Only) will be permitted for slab concrete in bridge decks and top slabs of direct traffic culverts and all other surfaces that require a higher grade of surface finish. For substructure concrete, only one Type of curing compound will be permitted on any one structure.

<b>TABLE 5</b>				
<b>STRUCTURE UNIT DESCRIPTION</b>	<b>REQUIRED</b>		<b>PERMITTED</b>	
	<b>Water for Complete Curing</b>	<b>Membrane for Interim Curing</b>	<b>Water for Complete Curing</b>	<b>Membrane for Complete Curing</b>
1. Upper surfaces of Bridge Roadway, Median and Side walk Slabs, Top Slabs of Direct Traffic, and Culverts.	X	X (resin base)		
2. Top Surface of any Concrete Unit upon which Concrete is to be placed and bonded at a later interval (Stub Walls, Risers, etc.). Other Super-structure Concrete (curbs, wing- walls, Parapet Walls, etc.).	X		*X	*X
3. Top Surface of Precast and/or Pre-stressed Piling.	X	X		
4. All Substructure Concrete Culverts. Box Sewers, Inlets, Manholes, Retaining Walls, Riprap.			*X	*X

\* Polyethylene Sheeting, Burlap-Polyethylene Mats or Laminated Mats in close intimate contact with the concrete surfaces, will be considered equivalent to water or membrane curing for items under 4.

The membrane curing shall be applied just after free moisture has disappeared in a single, uniform coating at the rate of coverage recommended by the manufacturer and as approved by the City Engineer or designated representative, but not less than 1 gallon per 180 square feet of area. Tests for acceptance shall be at this specified rate.

Membrane curing shall not be applied to dry surfaces but shall be applied just after free moisture has disappeared. Formed surfaces and surfaces which have given a first rub shall be dampened and shall be moist at the time of application of the membrane.

When membrane is used for complete curing, the film shall remain unbroken for the minimum curing period specified. Membrane, which is damaged, shall be corrected immediately by reapplication of membrane. Polyethylene sheeting, burlap-polyethylene mats or laminated mats in close intimate contact with the concrete surfaces, will be considered equivalent to membrane curing. Unless otherwise indicated on the drawing, the choice of membrane type shall be at the option of the Contractor, except that the City Engineer or designated representative may require the same curing method for like portions of a single structure.

#### 410S.21 - Removal of Forms and Falsework

Unless otherwise indicated on the drawing, forms for vertical surfaces may be removed when the concrete has aged 12 hours after initial set, provided it can be done without damage to the concrete. Forms for mass concrete placements shall be maintained in place for 4-days following concrete placement. Mass placements are defined as concrete placements with a least dimension greater than equal to 5 ft., or those designated as such on the drawings.

Forms for inside curb faces may be removed in approximately 3 hours provided it can be done without damage to the curb.

Unless indicated otherwise on the drawings weight supporting forms and falsework spanning more than 1 ft. for structures, bridge components and culvert slabs shall remain in place until the concrete has attained a minimum compressive strength of 2500 psi. Forms for other structural components may be removed as specified by the City Engineer or designated representative.

Inside forms (walls and top slabs) for inlets, box culverts and sewers may be removed after the concrete has attained a minimum compressive strength of 1800 psi, provided an overhead support system, approved by the City Engineer or designated representative, is used to transfer the weight of the top slab to the walls of the box culvert or sewer before the support provided by the forms is removed.

If all test cylinders made for the purpose of form removal have been broken without attaining the required strength, forms shall remain in place for a total of 14 curing days.

The above provisions relative to form removal shall apply only to forms or parts thereof which are constructed to permit removal without disturbing forms or falsework required to be left in place for a longer period on other portions of the structure.

Remove all metal appliances used inside forms for alignment shall be removed to a depth of at least 1/2 in. from the concrete surface. The appliances shall be manufactured to allow the removal without undue chipping or spalling of the concrete, and so that it leaves a smooth opening in the concrete surface when removed. Rods, bolts and ties shall not be burned-off.

Backfilling against walls of Type I or Type II cement shall not take place for a minimum of 7 days. Backfilling against walls of Type III cement shall not take place until the cylinder compressive strength has reached 3000 psi or the wall has cured for 5 days.

All forms and falsework shall be removed unless indicated otherwise on the drawings.

#### 410S.22 - Defective Work

Any defective work discovered after the forms have been removed shall be repaired as soon as possible in accordance with "Finishing Exposed Surfaces", below.

If the surface of the concrete is bulged, uneven or shows excess honeycombing or form marks, which in the opinion of the City Engineer or designated representative, cannot be repaired satisfactorily, the entire section shall be removed and replaced at the expense of the Contractor.

#### 410S.23 - Finishing Exposed Surfaces

##### A. Ordinary Surface Finish

An Ordinary Surface Finish shall be applied to all concrete surfaces either as a final finish or preparatory to a higher grade or class of finish. Higher grades and classes of finish shall conform to Item No. 411S, "Surface Finishes for Concrete". Where neither a grade or class of finish is specified, an Ordinary Surface Finish only, will be required.

Ordinary Surface Finish shall be provided as follows:

1. After form removal, all porous, honeycombed areas and spalled areas shall be corrected by chipping away all loose or broken material to sound concrete.
2. Feathered edges shall be eliminated by saw-cutting and chipping spalled areas to a depth at least 1/2 in. deep perpendicular to the surface. Shallow cavities shall be repaired using a latex adhesive grout, cement mortar or epoxy grout approved by the City Engineer or designated representative. If judged repairable by the City Engineer or designated representative, large defective areas shall be corrected using concrete or other material approved by the City Engineer or designated representative.
3. Holes and spalls caused by removal of form ties, etc., shall be cleaned and filled with latex adhesive grout, cement mortar or epoxy grout approved by the City Engineer or designated representative. Only the holes shall be filled. The patch shall not be blended with the surrounding concrete. On surfaces to receive a rub finish in accordance with Standard Specification Item No. 411S, "Surface Finishes for Concrete" the exposed parts of metal chairs shall be chipped out to a depth of 1/2 inch and the surface repaired.
4. All fins, runs, drips or mortar that will be exposed shall be removed from surfaces. Form marks and chamfer edges shall be smoothed by grinding and/or dry rubbing.
5. Grease, oil, dirt, curing compound, etc., shall be removed from surfaces requiring a higher grade of finish. Discolorations resulting from spillage or splashing of asphalt, paint or other similar material shall be removed.

6. Repairs shall be dense, well bonded and properly cured and when made on surfaces, which remain exposed and do not require a higher finish, shall be finished to blend with the surrounding concrete.

Unless otherwise indicated on the drawings Ordinary Surface Finish shall be the final finish for the following exposed surfaces:

1. inside and top of inlets,
2. inside and top of manholes,
3. inside of sewer appurtenances,
4. inside of culvert barrels,
5. bottom of bridge decks between beams or girders,
6. vertical and bottom surfaces of interior concrete beams or girders.

#### B. Rubbed Finish

In general, the following areas shall require a rubbed finish and shall receive a first and second rubbing:

1. The top, exterior and roadway facia of curbs and parapet walls.
2. All concrete surfaces of railing.
3. The exterior vertical facia of slab spans, rigid frames, arches and box girders.
4. The outside and bottom surfaces of facia beams or girders (except precast concrete beams).
5. The underside of overhanging slabs to the point of juncture of the supporting beams.
6. All vertical surfaces of piers, columns, bent caps, abutments, wing walls and retaining walls which are exposed to view after all backfill and embankments is placed.
7. Exposed formed surfaces of inlet and outlet structures on culverts, transition structures, headwalls and inlets.
8. Such other surfaces specified elsewhere to receive a rubbed finish and such additional surfaces required by the City Engineer or designated representative to receive a rubbed finish.

After removal of forms and as soon as the mortar used in pointing has set sufficiently, surfaces to be rubbed shall be wet with a brush and given a first surface rubbing with a medium coarse carborundum stone. This rubbing shall be done before the concrete has cured more than 48 hours.

The second rubbing shall present a cleaned uniform appearance free from drip marks and discoloration. It shall be given with a No.30 carborundum stone or an abrasive of equal quality.

If the Contractor elects to use epoxy paint in lieu of the second rubbings the Contractor may do so upon approval of the City Engineer or designated representative.



C. Special Surface Finishes

Striated, exposed aggregate and other special surface finishes shall conform to Standard Specification Item No. 411S, "Surface Finishes for Concrete" and/or with the requirements indicated on the drawings.

410S.24 - Measurement and Payment

No direct measurement or payment will be made for the work to be done or the equipment to be furnished under this item but shall be included in the unit price bid for the item of construction in which this item is used.

**END**

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## ITEM NO. 411S - SURFACE FINISHES FOR CONCRETE

### 411S.1 - Description

This item shall govern the furnishing of all materials and the application by the methods of construction indicated on the Drawings for the application of a surface finish to concrete.

### 411S.2 - Submittals

The submittal requirements of this specification item include:

- A. Type and manufacturer of cement(s).
- B. Type and manufacturer of membrane curing compound.
- C. Type and manufacturer of adhesive grout.
- D. Type and manufacturer of resin paint.
- E. Samples as requested.
- F. Locations of proposed grade/class of finishes.

### 411S.3 - Materials

#### (1) Masonry Sand

Masonry sand shall conform to ASTM C 144.

#### (2) White Cement

White cement shall conform to ASTM C 150.

#### (3) Portland Cement

All cement unless otherwise indicated shall be Portland cement conforming to ASTM C 150.

Portland cement manufactured in a cement kiln fueled by hazardous waste shall be considered as an approved product if the production facility is authorized to operate under regulation of the Texas Natural Resource Conservation Commission (TNRCC) and the U. S. Environmental Protection Agency (EPA). Supplier shall provide current TNRCC and EPA authorizations to operate the facility.

#### (4) Membrane Curing

Membrane curing shall conform to Item No. 409S, "Membrane Curing".

#### (5) Adhesive Grout

This subsection sets forth the requirements for three epoxy adhesives with different viscosities designed to bond fresh Portland Cement concrete to existing Portland

Cement concrete, hardened concrete to hardened concrete and steel to fresh or hardened concrete. These adhesives are as follows:

Type V: Standard (medium viscosity) for applying to horizontal and vertical surfaces. This material is suitable for surface sealing of fine cracks in concrete.

Type VI: Low viscosity for application with spray equipment to horizontal surfaces.

Type VII: Paste consistency for overhead application and where a high buildup is required. This material is suitable for surface sealing of cracks in concrete, which are v-ed out prior to sealing, and for grouting of dowel bars where clearance is 1/16 inch or less.

- (a) **Mixing Ratio:** The ratio of resin and hardener components to be mixed together to form the finished adhesive shall be either 1 to 1 or 2 to 1 by volume.

Any specific coloring of resin and/or hardener components desired will be stated by the Engineer or designated representative.

Fillers, pigments and thixotropic agents. All fillers, pigments and/or thixotropic agents in either the epoxy resin or hardener component must be of sufficiently fine particle size and dispersed so that no appreciable separation or settling will occur during storage.

Any fillers present in the low viscosity version must be of such a nature that they will not interfere with application by spray equipment or abrade or damage such equipment.

The concrete adhesive shall contain no volatile solvents.

- (b) **Consistency:** The adhesives shall comply with the following:

	Type V	Type VI	Type VII
Viscosity of mixed adhesive 77° ± 1°F, Poises	400 Maximum	150 Maximum	must be sufficiently fluid to apply by trowel or spatula without difficulty
Pot Life at 77°F, minutes minimum - 30			
Set Time at 77°F (Time required to attain 180 psi), hours maximum - 12			

Thixotropy test shall be performed at both 77° and 120°F. Average thickness of cured adhesive remaining on test panel, mils minimum.

Type V	Type VII
30	45

Samples of the individual components in sealed containers shall be maintained at 115° + 3°F for 2 weeks. The mixed adhesive prepared from these samples must still comply with the minimum thixotropy requirements.

The viscosity of the Type V and Type VI versions must not show an increase of more than 20 percent compared with the viscosity prior to the stability test. The Type VII adhesive must still be sufficiently fluid to apply by trowel or spatula without difficulty.

(c) Physical Properties of the Cured Adhesive

Property	Requirements
Adhesive Shear Strength, psi, minimum	2200
Water Gain, percent by weight, maximum	0.20
Ability to bond fresh Portland cement concrete to cured Portland cement concrete psi, minimum (7 days cure time)	400

(6) Synthetic Resin Paint

Type X Epoxy: This is a high solids epoxy coating designed for application by brush or roller. The materials can also be applied by airless spray by addition of a maximum of 5 percent toluene solvent at the direction of the Engineer or designated representative.

Raw Materials: The basic raw materials to be incorporated into this coating are listed below, along with the specific requirements for each material. The final decision as to the quality of materials shall be made by the Engineer or designated representative. After the Engineer or designated representative has approved the brand names of raw materials proposed by the Contractor, no substitution will be allowed during the manufacture without prior approval of the Engineer or designated representative.

Epoxy Resin: The basic epoxy resin used in the formulation shall be an unmodified liquid resin conforming to the following chemical and physical requirements:

Viscosity at 25.0 + 0.1 C, cps	7,000 to 10,000
Weight per epoxy equivalent, gms per gm - mole	175 to 195
Color (Gardner Number), maximum	5
Hydrolyzable chlorine, maximum % by weight	0.2
Specific gravity, 25/25 degrees	1.14 to 1.18

Test methods to be used in determining these qualities are listed below:

- (a) Viscosity - Test for Kinematic Viscosity (ASTM Designation: D 445).

- (b) Weight per Epoxy Equivalent - Test for Epoxy Content of Epoxy Resins (ASTM Designation: D 1652).
- (c) Color - Test for Color of Transparent Liquids (Gardner Color Scale) (ASTM Designation: D 1544).
- (d) Hydrolyzable Chlorine - Test for Hydrolyzable Chlorine Content of Liquid Epoxy Resins (ASTM Designation D: 1726).
- (e) Specific Gravity - Method of Test for Density of Paint, Varnish, Lacquer and Related Products (ASTM Designation: D 1475).

**Pigment**

Titanium Dioxide: The titanium dioxide used in this formulation shall be equivalent to DuPont R-900. This shall be a pure, chalk-resistant, rutile titanium dioxide meeting the requirements of ASTM D 476, Type III.

Extender: The extender used in this formulation shall be Nyad 400, manufactured by Interpace Pigments. Specific requirements are as follows:

<b>Particle size distribution</b>	<b>Minimum</b>	<b>Maximum</b>
Minus 20 microns, percent by weight	95	
Minus 10 microns, percent by weight	70	80
Minus 5 microns, percent by weight	40	50
Minus 3 microns, percent by weight	30	40
Minus 1 micron, percent by weight	14	20
Oil Absorption (rub out, lbs/100 lbs)		25 maximum
Brightness (G.E.)	92.5 minimum	

**411S.4 - Grade of Finish**

**(1) General**

The grade and/or class of finish shall be as described herein and as indicated.

"Grade" of finish designates the areas to which a higher finish is to be applied beyond the requirements of an Ordinary Surface Finish. Four grades of finish are included herein.

"Class" of finish designates the materials or the process to be used in providing the grade of finish. Three classes of finish are included herein.

For structures and surfaces not described herein under grade of finish, a class of finish only may be indicated. Where neither a grade nor class is specified, an Ordinary Surface Finish only will be required as specified in Item No. 410S, "Concrete Structures".

Where the plans specify a grade and class of finish, i.e., Grade II, Class C, only that type of finish shall be furnished.

Where the plans specify a grade of finish only, i.e., Grade I Finish, any of the classes of finish may be furnished. Only one class of finish shall be furnished on any individual structure, twin structures or on structures in close proximity to each other, except as specified for prestressed concrete members below.

(2) Grade I

The following areas shall receive a Class A, B or C (two rub) Finish, except that prestressed members shall receive either a Class A or B Finish only.

All concrete surfaces of railing, including the parapet types; exterior vertical faces of slabs, slab spans, arches and box girders; the outside and bottom surfaces of fascia beams or girders (including prestressed members); the underside of overhanging slabs to the point of juncture of the supporting beam; all exposed vertical surfaces of bents and piers and bottom surfaces of bent caps; all exposed surfaces of tie beams, abutments, bridge wingwalls, culvert headwalls and wingwalls and retaining walls exposed to view after all backfill and is placed.

Unless otherwise indicated, the underside of the slab of slab spans shall be finished its entire width.

Unless otherwise indicated, exposed surfaces of pump houses and other miscellaneous concrete surfaces shall receive a Class A, B or C (one rub) Finish.

(3) Grade II

All concrete surfaces of railing, including the parapet types, all exposed surfaces of bridge wingwalls and the exterior vertical faces of slabs and slab spans shall receive a Class A, B or C (two rub) Finish. All other surfaces described under Grade I Finish shall receive a Class A or B finish only. The underside of slab spans shall receive an Ordinary Surface Finish only.

(4) Grade III

All concrete surfaces of railing, including the parapet types, all exposed surfaces of bridge wingwalls and the exterior vertical faces of slabs shall receive a Class A, B or C (two rub) Finish. All other surfaces described under Grade I Finish shall receive an Ordinary Surface Finish.

(5) Grade IV

The top and roadway faces only of all concrete railing, including the parapet types and bridge wingwalls shall receive a Class A, B or C (one rub) Finish. All other surfaces described under Grade I shall receive an Ordinary Surface Finish.

#### 411S.5 - Class of Finish

The Class of Finish designates either an adhesive grout material, a paint-type material or a rubbing process applied to surfaces specified in "Grade of Finish", as required above and/or as indicated.

Unless otherwise indicated the color shall be concrete gray.

(1) Class A

This finish shall consist of an adhesive grout textured coating with a minimum 1/16 inch thickness, composed of 1 part white cement, 1 part natural (gray) cement, 2 parts masonry sand, 1 part (latex) emulsion and enough water to form a viscous slurry of a consistency that may be applied by spray gun, brush or roller without appreciable running or sagging. The proportions of white and gray cement may be varied slightly to obtain the desired color.

Gradation of the masonry sand shall be as required to produce a texture satisfactory to the Engineer or designated representative.

Prepackaged materials meeting these requirements and acceptable to the Engineer or designated representative as to color, texture and appearance will be permitted.

(2) Class B

The finish shall be a paint-type material, consisting of a synthetic resin, containing fibrous as well as texturing pigments, which when applied by a 1 coat spray application at the rate of  $45 \pm 5$  square feet per gallon yield an acceptable textured coating. Certification by the manufacturer of the above materials will be required.

(3) Class C

This finish shall consist of a one rub or two rub system, as the case may be, meeting the requirements set forth below under "Construction Methods".

411S.6 - Approval of Surface Finishing Materials

The material to be furnished shall meet the requirements of TxDOT Specification DMS-8110, Structural Coatings, latest revision.

In addition to the above, the manufacturer shall furnish the following:

- (1) At the time of original request for approval of the surface furnishing material, the manufacturer shall supply a 1-gallon sample of the material to the Engineer or designated representative, if requested.
- (2) Each 6 months after approval of the material, the manufacturer shall furnish a notarized certification indicating that the material originally approved has not been changed or altered in any way. Any change in formulation of a surface finish shall require retesting prior to use.

The Engineer or designated representative may request additional information to be submitted such as infrared spectrophotometry scan, solids content, etc., for further identification. A change in formula discovered by any of the tests prescribed herein or by other means and not reported and retested, may cause to permanently bar the manufacturer from furnishing surface finish materials for City work.

The City reserves the right to perform any or all of the tests required by this specification as a check on the tests reported by the manufacturer. In case of any variance the City tests will govern.

#### 411S.7 - Construction Methods

Prior to application of any of the finishes required herein, concrete surfaces shall be given an Ordinary Surface Finish. For Class A and B materials, concrete surfaces shall be clean and free of dirt, grease, curing compound or any other bond breaking substance. Class A shall be applied on moistened surfaces, but Class B requires a dry surface. The temperature of the atmosphere, concrete and compound shall be above 50°F for Classes A and B at the time of application. The finished surfaces shall be protected against rain or freezing for a period of 24 hours after application.

Class A materials shall be applied by spraying, by roller or by brush. Class B materials shall be applied by spraying only. All applications shall provide an acceptable texture of the proper coverage.

The Class A and B material shall be applied after all preparation work required by Ordinary Surface Finish has been completed.

The Class C Finish shall be performed with a carborundum stone as follows, after all preparatory work required by Ordinary Surface Finish has been completed:

For a two-rub system, the first rubbing shall bring the wetted concrete face to a paste and produce a smooth dense surface without pits, form marks or other irregularities. The use of cement or grout to form the paste will not be permitted. Striping with a brush and washing after the first rubbing will not be required. Chamfer lines shall be finished during the second rubbing.

The first rubbing shall be done soon after form removal. Membrane curing, if used, shall be applied after the first rub is complete. Prior to the second rubbing, any remaining curing membrane shall be removed from the surface by brushing, buffing or other satisfactory methods.

The second rubbing shall be performed when conditioning the structure for final acceptance. The specified surfaces shall be cleaned of drip marks and discolorations and given a final rubbing. The surface shall be striped neatly with a brush and the paste allowed to take a reset, after which the surfaces shall be washed with clean water leaving them with a neat and uniform appearance and texture.

For a one rub system, the rubbing requirements shall be the same as for the first rub above, except chamfer lines shall be finished and the paste spread uniformly, striped with a brush and allowed to take a reset after which the surfaces shall be washed with clean water leaving them with a neat and uniform appearance and texture.

#### 411S.8 - Special Surfaces Finishes

##### (1) General

When special surface finishes are required for retaining walls, panels, copings or similar construction, the Contractor shall prepare sample panels for approval of the finish and the method of application. Unless otherwise indicated, panel or pattern arrangement and dimensions may be varied to achieve a more pleasing appearance or to utilize forming material more efficiently when approved by the Engineer or designated representative. Aggregates, materials, variation of panel or pattern arrangement, dimensions and other features affecting the work shall be approved prior to start of the work.



(2) Striated Finish

The striated (grooved) pattern shall be as indicated or as approved by the Engineer or designated representative.

The finish shall be made by lining the forms with striated sheets of plywood, plastic, fiberglass, metal or other material acceptable to the Engineer or designated representative. The striations on the panels shall be of a smooth, wide pattern, not sharp or angular.

A chamfer groove shall be used along all edges of each panel. All ties, bolts or other forming accessories shall be located along the chamfer grooves or panel edges.

411S.9 - Measurement and Payment

No direct measurement or payment will be made for the work to be done, the equipment or materials to be furnished under this item but shall be included in the unit price bid for the item of construction in which this item is used.

**END**

ITEM NO. 413S - CLEANING AND/OR SEALING JOINTS AND CRACKS (PORTLAND CEMENT CONCRETE)

413S.1 - Description

This item shall govern the cleaning and/or sealing of joints and cracks in either new or existing Portland Cement (PC) concrete pavements and bridge decks in conformance with the requirements herein and the details indicated on the Drawings or as established by the Engineer or designated representative.

413S.2 - Submittals

The submittal requirements of this specification item include:

- A. Sealant Type (Rubber-Asphalt, Polymer Modified Emulsion, Low Modulus Silicone or Polyurethane), Class and method of application (crack sealing, joint sealing, etc),
- B. Manufacturer recommendations concerning the use of primer and backer rod
- C. Manufacturer recommended equipment and procedures for preparation, dispensing, application, curing etc of the sealant, and
- D. Manufacturer certification that the product to be supplied meets or exceeds the specifications,
- E. Listing of the equipment proposed for the Work.

413S.3 - Materials

Joints and/or cracks shall be sealed with the type and/or class of materials indicated on the Drawings. The materials shall conform to the requirements of TxDOT Specification Item No. 433S, "Joint Sealants and Fillers" and TxDOT Departmental Materials Specification No. DMS-6310, "Joint Sealants and Seals".

Primers, if required, shall be as recommended by the manufacturer of the sealant. Backer rods, when required, shall be compatible with the sealant and shall not react with or bond to the sealant.

The sealing compound shall be delivered in the manufacturer's original sealed containers. Each container shall be legibly marked with the name of the manufacturer, the trade name of the sealer, the manufacturer's batch number or lot, the pouring temperature, and the safe heating temperature.

413S.4 - Equipment

All equipment shall be in accordance with the sealant manufacturer's recommendations. Air compressors shall be equipped with appropriate filters for removing oil and water from the air.

Any equipment, that damages dowels, reinforcing steel, PC concrete, base, subbase or subgrade in the process of cleaning the joints and/or cracks, shall be discontinued and the joint and/or crack shall be cleaned by other methods approved by the Engineer or designated representative, which do not cause such damage.

413S.5 - Construction Methods

Equipment, tools and machinery recommended for proper prosecution of the Work shall be on the project and shall be approved by the Engineer or designated representative prior to the initiation of the joint and/or crack cleaning and sealing operations.

#### A. Joint and Crack Preparation.

The bonding surface of cracks and joints shall be cleaned of infiltrated material, saw cuttings or other foreign material. All material removed from joints and cracks shall be removed from the paved surface of the roadway.

No sealing of any joints or cracks shall be done when the joints or cracks are damp, unless drying of the joints and cracks with compressed air can be demonstrated and meets with the approval of the Engineer or designated representative.

##### 1. Joint Preparation.

The joints shall be cleaned with filtered compressed air or other methods approved by the Engineer or designated representative. Unless noted otherwise on the Drawings, hand tools, air guns, power routers, abrasive equipment or other equipment may be used to clean the joints. Where indicated on the Drawings, the joint sealant space shall be resized by sawing to the width and depth shown on the Drawings to accommodate the type of sealant specified.

##### 2. Crack Preparation.

Unless indicated otherwise on the Drawings, the crack shall be grooved initially at the surface so that a reservoir of rectangular cross section is provided for the sealant. The grooves shall be cut to the dimensions shown on the Drawings. The devices that are used for grooving, such as diamond blade random cut saws, random-crack grinders, etc., shall be capable of following the path of the crack without causing excessive spalling or other damage to the concrete.

#### B. Joint and Crack Sealing

The sealant shall be installed in accordance with the manufacturer's recommended procedure. The joint and/or crack surfaces shall be surface dry unless recommended otherwise by the manufacturer of the sealant.

The surface temperature at the time of the sealing operation shall not be less than 40°F.

The minimum depth of sealant shall be 1/2 inch or a depth recommended by the sealant manufacturer and the top of the sealant shall be located 1/8 to 1/4 inch below the adjacent pavement surface.

##### 1. Primer.

If required, the primer shall be applied as soon as possible after cleaning is accomplished. The primer shall be applied uniformly at the rate recommended by the sealant manufacturer. The primer shall be applied to exposed metal surfaces before new corrosion begins and shall be allowed to cure for a minimum of thirty (30) minutes, but no longer than eight (8) hours prior to the application of the sealant, unless sealant manufacturer recommendations indicate otherwise.

##### 2. Backer Rods.

Backer rods shall be used to prevent a fluid type sealant from flowing through the joint and crack and to retain the sealant at its required elevation. The application and use of backer rod

shall be as recommended by the sealant manufacturer and approved by the Engineer or designated representative.

**413S.6 - Measurement**

Accepted work performed under this item shall be included in other pay items and will not be measured and paid for unless a separate pay item is provided in the contract bid form documents.

If a pay item is included in the contract documents, acceptable work for "Cleaning and/or Sealing Joints and Cracks" shall be measured by the lineal foot of sealant in place.

If a pay item is included in the contract documents, acceptable work "Cleaning and/or Sealing Joints and Cracks" shall be measured by the pound.

**413S.7 - Payment**

When included as a pay item in the contract documents, the work performed and materials furnished as provided by this item and measured in accordance with Article 413S.6, "Measurement", will be paid for at the appropriate unit bid price bid. The unit bid prices shall include full compensation for cleaning and, if necessary, grooving and/or sawing the crack/joint; furnishing, hauling and placing primer and backer rod, if necessary; furnishing, heating, hauling, and placing the crack/joint sealer; all freight involved and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment, when included as a contract pay item, will be made under:

<b>Pay Item No. 413S-A:</b>	_____ Sealer	Per Lineal Foot.
<b>Pay Item No. 413S-B:</b>	_____ Sealer	Per Pound of Sealer Used.

**END**

## ITEM NO. 414S - CONCRETE RETAINING WALLS

### 414S.1 - Description

This item shall govern reinforced PC (PC) concrete precast or cast-in-place retaining walls constructed in conformity with the lines, grades and details indicated on the Drawings or as directed by the Engineer or designated representative.

When indicated on the drawings or directed by the Engineer or designated representative, this item shall also govern any requirements for pumping, bailing, drainage and/or protection of workers in trenches in compliance with Standard Specification Item No. 509S, "Excavation Safety Systems".

### 414S.2 - Submittals

The submittal requirements of this specification item may include:

- A. Type of concrete
- B. Reinforcing steel type, size, area, lengths
- C. Joint sealants and fillers type, manufacturer, fact sheets and application recommendations.
- D. Curing compound; manufacturer, type compound material, batch number or symbol and appropriate fact sheets
- E. Filter fabric manufacturer, fact sheets and test results.
- F. Select Backfill source, gradation and test results.
- G. Type and manufacturer of waterstops

### 414S.3 - Materials

#### A. Concrete

Cast-in-place PC concrete shall conform to the requirements of a Class C Concrete, as specified in Standard Specification Item No. 403S, "Concrete For Structures". Precast PC concrete shall conform to the requirements of Standard Specification Item No. 403S, "Concrete for Structures" but shall have a minimum 28-day compressive strength of 4500 psi.

#### B. Reinforcing Steel

Reinforcing steel shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

#### C. Joint Sealants and Fillers

Preformed Bituminous Fiber Material shall meet the requirements of ASTM D 1751. Joint sealant shall be a non-sag low-modulus silicone.

#### D. Membrane Curing Compound

Membrane curing compound shall conform to Standard Specification Item No. 409S, "Membrane Curing".

E. Filter Fabric

Filter fabric shall conform to TxDOT DMS – 6200 “Filter Fabric.”

F. Select Backfill

Select backfill shall conform to Standard Specification Item No. 210S, "Flexible Base".

G. Waterstops

Waterstops, if shown on the Drawings, shall conform to Standard Specification Item 416S, "Waterstops".

H. Pipe Underdrains

Pipe Underdrains, if shown on the Drawings, shall conform to Standard Specification Item 551, "Pipe Underdrains".

414S.4 - Construction Methods

A. General

All excavation shall be done in accordance with Standard Specification Item No. 401S, "Structural Excavation and Backfill".

All forms and forming, placement of reinforcement, placement of PC concrete, form removal, finishing and curing shall conform to Standard Specification Item No. 410S, "Concrete Structures". Cast-in-place PC concrete retaining walls shall be constructed in one continuous vertical pour from the top of the footing to the top of the wall unless intermediate horizontal construction joints are shown on the Drawings.

The height of the retaining wall will be determined by established grades or as directed by the Engineer or designated representative but and shall be such that water will not be trapped or ponded on private or public property.

Reinforcement for the wall shall be as indicated on the Drawings. The Contractor shall provide dowel bars of the proper size, shape and spacing, as indicated on the drawings.

Devices to release the hydrostatic head shall be installed as indicated on the drawings.

**[NOTE TO SPECIFIER: VERIFY THAT WEEPHOLES ARE SHOWN ON THE DRAWINGS]**

All exposed corners and edges shall be filleted with triangular chamfer strips measuring 3/4 inch on each side. Exposed horizontal surfaces shall be level and flat, and exposed vertical surfaces shall be plumb and flat, unless indicated otherwise on the Drawings.

B. Vertical Control Joints

Unless indicated otherwise on the Drawings, vertical control joints shall be constructed in the retaining wall stem (the vertical portion of the wall) to create planes of weakness to control cracking. Horizontal wall reinforcement shall extend through the vertical control joints. These joints shall be constructed at abrupt changes in wall height and at a spacing not to exceed 20 feet in wall sections of uniform. The joints shall be formed by placing triangular chamfer strips to create grooves in both

faces of the wall to a depth of at least ten percent of the wall thickness. Control joints shall be sealed, on the backfilled side of the retaining wall, with a non-sag low-modulus silicone sealant, or, alternatively, the joint may be covered with a waterproofing material consisting of an 18-inch wide strip of self-adhering polyethylene having a rubberized asphalt mastic, as approved by the Engineer or designated representative.

C. Vertical Expansion Joints

Vertical expansion joints shall conform to the applicable section of Standard Specification Item 410S, "Concrete Structures". These joints shall be constructed at a spacing not to exceed 60 feet, unless indicated otherwise on the Drawings. They shall extend the full height and width of the wall, including the wall footing, and shall consist of sleeved dowels and 1/2-inch thick preformed bituminous fiber material. The edges and corners of the joints shall be formed by triangular chamfer strips measuring 3/4 inch on each side. The concrete on the two sides of an expansion joint shall be placed in two separate pours unless approved otherwise by the Engineer or designated representative.

D. Construction Joints

Construction joints shall conform to the applicable section of Standard Specification Item 410S, "Concrete Structures". Wall reinforcement shall extend through the construction joint unless indicated otherwise on the Drawings.

E. Waterstops

Waterstops shall be provided in construction and expansion joints in retaining walls where watertightness is essential to the function of the structure, as in detention, retention, or water quality ponds or flood walls.

414S.5 - Measurement

Accepted cast in place or precast PC concrete work as prescribed by this item will be measured by the cubic yard for reinforced concrete retaining wall, complete in place. All concrete quantities will be based on the dimensions indicated on the drawings.

414S.6 - Payment

The cast-in-place or precast PC concrete work performed as prescribed by this item will be paid for at the unit bid price per cubic yard for "Concrete Retaining Wall". The unit bid price shall include full compensation for all excavation, forms, concrete, curing, finishing, backfilling, sloping that is not part of an excavation safety system covered by Item No. 509S "Excavation Safety Systems", and for all labor, tools, materials, equipment and incidentals necessary to complete the work.

Payment will be made under one of the following:

<b>Pay Item No. 414S-C:</b>	Cast-in-place PC Concrete Retaining Wall, Including Reinforcement	Per Cubic Yard.
<b>Pay Item No. 414S-P:</b>	Precast Concrete Retaining Wall	Per Cubic Yard.

<b>Pay Item No. 414S-SF</b>	Cast-in-place PC Concrete Retaining Wall	Per Square Foot
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**END**

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## ITEM NO. 416S - WATERSTOPS

### 416S.1 - Description

This item shall govern the furnishing and installation of waterstops in accordance with the details shown on the Drawings and the requirements of this item.

### 416S.2 - Submittals

The submittal requirements of this specification item include:

- A. Type and manufacturer of proposed waterstop.
- B. Certification that waterstops meet the requirements of this section.
- C. Proposed method of performing splices.

### 416S.3 - Materials

(1) General: Except where otherwise shown on the Drawings, waterstops may be manufactured from either natural or synthetic rubber or from polyvinyl chloride (PVC) as specified below.

- (a) Natural Rubber. Natural rubber waterstops shall be manufactured from a stock composed of a high-grade compound made exclusively from new plantation rubber, reinforcing carbon black, zinc oxide, accelerators, anti-oxidants and softeners. This compound shall contain not less than 72 percent by volume of new plantation rubber.

Physical properties of the natural rubber for waterstops shall be as shown in Table A below.

- (b) Synthetic Rubber. Synthetic rubber water stops shall be manufactured from a compound made exclusively from neoprene or butadiene styrene rubber (GRS), reinforcing carbon black, zinc oxide, polymerization agents and softeners. This compound shall contain not less than 70 percent by volume of neoprene or GRS.

Physical properties of the synthetic rubber for waterstops shall be as shown in Table A below.

- (c) Polyvinyl Chloride. Polyvinyl chloride (PVC) waterstop material shall conform to the Corps of Engineers Specification Number CRD-C-572.

(2) Manufacturer's Certification: The manufacturer shall furnish test reports certified by a nationally known testing laboratory for each batch or lot of waterstops furnished under this contract, indicating compliance with this specification.

(3) Manufacturing Requirements: Natural and/or synthetic rubber waterstops shall be manufactured with an integral cross section which shall be uniform within plus or minus 1/8 inch in width. The web thickness or bulb diameter cross section shall be within plus 1/16 and minus 1/32 inch. No splices will be permitted in straight strips. Strips and special connection pieces shall be well cured so that any cross section shall be dense, homogeneous and free from all porosity. All junctions in the special connections shall be full-molded.

Requirements for PVC waterstops shall be the same as for natural or synthetic rubber waterstops except that splicing of PVC shall be done by heat sealing the adjacent surfaces in accordance with

the manufacturer's recommendations. A thermostatically controlled electric source of heat shall be used to make all splices. The heat shall be sufficient to melt but not to char the plastic.

416S.4 - Construction Methods

Waterstops shall be of the size and shape shown on the Drawings. They shall be installed in the locations as shown on the Drawings.

The waterstops shall be accurately located in the forms and firmly held in place, both before and during concrete placement, to prevent displacement.

No field splices shall be permitted unless otherwise indicated on the Drawings. Field splices shall be either vulcanized; mechanical, using stainless steel parts; or made with a rubber splicing union of the same stock as the waterstop. All finished splices shall have a tensile strength not less than 50 percent of the unspliced material.

**TABLE A**  
**Physical Properties for Rubber for Waterstops**

	Natural (Plain) Rubber	Synthetic (Neoprene or GRS) Rubber
Original Physical Properties		
Hardness, ASTM D676 (Durometer)	60 ± 5	55 ± 5
Tensile Strength, Min. psi, ASTM D412	3500	2500
Elongation at Break, Min. percent	550	425
Accelerated Tests to Determine Aging Characteristics (Alternate tests):		
(1) After 7 days in air at 158° ± 2°F, ASTM D573, or;		
(2) After 48 hours in oxygen at 158° ± 2° F and 300 psi pressure, ASTM D572:		
Tensile Strength, percent change, max.	35	35
Maximum Elongation, percent change, max.	35	—

416S.5 - Measurement and Payment

The work performed, materials furnished and all labor, tools, equipment and incidentals necessary to complete the work under this item will not be measured or paid for directly, but shall be included in the unit price bid for the item of construction in which this item is used.

**END**

## ITEM NO. 420S - DRILLED SHAFT FOUNDATIONS

### 420S.1 - Description

This item shall govern the construction of foundations consisting of "Reinforced Concrete Drilled Shafts" and/or "Non-reinforced Concrete Drilled Shafts", with or without concrete bell footings. Concrete shafts shall be placed in a drilled excavation when the shafts are without bell footings and in a drilled and underreamed excavation when shafts are with bell footings. Foundations shall be constructed in accordance with this item and in conformance with the details and dimensions indicated on the Drawings. Any required test loading of shafts shall be in accordance with standard foundation test loading procedures used by the TxDOT or by other procedures approved by the Engineer or designated representative.

### 420S.2 - Submittals

The submittal requirements of this specification item may include:

- A. The foundation Drawing and drilling/excavation details;
- B. Class APC concrete mix design;
- C. Anchor bolt Drawing and details;
- D. Reinforcing steel details and placement Drawings and
- E. Casing Drawing and details (if required).

### 420S.3 - Materials

All concrete and materials shall conform to Item No. 403S, "Concrete for Structures" and the requirements herein. Concrete shall be Class A. The maximum size coarse aggregate shall be 1½ inches for cased shafts. A retarder or water reducing agent will be required in all concrete when casing is used. Reinforcing steel shall conform to Item No. 406S, "Reinforcing Steel".

### 420S.4 - Construction Methods

#### (1) Excavation

The Contractor shall perform the excavation required for the shafts and bell footings, through whatever materials encountered, to the dimensions and elevations indicated or required by the site conditions.

Shaft alignment shall be within a tolerance of 1 inch per 10 feet of depth.

Bells shall be excavated to form a bearing area of the size and shape indicated. Bell outlines varying slightly from those indicated are permissible provided the bottom bearing area equals that specified.

Bells may be excavated either by hand or by mechanical methods. Blasting will not be used except with written permission of the Engineer or designated representative and shall be controlled to avoid disturbance of the formations below or outside the limits of the proposed shaft.

The plans indicate the expected depths and elevations where satisfactory bearing material will be encountered. This information will be used as a basis for the contract. If satisfactory material is not

encountered at plan elevation, the footing may be raised or lowered as determined by the Engineer or designated representative. Alteration of plan depth shall be made to satisfactorily comply with the design requirements. Casing will be required when necessary to prevent caving of the material or when necessary to exclude seepage water. Casing shall be metal of ample strength to withstand handling stresses, the pressure of concrete and of the surrounding earth or backfill materials and shall be watertight. The outside diameter of casing shall not be less than the specified size of shaft; otherwise, the size of casing and the size of drilled excavation in which it is to be placed will be left to the discretion of the Contractor, except as noted below. No extra compensation will be allowed for concrete required to fill an oversize casing or oversize excavation.

Where caving conditions and/or excessive ground water is encountered, no further drilling will be allowed until a construction method is employed which will prevent excessive caving that will make the excavation appreciably larger than the size of casing to be used. Drilling in a mud slurry or other method which will control the size of excavation, will be required.

If the elevation of the top of shaft is below ground level at the time of concrete placement, an oversize casing from ground elevation to a point below the top of the shaft will be required to control caving of any material into the freshly placed concrete.

Where casing is not required, any excavation for the bells or shafts beyond the lines indicated shall be filled with Class A concrete at the Contractor's expense. Where casings are used, the Contractor will be permitted to backfill around the upper portions of the casing with pea gravel or other granular material, but space shall be provided to allow for escape of muck, slurry or water displaced by the concrete.

When casing is used, it shall be smooth and well oiled and shall extend approximately to the top of the shaft.

Under normal operations, the removal of the casing shall not be started, until all concrete placement is completed in the shaft. Movement of the casing for short pulls of a few inches, rotating, exerting downward pressure and tapping it to facilitate extraction will be permitted. When unusual conditions warrant, the casing may be pulled in partial stages. A sufficient head of concrete shall be maintained above the bottom of the casing to overcome hydrostatic pressure. Casing extraction shall be at a slow uniform rate with the pull in line with the center of the shaft.

The elevation of the top of the steel cage shall be carefully checked before and after casing extraction. Generally, any upward movement of the steel not exceeding 2 inches or any downward movement thereof not exceeding 6 inches per 20 feet of shaft length will be acceptable. Any upward movement of the concrete or displacement of the steel beyond the above limits will be cause for rejection.

The minimum length of steel required for lap with column steel shall be maintained. Dowel bars may be used if the proper lap length is provided both into the shaft and into the column.

Placing of drilled shaft concrete under water shall not be done without the permission of the Engineer or designated representative. If permission is granted, the concrete shall be placed conforming to Item No. 410S, "Concrete Structures" and shall be placed with a closed tremie. Provisions shall be made for a sump or other approved method to channel displaced water away from the shaft.

Material excavated from shafts and bells, including drilling mud and not used in the backfill around the completed bents or piers shall be disposed of as directed by the Engineer or designated

representative and shall not be placed in the stream or otherwise impair the efficiency or appearance of the structure or other parts of the work.

At the time concrete is placed, the excavation shall be free from accumulated seepage water. All loose material shall be removed from the bottom of the excavation prior to placing concrete.

The Contractor shall provide suitable access and lighting for proper inspection of the completed excavation, to check the dimensions and alignment of shafts and underreamed excavation.

Any required lighting shall be electric. Any mechanical equipment used within the excavation shall be operated by air or electricity. The use of gasoline driven engines within the excavation for pumping or drilling will not be permitted.

In order that the Engineer or designated representative may judge the adequacy of a proposed foundation, the Contractor, if requested, shall make soundings or take cores at the Contractor's expense to determine the character of the supporting materials. The depth of such soundings or cores will not be required to exceed 5 feet below the proposed footing grade. It is the intent of this provision that soundings shall be made or cores taken at the time the excavation in each foundation is approximately complete.

When shafts in abutment bents are indicated, the embankment at the bridge ends shall be completed to grade and thoroughly compacted prior to drilling.

## (2) Reinforcing Steel

The cage of reinforcing steel, consisting of longitudinal bars and spiral reinforcement, lateral ties or horizontal bands, shall be completely assembled and placed as a unit immediately prior to concrete placement.

If the shaft is lengthened and the plans require full depth reinforcement, a minimum of 1/2 the longitudinal bars required in the upper portion of the shaft shall be extended to the bottom, with proper lateral reinforcement. These bars may be lap spliced, spliced by welding or unspliced bars of the proper length. Any splices required shall be in the lower portion of the shaft.

Where spiral reinforcement is used, it shall be tied or tack welded to the longitudinal bars at a spacing not to exceed 12 inches. Unless otherwise indicated welding will not be permitted within the top 15 feet of the steel cage.

Horizontal steel bands shall be placed and welded as indicated.

The cage shall be supported from the top by some positive method, to minimize its slumping downward during concrete placement and/or extraction of the casing. The support shall be concentric with the cage to prevent racking and distortion of the steel. A minimum of 1/2 of the vertical bars shall be supported.

In uncased shafts, concrete spacer blocks or steel chairs shall be used at sufficient intervals to insure concentric spacing for the entire length of the cage. In cased shafts, concrete spacer blocks shall not be used. Metal "chair" type spacers or bent pieces of steel bars shall be placed at sufficient intervals around the steel cage to insure con-centric spacing inside the casing.

### (3) Concrete

The work shall be performed conforming to Item No. 410S, "Concrete Structures", details indicated and with the requirements herein.

Concrete shall be placed as soon as possible after all excavation is complete and reinforcing steel placed and shall be of such workability that vibrating or rodding will not be required. Reinforcing steel and concrete shall be placed during the same work day that the drilled shaft is excavated. Drilled shafts that cannot be completed the same work day as they are excavated shall be backfilled that same day with material removed from the excavation, subject to the approval of the Engineer or designated representative.

Concrete placing shall be continuous in the shaft to the construction joint indicated. The height of free fall of concrete shall be limited to 3 to 4 feet, preventing segregation.

Concrete shall be placed through a suitable tube or tremie to prevent segregation of materials. The tube or tremie shall be made in sections to provide proper discharge and permit raising it as the placement progresses. A non-jointed pipe may be used if sufficient openings of the proper size are provided to allow for the flow of concrete into the shaft.

The elapsed time from the beginning of concrete placement in the cased portion of the shaft, until extraction of the casing is begun, shall not exceed 1 hour.

Where a cap or tie beam is required to be placed monolithically with the shaft, a time interval will be allowed for placing the required form and reinforcing after casing removal.

A riser block of equal diameter as the column and of a maximum height of 6 inches may be cast at the top of the completed shaft.

The top surface shall be cured and any construction joint area shall be treated as prescribed in Item No. 410S, "Concrete Structures".

#### 420S.5 - Test Holes

When indicated or when ordered by the Engineer or designated representative in writing, test holes will be required to establish elevations for "belling", to determine elevation of ground water or other soil characteristics.

The diameter and depth of test hole or holes shall be as indicated or as directed by the Engineer or designated representative.

#### 420S.6 - Test Bells

When indicated or when ordered by the Engineer or designated representative in writing, the reaming of bells on specified test holes will be required to establish the feasibility of belling in a specific soil strata.

The diameter and shape of the test bell shall be as indicated or as approved by the Engineer or designated representative in writing.

#### 420S.7 - Measurement

Acceptable drilled shafts (of the specified diameter), complete in place, will be measured by the linear foot. Shafts for interior bents and piers will be measured from a point approximately 6 inches below the

ground elevation at the center of shaft unless specific elevations or dimensions are indicated or unless the Engineer or designated representative directs otherwise to meet unusual conditions. (The bent height indicated is for estimating purposes only and does not control the top of shaft measurement.) For grade separations and railroad underpasses, the ground elevation used will be the completed subgrade section under the structure. At stream crossings and at railroad overpasses, the existing ground elevation at the time drilling begins will be used. For abutment bents and retaining walls, the length of shaft shall be measured from the bottom of footing or cap elevation. For sign structures and illumination towers, the elevation of top of shaft will be shown either as a dimension above ground or as a dimension to the bottom of footing.

Drilled shafts used with commercial designs of overhead sign bridges will not be measured for payment but will be included in the unit price bid for the item of construction in which this item is used.

The quantity for acceptable bell footings placed will be measured by the cubic yard, computed by using dimensions and shape indicated or as revised in diameter by the Engineer or designated representative. The bell shall consist of the volume outside the plan or authorized dimensions of the shaft, which will extend to the bottom of the bell for the purpose of measurement.

Test holes of the specified diameter will be measured from the elevation of the ground at the time drilling begins, by the linear foot of acceptable test hole drilled.

Test bells will be measured by the cubic yard of material excavated, computed from the dimensions indicated or those authorized by the Engineer or designated representative in writing.

#### 420S.8 - Payment

Drilled shafts will be paid for at the unit price bid per linear foot of "Drilled Shaft" or "Drilled Shaft (Non-reinforced)", of the specified diameter, subject to the following limitations for overruns authorized by the Engineer or designated representative.

- (1) Payment for individual completed shaft lengths up to and including 5 feet in excess of the maximum plan length shaft, as defined herein, will be made at the unit price bid per linear foot of the specified diameter of "Drilled Shaft".
- (2) Payment for that portion of individual completed shaft length in excess of 5 feet and up to and including 15 feet more than the maximum plan length shaft, as defined herein, will be made at a unit price equal to 115 percent of the unit price bid per linear foot of the specified diameter of "Drilled Shaft".
- (3) Payment for that portion of individual completed shaft length in excess of 15 feet and up to and including, 25 feet more than the maximum plan length shaft, as defined herein, will be made at a unit price equal to 125 percent of the unit price bid per linear foot of the specified diameter of "Drilled Shaft".
- (4) Payment for that portion of individual completed shaft length, over 25 feet in excess of the maximum plan length shaft, as defined herein, will be made at a unit price equal to 150 percent of the unit price bid per linear foot of the specified diameter of "Drilled Shaft".
- (5) For extra depth drilling at interior bents and piers, the maximum plan length shaft shall be the maximum length shaft, regardless of diameter, for any interior pier or bent of any bridge included in the contract.

- (6) For extra depth drilling for abutment bents and retaining walls, the maximum plan length shaft shall be the maximum length shaft, regardless of diameter, for any abutment bent of any bridge or of any retaining wall included in the contract.
- (7) For extra depth drilling for sign structures, the maximum plan length shaft shall be the maximum length shaft, regardless of diameter, for any sign structures included in the contract.
- (8) For extra depth drilling for illumination towers, the maximum plan length shaft shall be the maximum length shaft, regardless of diameter, for any illumination tower included in the contract.

The 20 percent limitation will not apply to overruns due to extra depth of drilled shafts.

Bell footings, constructed to the specified dimensions or to the altered dimensions authorized by the Engineer or designated representative, will be paid for at the contract unit price bid per cubic yard for "Bell Footings". Authorized increase in bell footing diameter beyond 3 times the specified shaft diameter, unless indicated, shall be considered as beyond the scope and intent of these specifications. Payment for such increased bell footing quantity shall conform to the following:

Test holes, of the specified diameter, when included in the contract as a bid item, will be paid for at the contract unit price bid per linear foot for "Test Hole".

Test bells of the diameter and shape specified, when included in the contract as a bid item or authorized by the Engineer or designated representative, will be paid for at the contract unit price bid per cubic yard of "Test Bells".

The foregoing unit prices shall be full compensation for making all excavations, for drilling all test holes and test bells, for doing any necessary pumping; for furnishing, placing and removing any required casings, for furnishing and placing all concrete and reinforcing steel, for all backfilling and for furnishing all tools, labor, equipment and incidentals necessary to complete the work. When the bottom of any drilled shaft is ordered to be placed at an elevation below plan grade and a splice of reinforcement is required, no payment will be made for the extra reinforcement required, but it shall be included in the unit price bid for the item of construction in which this item is used. No extra payment will be made for casings left in place.

No partial estimates will be allowed for "Bell Footing" or for "Drilled Shaft" until the concrete has been placed, except that partial payments will be made for reinforcing steel materials delivered on the job conforming to the "General Conditions".

Payment will be made under one of the following:

<b>Pay Item No. 420S-A:</b>	Drilled Shaft, Dia.	Per Linear Foot.
<b>Pay Item No. 420S-B:</b>	Drilled Shaft, Non-reinforced, Dia.	Per Linear Foot.
<b>Pay Item No. 420S-C:</b>	Bell Footings	Per Cubic Yard.
<b>Pay Item No. 420S-TB:</b>	Test Bells, Dia.	Per Cubic Yard.
<b>Pay Item No. 420S-TH:</b>	Test Holes, Dia.	Per Linear Foot.

**END**



## ITEM NO. 424S – PRE-STRESSED CONCRETE PLANKS

### 424S.1 - Description

This item shall govern furnishing materials, the construction and erection of precast pre-stressed concrete members in accordance with the details indicated on the Drawings, reviewed Shop Drawings and these specifications.

### 424S.2 - Submittals

The submittal requirements of this specification item include:

- A. Concrete mix design.
- B. Reinforcement details and placement Drawings.
- C. Curing materials, methods and equipment,
- D. Erection plan and Drawings.

### 424S.3 - Materials

#### (1) Concrete

Concrete shall be Class H and conform to Item No. 403S, "Concrete for Structures". The minimum release strength shall be 3500 psi.

#### (2) Reinforcement

Reinforcing steel shall conform to Item No. 406S, "Reinforcing Steel".

#### (3) Pre-stressing

Pre-stressing shall conform to the most current version of TxDOT Item No. 426, "Pre-stressing". The pre-stressing steel shall be 1/2 inch diameter 270K 7 wire stress relieved, high tensile steel strand conforming to ASTM A 416.

### 424S.4 - Construction Methods

#### (1) Curing

Careful attention shall be given to the proper curing of concrete. The Contractor shall inform the Engineer or designated representative regarding the methods and procedures proposed for curing, shall provide the proper equipment and necessary materials and have approval of the Engineer or designated representative of such methods, equipment and materials prior to placing concrete.

Inadequate curing facilities or lack of attention to the proper curing of concrete shall be cause for the Engineer or designated representative to stop all construction until approved curing is provided. Inadequate curing may be cause for rejection of the member.

Curing shall be commenced prior to the formation of surface shrinkage cracks but in no case delayed longer than 1 hour after the concrete has been placed in forms.

An approved water or membrane cure, when permitted, shall be used as an interim measure prior to elevated temperature or other methods of curing.

Concrete shall be cured continuously except as provided for form removal, until the concrete strength as indicated by compressive test of cylinders cured with the members, has reached the "Release Strength" or "Handling Strength" indicated. Members shall be covered to prevent rapid drying for a period of 72 hours after release of stress or after reaching handling strength. All members shall be protected from freezing during the above period. A period not to exceed 4 hours will be permitted for removal to a storage area prior to resuming the balance of curing and protection required.

A curing day is defined as a calendar day when the temperature, taken in the shade away from artificial heat is above 50°F for at least 19 hours or for colder days, if satisfactory provisions are made to maintain the temperature at all surfaces of the concrete above 50°F for the entire 24 hours.

All concrete shall be steam or water cured, except that membrane curing may be used as interim curing on the top surface of concrete piling. Only Type 1 membrane curing compound will be permitted for interim curing.

(a) Water Curing

All exposed surfaces of the concrete shall be kept wet continuously for the required curing time. The water used for curing shall meet the requirements for concrete mixing water as specified in Item No. 403S, "Concrete for Structures". Seawater will not be permitted. Water, which stains or leaves an unsightly residue, shall not be used.

Water curing will be permitted as follows:

1. Wet Mat Method

For water curing by wet mat method, cotton mats, polyethylene sheeting or polyethylene burlap blankets may be used.

The mats, sheets or blankets shall not be placed in contact with prestressed concrete member until such time that damage will not occur to the surfaces.

The mats, sheets or blankets shall be adequately anchored and weighted to provide continuous contact with all concrete surfaces. Any concrete surfaces, which cannot be cured by contact, shall be enclosed by mats, adequately anchored, so that outside air cannot enter the enclosure. Sufficient moisture shall be provided inside the enclosure to keep all of the surfaces of the concrete wet for the required curing time.

2. Water Spray Method

For water curing by the water spray method, overlapping sprays or sprinklers shall be used so that all concrete surfaces are kept wet continuously.

(b) Elevated Temperature Curing

Curing by elevated temperatures will be permitted as follows:

1. Steam Curing

(Steam curing is defined as use of steam above 85°F for curing.) When steam curing of concrete is provided, the temperature inside the curing jacket at the surface of the concrete shall not exceed 165°F for more than 1 hour during the entire steam-curing period. Concrete exposed to temperatures exceeding 180°F will not be accepted.

Sufficient moisture shall be provided inside the curing jacket so that all surfaces of the concrete are wet.

An unobstructed air space of not less than 6 inches shall be provided between all surfaces of the concrete and the curing jacket. Steam outlets shall be positioned so that live steam is not applied directly on the concrete, reinforcing steel or tendons.

The location of steam lines, location of control points for discharge of steam into the curing jacket, and the number and type of openings for steam distribution within the curing jacket shall be arranged so that temperature variation between any points in the enclosure shall not exceed 20°F.

Steam curing shall not commence until the concrete has been in place a minimum of 3 hours.

During the application of steam, the temperature inside the curing jacket shall be raised uniformly at a rate not to exceed 40°F per hour.

Temperature decrease at the end of the curing operation shall not exceed the same rate.

When elevated temperature curing is used, members shall remain protected until the differential between the temperature inside the curing jacket and the outside air is not more than 25°F.

## 2. Alternate Methods

Other methods of elevated temperature curing may be permitted by the Engineer or designated representative provided temperature maximums, rate of temperature variation, humidity control, etc. are in accordance with the requirements for steam curing. Permission shall be obtained from the Engineer or designated representative, in writing, for use of any alternate method.

### 424S.5 - Handling, Hauling and Erection

The Contractor shall be responsible for proper handling, lifting, storing, hauling and erection of all members so that they may be placed in the structure without damage.

Unless approved on erection and/or shop drawings, pre-stressed members shall be maintained in a flat position at all times and shall be picked up and supported near the ends of the member in such a way to prevent torsion. Members may be lifted by other methods approved by the Engineer or designated representative in writing.

No member shall be moved from the casting yard until all requirements for curing and strength requirements have been attained.

#### 424S.6 - Defects and Breakage

Failure of individual wires in a 7 wire strand or of wires in a parallel wire tendon is acceptable provided the total area of wire failure is not more than 2 percent of the total cross sectional area of tendons in any member. Failure of entire strand will be subject to structural review.

Fine hair cracks or checks on the surface of the member which, as determined by the Engineer, do not extend to the plane of the nearest reinforcement will not be cause for rejection unless they are numerous and extensive. Diagonal cracks, which indicate damage from torsion, will be subject to a structural review prior to acceptance. Vertical or horizontal cracks, which are 1/16 inch or less to the concrete, are acceptable. Cracks in excess of this are subject to review prior to acceptance.

Cracks, which extend into the plane of the reinforcing steel and/or pre-stressed tendons, but are acceptable otherwise, shall be repaired by sealing with a latex-base adhesive, grout or with epoxy.

Small damaged or honeycombed areas, which are purely surface in nature, (not over 1 inch deep) may be repaired. Damage or honeycomb in excess of this will be tentatively rejected but will be subject to structural review.

#### 424S.7 - Quality of Work

Concrete shall be placed in the forms and spaded, tamped or vibrated until thoroughly compacted and until it entirely covers the surface and has a monolithic finish. The top surface shall be floated and troweled to a uniform smooth surface, then finished with a camel hairbrush or wood float to a gritty texture. The outer edges and joints shall be rounded with approved tools to the radius indicated.

#### 424S.8 - Measurement

The work performed and the materials furnished as indicated will be measured by the square foot of top surface area of concrete.

#### 424S.9 - Payment

The work performed as indicated will be paid for at the unit price bid per square foot for "Pre-stressed Concrete Planks", which price shall be full compensation for furnishing and placing all materials, including all reinforcing steel, furnishing and tensioning Pre-stressing steel, for grouting holes and for any other materials, manipulation, transporting, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item No. 424-A:</b>	Pre-stressed Concrete Planks _____ Inch x _____ Inch	Per Square Foot.
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**END**

## ITEM NO. 430S - PC CONCRETE CURB AND GUTTER

### 430S.1 - Description

This item shall govern Portland Cement (PC) concrete curb, PC concrete curb and gutter with reinforcing steel or PC concrete laydown curb as required, that is constructed in accordance with this specification on an approved subgrade and base in conformity with Standard Detail Series 430S and the lines, grades, section indicated on the Drawings or as established by the Engineer or designated representative.

### 430S.2 - Submittals

Within 14 days prior to the commencement of related work, the Contractor shall electronically submit the following submittal requirements:

- A. Class A PC concrete mix design,
- B. Type of Installation (i.e. PC Concrete Curb and Gutter or PC Concrete Curb or PC Concrete Laydown Curb) and construction details (i.e. base, reinforcing steel, joints, curing membrane),
- C. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.

### 430S.3 - Materials

#### A. Concrete

The PC concrete shall conform to Class A Concrete, Section 403S.7 (Table 4) of Standard Specification Item No. 403S, "Concrete for Structures" or Sections 360S.4 and 360S.6 of Standard Specification Item No. 360S, "Concrete Pavement" when curb and gutter is to be constructed integral with the pavement.

#### B. Reinforcing Steel

Reinforcing steel shall conform to Standard Specification Item No. 406S, "Reinforcing Steel."

#### C. Expansion Joint Materials

Expansion joint materials shall conform to Standard Specification Item No. 408S, "Concrete Joint Materials."

#### D. Membrane Curing Compound

Membrane curing compound shall conform to Standard Specification Item No. 409S, "Membrane Curing."

#### E. Flexible Base

Aggregate shall conform to Standard Specification Item No. 210S, "Flexible Base".

#### 430S.4 - Construction Methods

##### A. Subgrade and Base Preparation

Subgrade for curb and gutter shall be excavated and prepared to depth and width requirements indicated on the Drawings, including a minimum of 12 inches behind the curb, unless a greater width is indicated on the Drawings. The subgrade shall be shaped to the line, grades, cross section and dimensions indicated on the Drawings. A minimum of 4 inches (unless a greater or different base is indicated on the Drawings) of flexible base shall be spread, wetted and thoroughly compacted under curb and gutter as specified in Standard Specification Item No. 210S, "Flexible Base". If dry, the base shall be sprinkled lightly with water before PC concrete is deposited thereon.

##### B. C & G Forms

Forms shall be of metal, well-seasoned wood or other approved material. The length of the forms shall be a minimum of 10 feet. Flexible or curved forms shall be used for curves of 100-foot radius or less. Wood forms for straight sections shall be not less than 2 inches in thickness. Forms shall be a section, that is satisfactory to the Engineer or designated representative, of the depth required and clean, straight, free from warp and, if required, oiled with a light form oil. All forms shall be securely staked to line and grade and maintained in a true position during the placement of PC concrete.

##### C. Reinforcing Steel

The reinforcing steel, if required, shall be placed as shown on the typical section of the Drawings. Care shall be exercised to keep all steel in its proper location during PC concrete placement.

##### D. Joints

Joints shall be of the type and spacing shown on the Drawings. Expansion joint material, 3/4 inch in thickness, shall be provided at intervals not to exceed 40 feet and shall extend the full width and depth of the PC concrete. Weakened plane joints shall be made 3/4 inch deep at 10-foot intervals. All joint headers shall be braced perpendicular and at right angles to the curb.

Two round smooth dowel bars, 1/2 inch in diameter and 24 inches in length, shall be installed at each expansion joint. 16 inches of one end of each dowel shall be thoroughly coated with hot oil, asphalt or red lead, so that it will not bond to the concrete. The dowels shall be installed with a dowel sleeve on the coated end as indicated on the Drawings or equivalent method as directed by the Engineer or designated representative.

##### E. PC Concrete Placement and Form Removal

Concrete shall be placed in the forms and properly consolidated. Within 1 hour after PC concrete placement, a thin coating, that is no more than 1/2 inch nor less than 1/4 inch thick of finish mortar, composed of 1 part Portland Cement to 2 parts fine aggregate, shall be worked into the exposed faces of the curb and gutter by means of a "mule". After the PC concrete has become sufficiently set, the exposed edges shall be rounded by the use of an edging tool to the radii indicated on Standard Detail 432S-1 "Sidewalk". The entire exposed surface of the curb and gutter shall be floated to a uniform smooth surface, and then finished with a camel hairbrush to a gritty texture. The forms shall remain in place a minimum of 24 hours unless approved otherwise by the Engineer or designated representative.

After removal of the forms, any minor honeycombed surfaces shall be plastered with a mortar mix as described above. Excessively honeycombed curb and gutter, as determined by the Engineer or designated representative, shall be completely removed and replaced when directed.

F. Curing

Immediately after finishing the curb, concrete shall be protected by a membrane curing conforming to Standard Specification Item No. 409S, "Membrane Curing."

After a minimum of 3 days curing and before placement of the final lift of the base course, the curb shall be backfilled to the full height of the PC concrete, tamped and sloped as directed by the Engineer or designated representative. The upper 4 inches of backfill shall be of clean topsoil that conforms to Standard Specification Item No. 130S, "Borrow" and is free of stones and debris.

G. Seeding in Turf Areas

When turf is to be established, preparation of the seedbed shall conform to Item No. 604S, "Seeding for Erosion Control".

430S.5 - Measurement

Accepted work as prescribed by this item will be measured by the lineal foot of PC concrete curb and gutter, PC concrete curb and/or PC concrete laydown curb, complete in place.

430S.6 - Payment

The work performed as prescribed by this item will be paid for at the unit bid price per lineal foot for "PC Concrete Curb and Gutter" or PC Concrete Curb. The price shall include full compensation for all work as set forth and described under payment Method A and/or B.

A. Method A (Pay Item No. 430S-A)

This payment method shall include all the work performed for "PC Concrete Curb and Gutter" complete, at the unit bid price. The unit bid price shall include full compensation for excavation, preparation of the subgrade, furnishing and placing all concrete and base material, reinforcing steel, dowels, expansion joint material, curing material, backfill and for all other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

B. Method B (Pay Item No. 430S-B)

This payment method includes all the work performed for "PC Concrete Curb and Gutter", complete, at the unit bid price. The unit bid price shall include full compensation for fine grading, furnishing and placing concrete and reinforcing steel, dowels, expansion joint material, curing material, backfill and for all other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

C. Method C (Pay Item No. 430S-C)

This payment method includes all the work performed for " PC Concrete Curb" complete, at the unit bid price. The unit bid price shall include full compensation for excavation, furnishing and placing all concrete and base material, reinforcing steel, dowels, expansion joint material, curing material,

backfill and for all other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

D. Method D (Pay Item No. 430S-D)

This payment method includes all the work performed for "PC Concrete Curb" complete, at the unit bid price. The unit bid price shall include full compensation for fine grading, furnishing and placing concrete and reinforcing steel, dowels, expansion joint material, curing material, backfill and for other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

E. Method E (Pay Item No. 430S-E)

This payment method shall include all the work performed for "PC Concrete Laydown Curb" complete, at the unit bid price. The unit bid price shall include full compensation for excavation, preparation of the subgrade, furnishing and placing all concrete and base material, reinforcing steel, dowels, expansion joint material, curing material, backfill and for all other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

F. Method F (Pay Item No. 430S-F)

This payment method includes all the work performed for "PC Concrete Laydown Curb" complete, at the unit bid price. The unit bid price shall include full compensation for fine grading, furnishing and placing concrete and reinforcing steel, dowels, expansion joint material, curing material, backfill and for other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under one of the following:

<b>Pay Item No. 430S-A:</b>	PC Concrete Curb and Gutter (Excavation)	Per Lineal Foot.
<b>Pay Item No. 430S-B:</b>	PC Concrete Curb and Gutter (Fine Grading)	Per Lineal Foot.
<b>Pay Item No. 430S-C:</b>	PC Concrete Curb (Excavation)	Per Lineal Foot.
<b>Pay Item No. 430S-D:</b>	PC Concrete Curb (Fine Grading)	Per Lineal Foot.
<b>Pay Item No. 430S-E:</b>	PC Concrete Laydown Curb (Excavation)	Per Lineal Foot.
<b>Pay Item No. 430S-F:</b>	PC Concrete Laydown Curb (Fine Grading)	Per Lineal Foot.

**END**



## ITEM NO. 431S - MACHINE LAID PORTLAND CEMENT CONCRETE CURB AND GUTTER

### 431S.1 - Description

This item shall govern Portland cement (PC) concrete curb and gutter and reinforcing steel dowels, constructed in accordance with this specification on an approved base in conformity with the lines, grades, sections and Standard Detail Series 430S and indicated on the Drawings or as established by the Engineer or designated representative.

### 431S.2 - Submittals

The submittal requirements of this specification item include:

- A. Class I PC concrete mix design,
- B. Type of Installation (i.e. PC Concrete Curb and Gutter or PC Concrete Curb) and construction details (i.e. base, reinforcing steel, joints, curing membrane),
- C. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.

### 431S.3 - Materials

- A. PC Concrete

The PC Concrete shall conform to Class I Concrete, Section 403S.7 (Table 4) of Standard Specification Item No. 403S, "Concrete for Structures."

- B. Reinforcing Steel

Reinforcing steel shall conform to Standard Specification Item No. 406S, "Reinforcing Steel."

- C. Expansion Joint Materials

Preformed expansion joint materials shall conform to Standard Specification Item No. 408S, "Concrete Joint Materials."

- D. Membrane Curing Compound

Membrane curing compound shall conform to Standard Specification Item No. 409S, "Membrane Curing."

- E. Flexible Base

Flexible base material shall conform to Standard Specification Item No. 210S, "Flexible Base."

- F. Stabilized Base

A stabilized base identified as a Type A or B shall conform to the requirements of Standard Specification Item 340S, "Hot Mix Asphaltic Concrete Pavement."

### 431S.4 - Construction Methods

- A. Subgrade and Base Preparation

Subgrade for curb and gutter shall be excavated and prepared to depth and width requirements indicated on the Drawings, including a minimum of 12 inches behind the curb, unless a greater width is indicated on the Drawings. The subgrade shall be shaped to the line, grade, cross section and dimensions indicated on Standard Detail 432S-1 "Sidewalk" or the Drawings. A minimum thickness of 4 inches of flexible base (Standard Specification Item No. 210S "Flexible Base") or stabilized base shall be placed, spread, wetted (flexible base only) and thoroughly compacted. If dry, the flexible base shall be sprinkled lightly with water before PC concrete is deposited thereon.

B. PC Concrete Curb and Gutter Extrusion

The PC concrete curb shall be laid by a curb extrusion machine approved by the Engineer or designated representative. The line for top of curb shall be maintained from a guideline or guide rails, set by the Contractor. Curb outline shall strictly conform to the details indicated on the Drawings. The forming tube of the extrusion machine shall be readily adjustable vertically during the forward motion of the machine, to provide required variable height of curb necessary to conform to the established grade line. If a guideline is used, a pointer or gage shall be attached to the machine in such a manner that a comparison can be made between the curb and the guideline in order to provide a continual check on the curb grade. Other methods may be used if approved in writing by the Engineer or designated representative.

C. PC Concrete Placement and Finish

The PC concrete shall be fed into the machine in such a manner and at such consistency that the finished curb will present a well-compacted mass with a surface free from voids and honeycomb and true to established shape, line and grade.

Any additional surface finishing indicated on the Drawings and/or required by the Engineer or designated representative shall be performed immediately after placement. Weakened plane joints shall be cut to a depth of 3/4 inch at 10-foot intervals or as directed by the Engineer or designated representative.

Whenever the curb end abuts a PC concrete structure a 3/4-inch pre-molded expansion joint conforming to the curb section shall be placed between the 2 concrete surfaces.

Whenever extrusion is suspended long enough to produce a cold joint, 1/2-inch smooth dowel bars, 24 inches long, shall be embedded 12 inches into the completed curb, 1/4 curb height from top and bottom. The end of the curb at the point of suspension of extrusion shall be cut back until all remaining PC concrete is of a dense, well-compacted nature.

Any addition of concrete to the extruded curb is to be applied and finished before the extruded curb has achieved its initial set. The final finish shall have a gritty surface approved by the Engineer or designated representative.

D. Reinforcing Steel

The reinforcing steel, if required by Standard 432S-1 "Sidewalk" or shown on approved plans, shall be placed as shown on the typical section of the Drawings. Care shall be exercised to keep all steel in its proper location during PC concrete placement.

E. Joints

Joints shall be of the type and spacing shown on the Drawings. Expansion joint material, 3/4 inch in thickness, shall be provided at intervals not to exceed 40 feet and shall extend the full width and depth of the PC concrete. Weakened plane joints shall be made 3/4 inch deep at 10-foot intervals. All joint headers shall be braced perpendicular and at right angles to the curb.

Two round smooth dowel bars, 1/2 inch in diameter and 24 inches in length, shall be installed at each expansion joint. Sixteen inches of one end of each dowel shall be thoroughly coated with hot oil, asphalt or red lead, so that it will not bond to the concrete. The dowels shall be installed with a dowel sleeve on the coated end as indicated on the Drawings or equivalent method as directed by the Engineer or designated representative.

F. Curing

When finishing operations are completed the curb shall be cured conforming to Standard Specification Item No. 409S, "Membrane Curing."

When the curb has cured a minimum of 3 days and prior to placement of the final lift of base course, it shall be backfilled to the full height of the PC concrete, tamped and sloped to drain as directed by the Engineer or designated representative.

In turf areas, the upper 4 inches of backfill shall be of clean topsoil, that conforms to Standard Specification Item No. 130S, "Borrow" and shall be free of stones and debris.

G. Seeding in Turf Areas

When turf is to be established, the preparation of the seedbed shall conform to Standard Specification Item No. 604S, "Seeding for Erosion Control".

431S.5 - Measurement

Machine Laid PC Concrete Curbs will be measured by the lineal foot of completed and accepted curb, complete in place.

431S.6 - Payment

The work performed as prescribed by this item will be paid for at the unit bid price per lineal foot for "Machine Laid PC Concrete Curb and Gutter". The unit bid price shall include full compensation for all work as set forth and described under payment Method A, B or C below.

A. Method A: With Excavation (Pay Item No. 431S-A)

This payment method includes all the work performed for "Machine Laid PC Concrete Curb and Gutter", complete, at the unit bid price. The unit bid price shall include full compensation for excavation, preparation of the subgrade, furnishing and placing all base material, reinforcing steel, dowels, expansion joint materials, curing material, backfill and all other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

B. Method B: With Fine Grading (Pay Item No. 431S-B)

This payment method includes all the work performed for "Machine Laid PC Concrete Curb and Gutter", complete, at the unit bid price. The unit bid price shall include full compensation for fine

grading, furnishing and placing reinforcing steel, dowels, expansion joint material, curing material, backfill and for all other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

C. Method C: Included in the unit price bid for this specification Incidental Work (Pay Item No. 431S-C)

This method includes all the work performed as incidental work relating to "Machine Laid PC Concrete Curb and Gutter" as may be detailed and noted on the Drawings or included and described in the "Special Provisions" of the Standard Contract Documents.

Payment will be made under one of the following:

<b>Pay Item No. 431S-A:</b>	Machine Laid Curb and Gutter (Excavation)	Per Lineal Foot.
<b>Pay Item No. 431S-B:</b>	Machine Laid Curb and Gutter (Fine Grading)	Per Lineal Foot.
<b>Pay Item No. 431S-C:</b>	Machine Laid Curb and Gutter (Incidental Work)	Per Lineal Foot.

**END**

## ITEM NO. 432S - PORTLAND CEMENT CONCRETE SIDEWALKS

### 432S.1 - Description

This item shall govern the construction of Portland Cement (PC) concrete sidewalks (Standard Detail No. 432S-10 "Mailbox Placement Detail"), as herein specified, on an approved subgrade and in conformance with the lines, grades and details indicated on the Drawings or as established by the Engineer or designated representative.

### 432S.2 - Submittals

Within 14 days prior to the commencement of related work, the Contractor shall electronically submit the following submittal requirements:

- A. Class A PC concrete mix design,
- B. Type of Installation (i.e. Type I, Type II, etc.) and construction details (i.e. cushion layer, base, reinforcing steel, joints, curing membrane),
- C. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding,
- D. Number, manufacturer, model, construction, finish and installation details of streetscape appurtenances of bicycle racks, benches, chairs, trash receptacles, streetlights, tree wells and above grade tree planters [for sidewalks, 12 feet or wider].

### 432S.3 - Materials

#### A. PC Concrete

PC concrete shall be Class A conforming to Specification Item No. 403S, "Concrete for Structures" or Specification Item No. 407S, "Fibrous Concrete."

#### B. Reinforcement

Reinforcement shall conform to Specification Item No. 406S, "Reinforcing Steel" or Specification Item No. 407S, "Fibrous Concrete."

#### C. Expansion Joint Materials

Expansion joint materials shall conform to Specification Item No. 408S, "Concrete Joint Materials."

#### D. Membrane Curing Compound

Membrane curing compound shall conform to Specification Item No. 409S, "Membrane Curing."

### 432S.4 - Construction Methods

The subgrade shall be excavated in accordance with Specification Item No. 111S, "Excavation," prepared in accordance with Specification Item No. 201S, "Subgrade Preparation," shaped to the lines, grades and cross section as indicated on the Drawings or as directed by the Engineer or designated representative and thoroughly compacted in accordance with Specification Item No. 201S "Subgrade Preparation". A granular cushion of a minimum thickness of 2 inches but maximum thickness of 5 inches, composed of

crusher screenings, gravel and sand, crushed rock or coarse sand, shall be spread, wetted thoroughly, tamped and leveled. The granular cushion shall be moist at the time the PC concrete is placed.

If the subgrade is undercut by more than 4 inches or the elevation of the natural ground is more than 4 inches below "top of subgrade," then a necessary backfill/embankment layer of an approved material shall be placed and compacted with a mechanical tamper. Hand tamping will not be permitted.

Where the subgrade is rock or gravel, 70% of which is rock; the 2-inch cushion need not be used. The Engineer or designated representative will determine if the subgrade meets the above requirements.

Sidewalk forms shall be constructed of metal or well-seasoned wood not less than 2 inches in thickness, with a section satisfactory to the Engineer or designated representative. The forms shall be clean, straight, and free from warp with a depth equal to the thickness of the finished work. All forms shall be securely staked to line and grade and maintained in a true position during the deposition of PC concrete. Before PC concrete is placed, the forms shall be thoroughly oiled with a light form oil.

Expansion joint material  $\frac{3}{4}$ -inch thick, shall be provided where the new construction abuts an existing structure, sidewalk or driveway. Similar expansion material shall be placed around all obstructions protruding through the sidewalk. The expansion joint material shall be placed vertically and shall extend the full depth of the PC concrete. Maximum spacing of expansion joints shall be 40 feet as indicated on the Drawings or as directed by the Engineer or designated representative. Weakened plane joints shall be spaced at 5 feet on center. Normal dimensions of the weakened plane joints shall be  $\frac{1}{4}$  inch wide and  $\frac{3}{4}$  inch deep. All joints shall be constructed perpendicular (90 degrees) to the centerline of walk and shall match any previously placed concrete joints. For sidewalks with widths exceeding 6 feet longitudinal weakened-plane tooled joints shall be provided as indicated on the Drawings or as directed by the Engineer or designated representative.

Reinforcement for sidewalks shall consist either of polypropylene fibrillated fibers (only when approved by the City Engineer) or 6" x 6" x W1.4 x W1.4 welded wire fabric or one layer #3 (10M) reinforcing bars, placed no more than 18 inches on center both directions. All reinforcement shall be accurately placed at slab mid-depth, equidistant from the top and bottom of the PC concrete and held firmly in place by means of bar supports of adequate strength and number that will prevent displacement and keep the steel at its proper position during the placement of the PC concrete. **In no instance shall the steel be placed directly on the subgrade or sand cushion layer.**

Prior to placement of the concrete, the reinforcement installation shall be inspected by the Engineer or designated representative to ensure conformance with the drawings, specifications and this item. In addition, care shall be exercised to keep all steel in its proper position during placement of the PC concrete. If during placement of the concrete, the reinforcement is observed to lose bar support, float upward or move in any direction, the placement shall be stopped until corrective action is taken.

Splices in wire fabric shall overlap sufficiently to allow two pairs of transverse wires to be tied together and no splice of less than 6 inches will be permitted. Splices in the #3 (10M) bars shall have a minimum lap of 12 inches.

Where driveways cross sidewalks, additional reinforcing shall be placed in the sidewalk as indicated on the Drawings.

PC concrete sidewalk ramps shall be formed to produce a finished surface with detectable warnings (Standard Detail 432S-2A "Detectable Warning Paver") in accordance with the requirements of the American Disabilities Act and Texas Accessibility Standards (TAS), including Sections 4.29.2 and

A4.29.2. The PC concrete sidewalk ramps shall be constructed in accordance with appropriate City of Pflugerville Standard Details (Standard Details 432S-3 "Type 1 Curb Ramps-Full Intersection", 432S-3A "Type 1 Curb Ramps- T Intersection" through 432S-3H "Type 1 Ramps Within PC/PT of Curb and Gutter", 432S-5 "Type 1 Sidewalk Curb Ramp", 432S-5A "Type 1 Sidewalk Curb Ramp With Left Flare", 432S-5B Type 1B Sidewalk Curb Ramp", etc.).

Detectable warning for the ramps shall consist of raised truncated domes with a diameter of nominal 0.9 inch, a height of nominal 0.2 inch and center-to-center spacing of nominal 2.35 inches and shall contrast visually with adjoining surfaces, either light on dark or dark-on-light. The material used to provide contrast shall be an integral part of the walking surface.

When indicated on the Drawings or as directed by the Engineer or designated representative, the construction of the sidewalk ramp shall include the installation of interlocking concrete paving units (Standard Specification Item No. 480S, "Concrete Paver Units for Sidewalks and Streetscape Requirements"). The concrete paving units shall be constructed in accordance with Standard Specification Item No. 485S, "Concrete Paving Units for Sidewalk Ramps" and appropriate City of Pflugerville Standard Details (Standard Details 432S-2A "Detectable Warning Paver", 432S-3 "Type 1 Curb Ramps-Full Intersection", 432S-3A "Type 1 Curb Ramps- T Intersection" through 432S-3H "Type 1 Ramps Within PC/PT of Curb and Gutter", 432S-5 "Type 1 Sidewalk Curb Ramp", 432S-5A "Type 1 Sidewalk Curb Ramp With Left Flare" and 432S-5B Type 1B Sidewalk Curb Ramp",

At the proper time after finishing, the surface shall be protected by a membrane, compound curing agent or by wetted cotton or burlap mats, conforming to Item No. 409S, "Membrane Curing." The sides of the PC concrete shall be cured in the forms. If the forms are removed during the curing process, the curing shall be continued by the placement of fill against the exposed concrete edges or by other procedures conforming to Item No. 410S, "Concrete Structures." The top 4 inches of fill shall be clean topsoil conforming to Item No. 604S, "Seeding for Erosion Control."

Existing sidewalk that is scheduled for removal and replacement shall be removed and the underlying material shaped to the lines, grades and cross section as indicated in the drawings or as directed by the Engineer or designated representative. The removal and/or relocation of obstructions, including but not limited to signs, trash cans and benches on concrete pads, abandoned manholes, sprinkler control valves and landscaping, shall be performed, as indicated on the drawings, in a manner acceptable to the Engineer or designated representative. Removal and/or relocation of obstructions will be considered incidental work to this item and will not be paid for directly.

Existing PVC pipe drains in and behind curb shall be removed and replaced as required in new sidewalk and/or curb and gutter. In areas of proposed sidewalk construction, where curb and gutter is to remain in place, existing PVC pipe shall be cut far enough behind the back of curb to allow sufficient room for joint fittings to connect to new or salvaged PVC pipe.

The Contractor shall be responsible for removing and replacing mailboxes that are located in the construction area, while assuring that mail delivery will not be interrupted as a result of the construction activities. Mailboxes shall not be laid on the ground.

All necessary excavation, filling and grading of the slopes adjacent to the completed concrete sidewalks will be considered incidental work pertaining to this item and will not be paid for directly. The adjacent excavation and grading of the slopes shall be done in a manner acceptable to the Engineer or designated representative.

#### 432S.5 - Streetscape Furniture Installation Requirements

## A. General

Bicycle racks, benches and chairs, trash receptacles, tree wells and above grade tree wells and planters shall only be installed in sidewalks that are 12 feet or wider. When installation is indicated on the Drawings or directed by the Engineer or designated representative, these items shall be permanently installed as indicated in; 432S-7A "New Trees Planted within Sidewalk 12' or Greater – Clay Soils" and 432S-7F "Tree Well Without Grate". Above grade tree wells shall be installed in conformance with Standard Detail 432S-7E "Tree Well With Seat", while above grade tree planters shall be installed in conformance with Standard Detail Nos. 432S-7D "Above Grade Tree Planters."

## B. Location Requirements

### 1. Benches.

Benches shall be placed either perpendicular to the curb with the center of the bench on line with trees and light poles and facing toward the building entry, or parallel to the building and within 6" (150 mm) of the building wall, facing out to the street.

### 2. Bike Racks.

Bike racks are to be placed perpendicular to the curb with the centerline of the rack on line with trees and light poles.

### 3. Trash Receptacles.

Trash receptacles shall either be placed along the curb, with the center line of the receptacle on line with the trees and light poles, or shall be located at the building entry in alignment with the structural bay system of the building. If located at the entry there shall be no more than 1 foot clearance between the receptacle and the building wall.

## 432S.6 - Pedestrian Railing

When a pedestrian railing installation is required along sidewalks for pedestrian protection as indicated on the Drawings or directed by the Engineer or designated representative, this type of pedestrian railing shall be permanently installed in conformance with one of the following designated Standard Details: 707S-1 "Pedestrian Rail", 707S-2 "Pedestrian ADA Handrail Option 1", 707S-3 "Pedestrian ADA Handrail on Curb-Option 2" or 707S-4 "Pedestrian ADA Handrail on Sidewalk Option 3".

When a pedestrian railing installation is required along portions of sidewalks identified as 'ramps' for ADA accessibility purposes as indicated on the Drawings or directed by the Engineer or designated representative, this type of pedestrian railing shall be permanently installed in conformance with one of the following designated Standard Details: 707S-2 "Pedestrian ADA Handrail Option 1", 707S-3 "Pedestrian ADA Handrail on Curb-Option 2" or 707S-4 "Pedestrian ADA Handrail on Sidewalk Option 3".

## 432S.7 - Measurement

Accepted work performed as prescribed by this item will be measured by the square foot of surface area of "Concrete Sidewalk."

Accepted work performed as prescribed by "Sidewalk Ramps" will be measured per each for the type of ramp indicated on the Drawings.



Accepted work performed as prescribed by "Streetscape Appurtenances" will be measured per each for the type of appurtenance indicated on the drawings.

Accepted work performed as prescribed by "Pedestrian Railing" will be measured per lineal foot of the type of railing indicated on the Drawings.

**432S.8 - Payment**

The work performed as prescribed by this item for concrete sidewalk will be paid for at the unit bid price per square foot for "Concrete Sidewalk" and/or "Sidewalks Reconstruction"; per each for "Concrete Sidewalk Ramps" and "Streetscape Appurtenances" or per lineal foot for "Pedestrian Railing".

The unit bid price for new sidewalk shall include full compensation for excavating and/or removal and/or relocating obstructions, vegetating adjacent areas disturbed by sidewalk construction, preparing the subgrade; for furnishing and placing all materials including cushion material, all reinforcement, bar supports, joints, expansion joint materials, and for any other materials, manipulations, labor, tools, equipment, finishing, curing and incidentals necessary to complete the work.

The unit bid price for sidewalk reconstruction shall include full compensation for excavating and/or removal of existing sidewalk and other obstructions, relocating obstructions, replacing PVC drain pipe, re-vegetating adjacent areas disturbed by sidewalk construction, preparing the subgrade; for furnishing and placing all materials including cushion material, all reinforcement, bar supports, joints, expansion joint materials, and for any other materials, manipulations, labor, tools, equipment, finishing, curing and incidentals necessary to complete the work.

The unit bid price for ramps shall include full compensation for preparing the subgrade when not included as a separate item; for furnishing and placing all materials, manipulation, labor, tools, equipment and incidentals necessary to complete the work. All necessary excavation, filling and grading of the slopes adjacent to the completed concrete paver units will be included in the unit price bid for the item of construction in which this item is used, unless included as a separate pay item in the Contract bid form.

The unit bid price for streetscape appurtenances shall include full compensation for the individual item (i.e. bench, chair, bicycle rack, trash receptacle, street light or above grade tree planter), as well as the removal of existing sidewalk, preparation of footings, furnishing and placing all materials, manipulation and finishing, labor, tools, equipment and incidentals necessary to complete the work.

The unit bid price for pedestrian railing shall include full compensation for the complete installation of the specific pedestrian railing including but not limited to preparation of footings or curb, furnishing and placing all materials, manipulation and finishing, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under one of the following:

<b>New Sidewalks</b>		
<b>Pay Item 432S-A:</b>	New PC Concrete Sidewalks, (Thickness ____)	Per Square Foot.
<b>Sidewalks Reconstruction</b>		
<b>Pay Item 432S-R:</b>	Reconstruct Concrete Sidewalks to ____ thickness, including removal of existing sidewalk	Per Square Foot.

<b>Ramps</b>		
<b>Pay Item 432S-RP-1:</b>	PC Sidewalk Curb Ramp with Pavers (Type I)	Per Each.
<b>Pay Item 432S-RP-1A:</b>	PC Sidewalk Curb Ramp with Pavers (Type IA)	Per Each.
<b>Pay Item 432S-RP-1B:</b>	PC Sidewalk Curb Ramp with Pavers (Type IB)	Per Each.
<b>Streetscape Appurtenances</b>		
<b>Pay Item 432S-SAC-1:</b>	Streetscape Bench ( _____ inches in length)	Per Each.
<b>Pay Item 432S-SAC-2:</b>	Streetscape Chair	Per Each.
<b>Pay Item 432S-SAC-3:</b>	Streetscape Bicycle Rack	Per Each.
<b>Pay Item 432S-SAC-4:</b>	Streetscape Trash Receptacle	Per Each.
<b>Pay Item 432S-SAC-5:</b>	Streetscape Street Light	Per Each.
<b>Pay Item 432S-SAC-7C:</b>	Streetscape Tree Well for Concrete Sidewalks	Per Each.
<b>Pay Item 432S-SAC-7D:</b>	Streetscape Above Grade Tree Planters	Per Each.
<b>Pay Item 432S-SAC-7E:</b>	Streetscape Tree Well with Seat	Per Each.
<b>Pay Item 432S-SAC-7F:</b>	Streetscape Tree Well without Grate	Per Each.
<b>Pay Item 432S-SAC-7G:</b>	Streetscape Above Grade Galvanized Steel Tree Planters	Per Each.
<b>Pesdestrian Railing</b>		
<b>Pay Item 432S-PRC-1:</b>	Pedestrian Railing (Standard 707S-1)	Per LF.
<b>Pay Item 432S-PRC-2:</b>	Pedestrian ADA Railing - Option 1 (Standard 707S-2)	Per LF.
<b>Pay Item 432S-PRC-3:</b>	Pedestrian ADA Railing - Option 2 (Standard 707S-3)	Per LF.
<b>Pay Item 432S-PRC-4:</b>	Pedestrian ADA Railing - Option 3 (Standard 707S-4)	Per LF.

END

## ITEM NO. 433S - PC CONCRETE DRIVEWAYS

### 433S.1 - Description

This item shall govern construction of Portland Cement (PC) concrete driveways, as herein specified, on an approved subgrade, in conformity with the lines, grades and cross section indicated on the Drawings, identified in Standard Detail Series 433S, or as established by the Engineer or designated representative.

### 433S.2 - Submittals

Within 14 days prior to the commencement of related work, the Contractor shall electronically submit the following submittal requirements:

- A. Class A and/or Item 360S "Concrete Pavement",
- B. Type of Installation (i.e. Type I, Flared Type I, Type II, etc.) and construction details (i.e. cushion layer, base, reinforcing steel, joints, curing membrane),
- C. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.

### 433S.3 - Materials

#### A. Concrete

The PC Concrete for a Type I driveway (Standards 433S-1 and 433S-1A) shall conform to Class A, Section 403S.7 (Table 4) of Standard Specification Item No. 403S, "Concrete for Structures." The PC Concrete for a Type II driveway (Standard 433S-2 "Type II Driveway") shall conform to a normal concrete mix design for concrete pavement, Section 360S.5(A) of Standard Specification Item No. 360S, "Concrete Pavement".

#### B. Reinforcing Steel

Reinforcing steel and welded wire fabric shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

#### C. Expansion Joint Materials

Expansion joint materials shall conform to Standard Specification Item No. 408S, "Concrete Joint Materials."

#### D. Membrane Curing Compound

Membrane curing compound shall conform to Standard Specification Item No. 409S, "Membrane Curing."

#### E. Cushion Layer

The Cushion layer shall consist of crusher screenings, gravel or coarse sand.

### 433S.4 - Construction Methods

All forms and forming, placement of reinforcement, placement of concrete, form removal, finishing and curing shall conform to Standard Specification Item No. 410S, "Concrete Structures".

#### A. Subgrade Preparation

The subgrade shall be excavated, prepared and shaped to the lines, grades and cross sections indicated on the Drawings or as directed by the Engineer or designated representative. The subgrade shall be thoroughly compacted in accordance with Standard Specification Item No. 201S, "Subgrade Preparation". A 2-inch minimum compacted thickness cushion shall be spread, wetted thoroughly, tamped and leveled. The cushion shall be moist at the time the PC concrete is placed.

If the subgrade is undercut or natural ground is located below the top of subgrade, the necessary backfill material shall conform to Standard Specification Item 130S, "Borrow" and shall be compacted with a mechanical tamper. Hand tamping will not be permitted.

Where the subgrade material consists of gravel or includes 70 percent of rock, the 2-inch cushion layer may not be required. The Engineer or designated representative will determine if the subgrade meets the above requirements.

#### B. Forms

Forms shall be of metal, well-seasoned wood or other approved material of a section satisfactory to the Engineer or designated representative. Wood forms shall not be less than 2 inches nominal thickness for straight runs and 1-inch nominal thickness for curved runs. Forms shall be a section satisfactory to the Engineer or designated representative and clean, straight, free from warp and of a depth equal to the thickness of the finished work.

All forms shall be securely staked to line and grade and maintained in a true position during the placement of PC concrete.

#### C. Joints

Joints shall be of the type and spacing shown on the Drawings. Expansion joint material, 3/4 inch thick, shall be provided where the new construction abuts the existing sidewalks or driveways or as directed by the Engineer or designated representative. The expansion joint material shall be placed vertically and shall extend the full depth of the PC concrete. Similar expansion material shall be placed around all obstructions protruding through the driveway. Weakened plane joints shall be located on 10-foot centers or as directed by the Engineer or designated representative. Normal dimensions of the weakened plane groove joints shall be 1/4-inch wide and 3/4-inch deep.

#### D. Reinforcement

Reinforcement for Type I driveways shall consist of 1 layer of 6 x 6 by W 1.4 x W 1.4 wire fabric or No. 3 bars placed not more than 18 inches on center, both directions. Reinforcement for Type II driveways shall consist of 1 layer of No. 4 bars placed no more than 18 inches on center, both directions.

All reinforcements shall be accurately placed equidistant from the top and bottom of the PC concrete slab and held firmly in place by means of bar supports of adequate strength and number that will prevent displacement and keep the steel at its proper position. In no instance shall the steel be placed directly on the subgrade or sand cushion layer.

Prior to placement of the concrete, the reinforcement installation shall be inspected by the Engineer or designated representative to ensure conformance with the drawings, specifications and this item. In addition, care shall be exercised to keep all steel in its proper position during the placement of PC

concrete. If during placement of the concrete, the reinforcement is observed to lose bar support, float upward or move in any direction, the placement shall be stopped until corrective action is taken.

Splices in wire fabric shall overlap sufficiently to allow two pairs of transverse wires to be tied together and no splice of less than 6 inches will be permitted. Splices in the No. 3 and No. 4 bars shall have a minimum lap of 12 inches.

E. PC Concrete Placement and Finishing

The PC concrete shall be placed in the forms and spaced, tamped and thoroughly compacted until it entirely covers the surface and has a monolithic finish. The top surface shall be floated and troweled to a uniform smooth surface, then finished with a broom or wood float to a gritty texture unless otherwise indicated on the Drawings. The outer edges and joints shall be rounded with approved tools to a 1/4-inch radius. Care shall be exercised to prevent loss of dummy joints or rounded edges when applying the broom finish.

F. Curing

At the proper time after finishing, the surface shall be protected by a membrane compound curing agent in conformance with Standard Specification Item No. 409S, "Membrane Curing" or by wetting cotton or burlap mats. Either method shall be subject to approval by the Engineer or designated representative.

Traffic shall be barricaded from using the driveway for a minimum of 4 days after initial placing and may be opened to traffic only with approval of the Engineer or designated representative.

G. Incidental Work

All necessary excavation, filling and grading of the slopes, adjacent to the completed PCC driveways, will be considered incidental work pertaining to this item and will not be paid for directly.

The adjacent excavation and grading of the slopes shall be done with topsoil conforming to Standard Specification Item No. 130S, "Borrow". When turf is to be established, the preparation of the seedbed shall conform to Standard Specification Item No. 604S, "Seeding for Erosion Control", in a manner acceptable to the Engineer or designated representative.

433S.5 - Measurement

Accepted work performed as prescribed by this item will be measured by the square foot of surface area of the specific type of PC concrete driveway.

433S.6 - Payment

The work performed as prescribed by this item will be paid for at the unit bid price per square foot for "Concrete Driveways." The unit bid price shall include full compensation for preparation of the subgrade; furnishing and placing all materials, including cushion layer, all reinforcing steel, bar supports and expansion joint materials; and any other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item No. 433S-A:</b>	Type I PC Concrete Driveway	Per Square Foot.
<b>Pay Item No. 433S-B:</b>	Flared Type I PC Concrete Driveway	Per Square Foot.
<b>Pay Item No. 433S-C:</b>	Type II PC Concrete Driveway	Per Square Foot.

END

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## ITEM NO. 434S - PC CONCRETE MEDIANS AND ISLANDS

### 434S.1 - Description

This item shall govern construction of Portland Cement (PC) concrete traffic islands and medians in accordance with these specifications and in conformity to the lines, grades, sections and details indicated on the Drawings or as established by the Engineer or designated representative.

### 434S.2 - Submittals

The submittal requirements of this specification item include:

- A. Class A PC concrete mix design,
- B. Type of Installation (i.e. Median or Island) and construction details (i.e. cushion layer, base, reinforcing steel, joints, curing membrane).

### 434S.3 - Materials

#### A. PC Concrete

The PC concrete shall conform to Class A Concrete, Section 403S.7 (Table 4) of Standard Specification Item No. 403S, "Concrete for Structures".

#### B. Reinforcing Steel

Reinforcing steel and welded wire fabric shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

#### C. Expansion Joint Materials

Preformed expansion joint materials shall conform to Standard Specification Item No. 408S, "Concrete Joint Materials".

#### D. Membrane Curing Compound

Membrane curing compound shall conform to Standard Specification Item No. 409S, "Membrane Curing".

#### E. Admixtures

Admixtures shall conform to Standard Specification Item No. 405S, "Concrete Admixtures".

#### F. Aggregate Cushion

Cushion layer shall consist of crusher screening, gravel, sand, crushed stone or "Flexible Base" materials (Standard Specification Item No. 210S "Flexible Base") approved by the Engineer or designated representative.

### 434S.4 - Construction Methods

All forms and forming, placement of reinforcement, placement of concrete, form removal, finishing and curing shall conform to Standard Specification Item No. 410S, "Concrete Structures".

A. PC Concrete Mix Design

The PC concrete shall conform to an approved design mix for a Class A PC concrete on file with the City or proposed Class A mix designs with the necessary test data may be submitted for approval by the Engineer or designated representative.

High range water reducing admixtures conforming to Standard Specification Item No. 360, "Concrete Pavement" may be used when approved by the Engineer or designated representative.

B. Subgrade and Base Preparation

The subgrade shall be excavated, prepared and shaped to the lines, grades and cross section indicated on the Drawings or as directed by the Engineer or designated representative, and shall be thoroughly compacted conforming to Standard Specification Item No. 201S, "Subgrade Preparation". A cushion layer, 2 inches minimum thickness, shall be spread, wetted thoroughly, tamped and leveled. The cushion shall be moist at the time the PC concrete is placed.

C. Forms

Forms shall be of metal, well-seasoned wood or other approved material. The length of the forms shall be a minimum of 10 feet. Flexible or curved forms shall be used for curves of 100-foot radius or less. Wood forms for straight sections shall be not less than 2 inches in thickness. Forms shall be a section, that is satisfactory to the Engineer or designated representative, and shall be clean, free from warp, and of a depth equal to the finished work. All forms shall be securely staked to line and grade and maintained in a true position during the placement of the PC concrete and, if required, forms shall be thoroughly oiled with a light form oil prior to PC concrete placement. If the adjacent existing asphalt pavement is damaged during construction, it shall be restored to its original condition.

D. Reinforcement

Reinforcement shall conform to the details indicated on the Drawings or the directions of the Engineer or designated representative. All reinforcement shall be accurately placed at slab mid-depth, equidistant from the top and bottom of the PC concrete, and held firmly in place by means of bar supports of adequate strength and number that will prevent displacement and keep the reinforcement in its proper position during the placement of the PC concrete. In no instance shall the steel be placed directly on the subgrade or sand cushion layer.

Prior to placement of the concrete, the reinforcement installation shall be inspected by the Engineer or designated representative to ensure conformance with the drawings, specifications and this item. In addition, care shall be exercised to keep all steel in its proper position during placement of the PC concrete. If during placement of the concrete, the reinforcement is observed to loose bar support, float upward or move in any direction, the placement shall be stopped until corrective action is taken.

E. Joints

Joints shall be of the type and spacing shown on the Drawings. Expansion joint material, 3/4 inch in thickness, shall be placed as indicated on the Drawings with a maximum spacing of 40 feet or as directed by the Engineer or designated representative. Expansion joints shall be placed on the same alignment when adjacent to a PC concrete pavement. Weakened plane joints shall be made 3/4 inch



deep and equally spaced, normally at 5 foot on centers or as directed by the Engineer or designated representative. Expansion joints shall be required between the curb and median PC concrete.

F. PC Concrete Placement and Finishing

The PC concrete shall be placed in the forms to the depth indicated on the Drawings, and properly consolidated and until mortar entirely covers the surface and forms a monolithic finish. If a vibrator is used, care shall be taken not to leave it in one location long enough to induce segregation. The top surface shall be floated and troweled to a uniform smooth surface, then finished with a camel hairbrush or wood float to a gritty texture. The outer edges shall be rounded with approved tools to the radii indicated on the Drawings.

When the ambient air temperature is above 85°F, an approved retarding agent will be required in all PC concrete. The maximum temperature of all PC concrete placed shall not exceed 95°F, unless High Range Water Reducer Admixtures are used.

G. Curing

Immediately after finishing the PC concrete median or island, the PC concrete surface shall be protected by a membrane-compound curing agent conforming to Standard Specification Item No. 409S, "Membrane Curing". The curing procedures shall be acceptable to the Engineer or designated representative.

434S.5 - Measurement

Accepted work as prescribed by this item will be measured by the square foot of surface area of PC concrete medians and/or PC concrete island, complete in place.

434S.6 - Payment

The work performed as prescribed by this item will be paid for at the unit bid price per square foot for "PC Concrete Medians and Islands." The unit bid price shall include full compensation for preparation of the subgrade; finishing and placing all materials, including all reinforcing steel, welded wire fabric; bar supports and any other materials, manipulation, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item No. 434S-A:</b>	_____ Inch PC Concrete Medians and Islands	Per Square Foot.
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**END**

## ITEM NO. 435S - PC CONCRETE STEPS

### 435S.1 - Description

This item shall govern construction of Portland Cement (PC) concrete steps (with or without reinforcing steel as required) on approved subgrade and in conformity with the lines, grades, sections and details indicated on the Drawings or as established by the Engineer or designated representative.

### 435S.2 - Submittals

The submittal requirements of this specification item include:

- A. Class A PC concrete mix design,
- B. Construction details (i.e., reinforcing steel, curing membrane, etc.)

### 435S.3 - Materials

#### A. Concrete

The PC concrete shall be Class A Concrete, Section 403S.7 (Table 4) of Standard Specification Item No. 403S, "Concrete for Structures".

#### B. Reinforcing Steel

Reinforcing steel shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

#### C. Expansion Joint Materials

Expansion joint materials shall conform to Standard Specification Item No. 408S, "Concrete Joint Materials".

#### D. Membrane Curing Compound

Membrane curing compound shall conform to Standard Specification Item No. 409S, "Membrane Curing".

### 435S.4 - Construction Methods

All excavation, including removal of existing steps or sidewalks and backfill, shall conform to Standard Specification Item No. 401S, "Structural Excavation and Backfill".

All forms and forming, placement of reinforcement when required, placement of concrete, form removal, finishing and curing shall conform to Standard Specification Item No. 410, "Concrete Structures".

The height of the steps will be determined by the existing grade or as directed by the Engineer or designated representative. The tread width is normally 10 inches and the riser is normally 7 ½ inches, but these dimensions may be varied to fit existing conditions as directed by the Engineer or designated representative. Step width will match the existing sidewalk, but not less than 3 feet.

Reinforcement for the steps, when required, shall be as indicated on the Drawings.

Expansion joints shall be placed along the lower and upper tread and along each side when abutting PC concrete.

The steps shall be constructed monolithically. The PC concrete shall be placed in the forms and properly consolidated until it covers the area. The top surface shall be floated and troweled to a smooth surface, then finished with a camel hairbrush or wood float to a gritty texture and neat appearance. The outer edges and joints shall be rounded with approved tools with a 1/4-inch radius.

At the proper time after finishing, the surface shall be protected by a membrane compound curing agent conforming to Standard Specification Item No. 409S, "Membrane Curing" or by wetting cotton or burlap mats. Either method shall be subject to approval by the Engineer or designated representative.

435S.5 - Measurement

Accepted work as prescribed by this item will be measured by the cumulative width in feet of individual steps (treads) including the bottom step.

435S.6 - Payment

The work performed as prescribed by this item will be paid for at the unit bid price per lineal foot for "PC Concrete Steps". The unit bid price shall include full compensation for all excavation, forms, concrete, reinforcement, curing, backfill, sloping; all labor, tools, materials, equipment; and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item No. 435S-A:</b>	PC Concrete Steps	Per Lineal Foot.
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**END**

## ITEM NO. 436S - PC CONCRETE VALLEY GUTTERS

### 436S.1 - Description

This item shall govern the construction of Portland Cement (PC) concrete valley gutters on an approved subgrade in conformity to the lines, grades, Standard Detail No. 436S-2 "Concrete Valley Gutter" and details indicated on the Drawings or as established by the Engineer or designated representative.

### 436S.2 - Submittals

The submittal requirements of this specification item include:

- A. Class A PC concrete mix design,
- B. Construction details (i.e., reinforcing steel, curing membrane, etc.).

### 436S.3 - Materials

#### A. PC Concrete

The Portland cement concrete shall be Class A Concrete, Section 403.7 (Table 4) of Standard Specification Item No. 403, "Concrete for Structures".

#### B. Reinforcing Steel

Reinforcing steel and welded wire fabric shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

#### C. Expansion Joint Materials

Expansion joint materials shall conform to Standard Specification Item No. 408S, "Concrete Joint Materials".

#### D. Membrane Curing Compound

Membrane curing compound shall conform to Standard Specification Item No. 409S, "Membrane Curing".

### 436S.4 - Construction Methods

All forms and forming, placement of reinforcement, placement of concrete, form removal, finishing and curing shall conform to Standard Specification Item No. 410S, "Concrete Structures".

#### A. Subgrade Preparation

Where a stabilized subbase is not provided, the subgrade shall be excavated in accordance with Standard Specification Item No. 111S, "Excavation" to remove all unstable or otherwise objectionable material and all holes, ruts and depressions shall be filled with approved material.

Rolling shall be performed in accordance with Standard Specification Item No. 230S "Rolling (Flat Wheel)" or 232S "Rolling (Pneumatic Tire)", to the extent indicated on the Drawings or directed by the Engineer or designated representative. The roadbed shall be completed to the plane of the typical sections indicated on the Drawings and the lines and/or grades established by the Engineer

or designated representative. All work shall conform to Standard Specification Item No. 201S, "Subgrade Preparation".

If the subgrade is dry, the valley gutter area shall be sprinkled lightly immediately before the PC concrete is placed.

Unless otherwise specified on the Drawings, all necessary excavation, filling and grading of the subgrade will be considered incidental work pertaining to this item and will not be paid for directly.

B. Forms

Forms shall be of metal, well-seasoned wood or other approved material. Wood forms for straight sections shall be not less than 2 inches nominal thickness. Forms shall be a section satisfactory to the Engineer or designated representative and clean, straight, free from warp and of a depth equal to the thickness of the finished work. All forms shall be securely staked to line and grade and maintained in a true position during the placement of concrete and, if necessary, forms shall be oiled with a light form oil, prior to placement of PC concrete.

C. Reinforcing Steel

Reinforcement for PC concrete valley gutters shall conform to Standard Detail No. 436S-2 "Concrete Valley Gutter"; details indicated on the Drawings or as directed by the Engineer or designated representative. Care shall be exercised to keep the reinforcement in its proper position during the placement of PC concrete.

D. Joints

Joints shall be of the type and spacing shown on the Drawings. Expansion joint material 3/4 inch thick shall be provided as indicated on the Drawings or as directed by the Engineer or designated representative. The expansion joint material shall be placed vertically and shall extend the full depth of the PC concrete. Weakened plane joints shall be provided on 10-foot centers or as directed by the Engineer or designated representative. Normal dimensions of the weakened plane joints shall be 1/4 inch wide and 3/4 inch deep.

E. Placement and Finishing

The PC concrete shall be placed in the forms and properly consolidated until it entirely covers the surface and has a monolithic finish. The top surface shall be screeded and floated to a uniform smooth surface, then finished with a wood float to a gritty texture. The outer edges shall be rounded with approved tools to a 1/4-inch radius.

F. Curing

At the proper time after finishing, the surface shall be protected by a membrane-curing compound conforming to Standard Specification Item No. 409S, "Membrane Curing" or by wetting cotton or burlap mats. Either method shall be subject to approval by the Engineer or designated representative. Traffic shall be securely barricaded from using the PC concrete valley gutter for a minimum of 4 days after initial placement and may be opened to traffic only with the approval of the Engineer or designated representative.

436S.5 - Measurement

Accepted work performed as prescribed by this item will be measured by the square foot of surface area of PC concrete placed. The square foot measurement shall include the reinforced monolithic curb placed at the ends of the valley gutter.

436S.6 - Payment

The work performed as prescribed by this item will be paid for at the unit bid price per square foot for "PC Concrete Valley Gutters". The unit bid price shall include full compensation for preparation the subgrade; furnishing and placing all materials, including reinforcing steel and expansion joint materials; any other materials, manipulations, labor, tools, equipment, barricading and all incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item No. 436S-A:</b>	PC Concrete Valley Gutters	Per Square Foot.
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**END**

## ITEM NO. 438S - ELASTOMERIC MATERIALS

### 438S.1 - Description

This item shall govern the materials, testing, fabrication and placement of elastomeric materials, except as otherwise covered in other specifications or on the Drawings.

### 438S.2 - Submittals

The submittal requirements of this specification item include:

- A. Type and Manufacturer of proposed products.
- B. Certification that proposed products meet the requirements of this section.

### 438S.3 - Materials

#### (1) Elastomeric Bearings

When specified on the Drawings, structural members shall be seated on elastomeric bearings.

These bearings may be either "plain" (consisting of elastomer only) or "laminated" (consisting of alternating individual layers of elastomer and nonelastic laminates) as indicated. Elastomeric bearings shall be specified on the Drawings by hardness (durometer), size and configuration and, in the case of laminated bearings, by the thickness of the individual layers of elastomer and the size and position of special connection members, if any, required to be vulcanized with the bearing.

#### (a) General

Unless otherwise indicated, the elastomer for bearings shall be formulated from previously unvulcanized 100 percent virgin polychloroprene or 100 percent virgin polyisoprene rubber polymers. Rubber-like polymers employed in the elastomer formulation shall be exclusively of the polychloroprene or natural polyisoprene type. Bearings will not be acceptable if the elastomer employed contains previously vulcanized rubber (natural or synthetic) or other synthetic rubber-like polymers.

Nonelastic laminates shall be 1/16 inch [-0 inch, + 1/16 inch] thick steel strip or sheet. Metal for special connections shall conform to ASTM A 36, unless otherwise shown on the plans.

#### (b) Physical Properties of the Elastomer

Elastomer formulated from polychloroprene shall meet the requirements shown in Table A. Elastomer formulated from polyisoprene shall meet the requirements of Table B. Material tests shall be made in accordance with the test methods stipulated except that all tests shall be made on the finished product and standard laboratory test slabs will not be utilized for this purpose. The values shown in Tables A and B pertain to tests performed on samples taken from the finished product.

The apparatus employed in preparing test specimens from the finished product shall be in accordance with ASTM Designation: D 3183, "Standard Practice for Rubber-Preparation of Pieces for Test Purposes from Products".

Compression set test specimens shall be taken from the finished product. In bearing thicknesses exceeding 1/2 inch or elastomer layers in laminated bearings exceeding 1/2 inch, the full thickness of the bearing or elastomer layer shall be utilized. The 25 percent compression shall be employed and obtained through the utilization of appropriate thickness of space bar and/or shims.

Beveled or wedge shaped bearings of elastomer layers in laminated bearings shall have the compression set specimens selected from sections of the bearings or layers which have been properly cut or ground so that the top and bottom surfaces of the circular compression set specimens will have essentially parallel surfaces. The maximum permissible thickness of such bearings or layers, after rendering the upper and lower surfaces parallel, will be used as a source for the cutting of the cylindrical test specimens employed in the compression set test in accordance with ASTM D 395, "Standard Test Methods for Rubber Property-Compression Test", as modified herein.

(c) Formulation Prequalification and Certification

All bearings furnished by the Contractor shall be produced by a bearing manufacturer who has previously submitted the required prequalification test samples and certification and whose elastomer formulation has been initially approved for use by the Engineer or designated representative. Each elastomer formulation produced by a manufacturer must be approved by the Engineer or designated representative prior to its first use on Department projects. To prequalify and obtain initial approval of a particular formulation, the bearing manufacturer shall submit to the Engineer or designated representative, well in advance of anticipated use of the manufacturer's product, certified test results of actual test values obtained when the physical properties of the elastomer to be furnished were tested for compliance with the pertinent specifications.

The bearings manufacturer shall certify that all of the samples submitted are of the same basic elastomer formulation and of equivalent cure to that used in the finished products to be furnished on City projects.

The Producer may be required to perform the complete prequalification testing procedure again during later production should the Engineer or designated representative require such retesting.

(d) Manufacturing Requirements

All components of a "laminated" bearing shall be molded together to form an integral unit free of voids or separations in the elastomer or between the elastomer and the nonelastic laminates or special connections unless specifically required or permitted by the plans or these specifications. The elastomer between laminates or special connections and on the outer surfaces of the bearing shall be well vulcanized, uniform and integral such that it is incapable of being separated by any mechanical means into separate, definite, well-defined elastometric layers. Evidence of this layered construction, either at the outer surfaces or within the bearing, shall be cause for rejection of such laminated bearing shipments.

All edges of nonelastic laminates shall be covered by a minimum of 1/8 inch of elastomer, except that exposure of the laminates will be permitted at approved laminate restraining devices and around holes that will be entirely enclosed in the finished structure. Unless otherwise indicated, all laminates shall be parallel with the bottom surface of the bearing, subject to the tolerances that follow.



Plain bearings may be molded individually, cut from previously molded strips or slabs, molded to the full thickness of the finished bearings or extruded and cut to length. The finished bearings shall have no voids or separations detectable either at the bearing surfaces or within the bearing unless specifically required or permitted by the Drawings or these specifications. Plain elastomeric bearings shall be well vulcanized, uniform and integral units of construction such that the bearing is incapable of being separated by any mechanical means into separate, definite and well-defined elastomeric layers.

Evidence of layered construction, either at the outer surfaces or within the bearing, shall be cause for rejection of such bearing shipments.

<b>TABLE A</b>					
<b>Interpolate Between Values Shown for Other Hardness Values</b>					
<b>Hardness</b>	<b>50</b>	<b>60</b>	<b>70</b>	<b>80</b>	<b>90</b>
<b>ORIGINAL PHYSICAL PROPERTIES</b>					
Hardness ASTM D 2240, Type A Durometer	50+5	60+5	70+5	80+5	90+5
Tensile Strength, Minimum psi	2250	2250	2250	1800	1800
ASTM D 412	450	360	270	135	90
Elongation at Break, minimum percent					
<b>ACCELERATED TESTS TO DETERMINE LONG TERM AGING CHARACTERISTICS, OVEN AGED 70 HR at 212°F ASTM D 573;</b>					
Hardness points change, maximum	0 to +15	0 to +15	0 to +15	0 to +15	0 to +15
Tensile Strength, % change maximum	-15	-15	-15	-15	-15
Elongation at Break, % change maximum	40	40	40	40	40
<b>OZONE: 100 PPHM IN AIR BY VOLUME; 20% STRAIN AT 100 +2°F — ASTM D 1149*, 100 hours</b>	No Cracks	No Cracks	No Cracks	No Cracks	No Cracks
<b>COMPRESSION SET-22 HRS AT 158°F ASTM D 395(Method B)** , % Maximum</b>	25	25	25	25	25
<b>LOW TEMPERATURE RESISTANCE ASTM D 746 PROCEDURE B, Brittleness at -14.8°F</b>	No Failure	No Failure	No Failure	No Failure	No Failure
<b>ADHESION (PREQUALIFICATION ONLY)</b>					
For laminated bearings, bond between the elastomer and laminates will be qualitatively evaluated by the procedure outlined in the TxDOT Manual of Testing Procedures, Test Method Tex-601-J.					
* Samples to be solvent wiped before test to remove traces of surface impurities.					
** Modified in that test is performed on specimens of essentially full bearing or layer thickness with the					

25 percent compression obtained through the use of appropriate spacer bars and/or shims.

**TABLE B**  
**Interpolate Between Values Shown for Other Hardness Values**

Hardness	50	60	70	80	90
<b>ORIGINAL PHYSICAL PROPERTIES</b>					
Hardness ASTM D 2240, Type A Durometer	50+5	6-+5	70+5	80+5	90+5
Tensile Strength, Minimum psi	2250	2250	2250	1800	1800
<b>ASTM D 412</b>					
Elongation at Break, minimum percent	405	360	270	135	90
<b>ACCELERATED TESTS TO DETERMINE LONG TERM AGING CHARACTERISTICS, OVEN AGED 70 HR at 212°F ASTM D 573;</b>					
Hardness points change, maximum	0 to +10	0 to +10	0 to +10	0 to +10	0 to +10
Tensile Strength, % change maximum	-25	-25	-25	-25	-25
Elongation at Break, % change maximum	-25	-25	-25	-25	-25
<b>OZONE: 25 PPHM IN AIR BY VOLUME; 20% STRAIN AT 100 +2°F— ASTM D 1149*, 48 hours</b>	No Cracks	No Cracks	No Cracks	No Cracks	No Cracks
<b>COMPRESSION SET-22 HRS AT 158°F ASTM D 395(Method B)**, % Maximum</b>	25	25	25	25	25
<b>LOW TEMPERATURE RESISTANCE ASTM D 746 PROCEDURE B, Brittleness at -14.8°F</b>	No Failure	No Failure	No Failure	No Failure	No Failure

**ADHESION (PREQUALIFICATION ONLY)**

For laminated bearings, bond between the elastomer and laminates will be qualitatively evaluated by the procedure outlined in the TxDOT Manual of Testing Procedures, Test Method Tex-601-J.

\* Samples to be solvent wiped before test to remove traces of surface impurities.

\*\* Modified in that test is performed on specimens of essentially full bearing or layer thickness with the

25 percent compression obtained through the use of appropriate spacer bars and/or shims.

The finish of cut surfaces shall be ANSI Number 250 or smoother. The batch or lot number and the dimensions or piece mark shall be marked on each bearing and they shall remain legible until placement in the structure.

(e) Appearance and Dimensions

Flash tolerance, finish and appearance shall meet the requirements of the latest edition of the Rubber Handbook as published by the Rubber Manufacturers Association, Inc.; MA-F3-T.063 for molded bearings and RMA-F2 for extruded bearings.

For both plain and laminated bearings, the permissible variation from the dimensions and configuration required by the plans and these specifications shall be as follows:

1. Overall Vertical Dimensions:
  - Average Total Thickness 1 ¼ inch or less: -0, + 1/8 inch
  - Average Total Thickness Over 1 ¼ inch: -0, +1/4 inch
2. Overall Horizontal Dimensions: -0, +1/4 inch
3. Thickness of Individual Layers of Elastomer (Laminated Bearings Only): + 1/8 inch
4. Variation from a Plane Parallel to the Theoretical Surface:
  - Top: 1/8 inch
  - Sides: 1/4 inch
  - Individual Nonelastic Laminates: 1/8 inch
  - (As determined by measurements at the edges of the bearing)
5. Position of Exposed Connection Member: 1/8 inch
6. Edge Cover of Embedded Laminates or Connection members: 0, + 1/8 inch
7. Size of Holes, Slots or Inserts: 0, + 1/8 inch
8. Position of Holes, Slots or Inserts: 0, + 1/8 inch
9. Thickness of Nonelastic Laminates: 0, + 1/16 inch

(f) Routine Inspection, Sampling and Testing

After prequalification approval, the inspection, sampling and testing of actual bearing production will be as outlined below:

Plain Bearings

A minimum of one plain bearing will be taken by a representative of the Engineer from each project or from each batch or lot in case the same batch or lot is used for more than one project.

Routine tests for compliance with the requirements of Table A or Table B, whichever is applicable, will be performed by the Engineer or designated representative. Samples will not be returned.

#### Laminated Bearings

Each laminated bearing shall be subjected, by the manufacturer, to an average compression of 1,000 psi or to lower average compression if so indicated in the plans or approved by the Engineer or designated representative. This compression test will be performed in the presence of a representative of the Engineer or designated representative who will perform visual inspections and accept or reject the bearings at that time. The performance of each bearing will be considered satisfactory, provided there is no visible evidence of bond failure or other damage to the bearing because of this loading and provided the finished bearing meets all other pertinent portions of this specification. Samples of laminated bearings may be taken if the quality of the plant production becomes questionable. If samples are taken, they shall be taken and tested as outlined for plain bearings.

The manufacturer shall furnish certified laboratory test results on the elastomer properties of each batch or lot of compound used in the manufacture of bearings, both plain and laminated.

#### (2) Waterstops

Waterstops shall be furnished and installed in accordance with the details indicated. Except where otherwise indicated on the plans, waterstops may be manufactured from either natural (plain) or synthetic rubber or from polyvinyl chloride (PVC) as specified below:

##### (a) Materials

1. Natural (plain) rubber waterstops shall be manufactured from a stock composed of a high-grade compound made exclusively from new plantation rubber, reinforcing carbon black, zinc oxide, accelerators, antioxidants and softeners. This compound shall contain not less than 72 percent by volume of new plantation rubber.
2. Synthetic rubber waterstops shall be manufactured from a compound made exclusively from neoprene or GRS, reinforcing carbon black, zinc oxide, polymerization agents and softeners. This compound shall contain not less than 70 percent by volume of neoprene or GRS.
3. Physical properties of natural or synthetic rubbers for waterstops shall be as shown in Table C below:

<b>TABLE C: Physical Properties for Rubber for Waterstops</b>		
	Natural (Plain) Rubber	Synthetic (Neoprene GRS) Rubber
Original Physical Properties:		
Hardness-ASTM D 2240 (Durometer)	60 + 05	55 + 5
Tensile Strength, Minimum psi ASTM D 412	3500	2500
Elongation at Break, Minimum percent	550	425
Accelerated Tests to Determine Long-term Aging Characteristics: either- after 7 days in air at 158° (+2°) F (ASTM D 573) or - after 48 hours in oxygen (ASTM D 572) at 158° (+2°)F and 300 psi pressure		
Tensile Strength, %change, Maximum	35	35
Elongation, % change, Maximum	35	—

4. Polyvinyl Chloride (PVC). Unless otherwise specified on the plans, the material shall conform to the U.S. Army Corps of Engineers Specification Number, CRD-C-572-74. "Polyvinylchloride Waterstop".

(b) Manufacturer's Certification

The manufacturer shall furnish certified test results indicating compliance with this specification for each batch or lot of waterstop furnished under this contract. In case of doubt of the quality furnished, the burden of proof shall be on the manufacturer and the decision of the Engineer or designated representative shall be final.

(c) Manufacturer's Requirements

1. Rubber Waterstops

Waterstops shall be manufactured with an integral cross section which shall be uniform within + 1/8 inch in width and the web thickness or bulb diameter, within + 1/16 and - 1/32 inch. No splices will be permitted in straight strips. Strips and special connection pieces shall be well cured so that any cross sections shall be dense, homogeneous and free from all porosity. All junctions in the special connection pieces shall be full-molded. During the vulcanizing period, the joint shall be securely held by suitable clamps.

## 2. PVC Waterstops

Requirements shall be as in 1 above for rubber waterstops, except that splicing of PVC shall be done by heat sealing the adjacent surfaces in accordance with the manufacturer's recommendations. A thermostatically controlled electric source of heat shall be used to make all splices. The heat shall be sufficient to melt but not to char the plastic.

## 3. Elastomeric Pads

When so specified on the plans, rail posts, rail members, metal shoes or minor structural members shall be insulated, leveled, shimmed or otherwise protected by elastomeric pads, sheets or washers.

Such bearings may be any elastomeric material, plain, fibered or laminated, having a hardness (durometer) between 70 and 100 as certified by the manufacturer to the Engineer.

Acceptance testing will not be required.

## 4. Other Elastomeric Products

Other elastomeric products shall be in accordance with the requirements on the plans.

### 438S.4 - Construction Methods

#### Elastomeric Bearings

Unless otherwise indicated, concrete bearing seats shall be float finished to the required elevation. Variation from a level plane shall not exceed 1/16 inch within the limits of the bearing.

After erection of members on steel structures only, the horizontal distortion of the bearings shall be measured, corrected for temperature and adjusted if necessary, so that the horizontal displacement between top and bottom of bearings at 70° F does not exceed 15 percent of the elastomer thickness.

Welding in the vicinity of the bearings shall be done with care to avoid injury to the elastomer.

#### Waterstops

Waterstops shall be installed as indicated, to prohibit the flow of liquid through a joint in the concrete.

Field splices shall be either vulcanized, mechanical, using stainless steel parts or made with a rubber splicing union of the same stock as the waterstop, at the option of the Contractor. All finished splices shall have a tensile strength not less than 50 percent of the unspliced material.

### 438S.5 - Measurement

Elastomeric bearings or waterstops used with concrete units will not be measured for payment but will be included in the unit price bid for the item of construction in which these activities are used.

**END**

## ITEM NO. 439S - PARKING LOT BUMPER CURBS

### 439S.1 - Description

This item shall govern parking lot bumper curbs, composed of precast concrete and reinforcing steel for placement on gravel, asphalt and concrete surfaces as indicated on the Drawings.

### 439S.2 - Submittals

The submittal requirements of this specification item include:

- A. Type A Portland Cement (PC) concrete design mix.
- B. Reinforcing steel details.

### 439S.3 - Materials

- A. Concrete. All precast concrete shall be Class A Concrete conforming to Specification Item No. 403S, "Concrete for Structures".
- B. Reinforcing Steel. All reinforcing steel shall be #3 bar conforming to Specification Item No. 406S, "Reinforcing Steel."

### 439S.4 - Construction Methods

All forms and forming, placement of reinforcement, placement of concrete, form removal, finishing and curing shall conform to Specification Item No. 410S, "Concrete Structures".

Reinforcement shall conform to the details indicated on the Drawings. Care shall be exercised to keep reinforcement in its proper position during the depositing of concrete.

Concrete shall be placed in the forms to the depth indicated and vibrated until thoroughly compacted. Care shall be taken during vibration to ensure that a vibrator is not held too long at one location that segregation is produced. The top surface of the concrete shall be floated and troweled to a uniform smooth surface, and then finished with a camel hairbrush or wood float to a gritty texture. The outer edges shall be rounded with approved tools to the radii shown on the Drawings.

When the ambient air temperature is above 85°F, an approved retarding agent will be required in all concrete unless moist curing procedures are employed. The maximum temperature of all concrete placed shall not exceed 95°F.

### 439S.5 - Measurement

Parking Lot Bumper Curbs shall be measured per each, complete and in place.

### 439S.6 - Payment

The work performed as prescribed by this Specification Item will be paid for at the unit bid price per each. The unit bid price shall include full compensation for: all materials, including all reinforcing steel, placing and the concrete curb, and all labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item No. 439S-A:	Parking Lot Bumper Curbs	Per Each.
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END

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## ITEM NO. 470S - CURB CUTS FOR SIDEWALK RAMPS AND DRIVEWAYS

### 470S.1 - Description

This item shall govern horizontal and vertical curb saw cuts, which are undertaken on existing or newly placed Portland Cement (PC) concrete curb, in order to accommodate the construction of new concrete sidewalk ramps and/or driveways at the locations indicated on the Drawings or as directed by the Engineer or designated representative. The curb cutting operation shall be conducted from the street side of the existing or newly placed curb.

### 470S.2 - Submittals

The submittal requirements of this specification item include:

- A. Manufacturer and model number of saw to be used for curb cuts.
- B. Documentation that the saw that is to be used on the project is designated specifically to curb cuts.

### 470S.3 - Materials

A diamond-blade-cutting saw shall be utilized for all required curb sawing/cutting. The saw shall be capable of cutting existing or newly placed curb material into the shape of a ramp and/or driveway; leaving a smooth, accurate top face. The saw shall be specifically designed for this purpose and shall be approved by the Engineer or designated representative prior to the start of any curb cut work.

A diamond-grinding wheel shall be used for rounding the sawed concrete edges.

### 470S.4 - Construction Methods

The curb shall be sawn in accordance with City of Pflugerville Standard Detail 470S-1 "Curb Cut for Ramp or Driveway" or as directed by the Engineer or designated representative. The sawing shall be made along neat lines and shall result in smooth edges and top faces. The length of curb face, which must be removed in order to conform to the proposed sidewalk ramp or driveway, shall be sawn full depth at the bottom of the curb face using a diamond saw blade.

The saw cutting of the curb face shall be initiated at an elevation 1/2 inch above the existing gutter and extended at an angle of 3/4 inch per foot upwards and away from the gutter pan to conform with the new sidewalk ramp or driveway grade. End cuts shall be sawn full depth on an angle so that the saw cut face provides a dimension of 55 to 60 inches for ADA ramps and 30 inches for driveways (Standard Detail 470S-1 "Curb Cut for Ramp or Driveway"). The corners of the tops of the end cuts shall be ground using a diamond-grinding wheel to a radius of 1/4 inch.

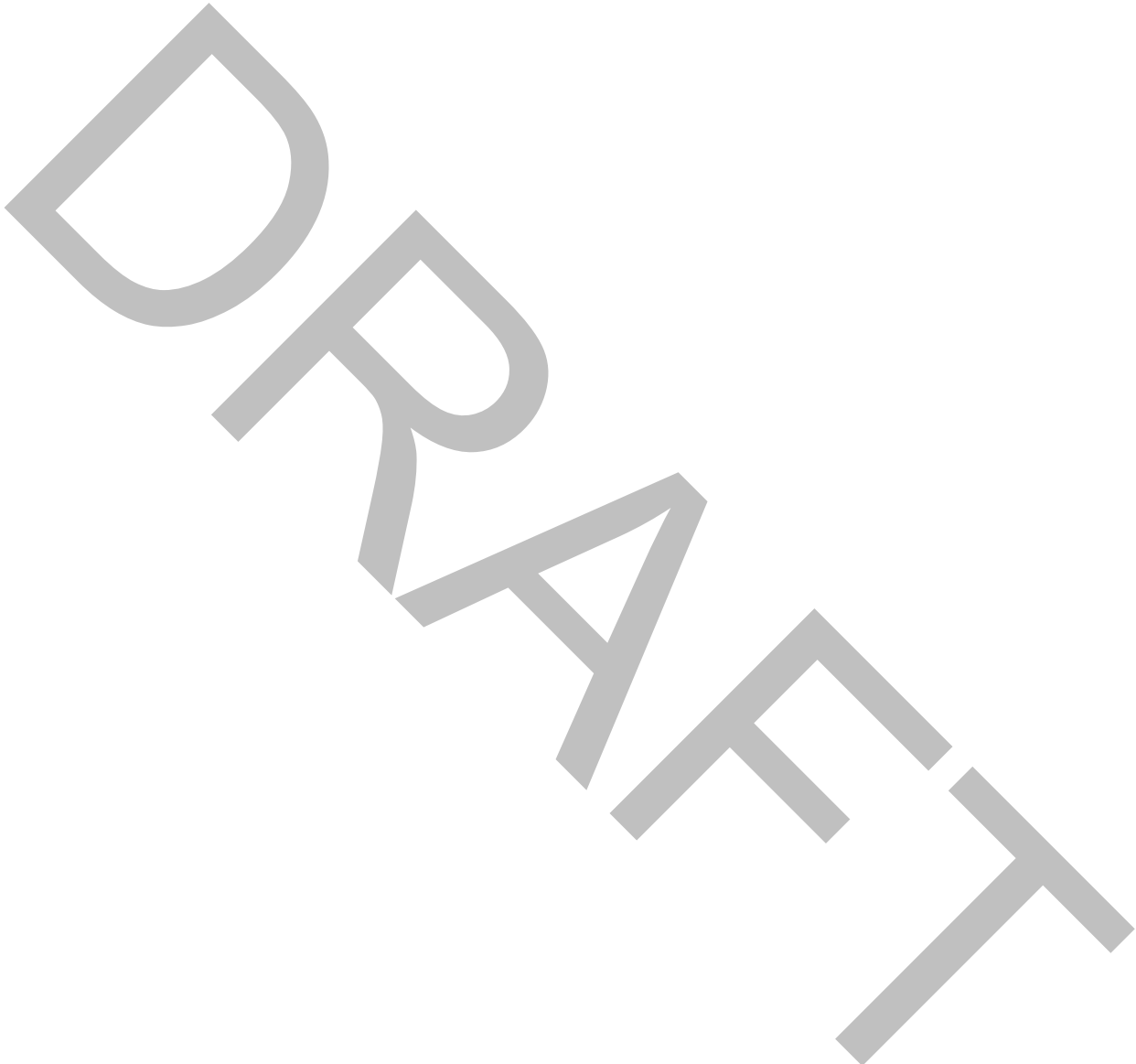
Special care shall be taken to ensure that there is no disturbance or damage to the existing roadway pavement, sidewalk pavement or curbs scheduled to remain. Any damage to remaining pavements, sidewalks and/or curb due to the Contractor's operations shall be repaired at the Contractor's sole cost and expense.

The work under this specification item shall also include the disposal of all concrete curb materials removed during the curb cutting operation. Disposal shall conform to the requirements of City of Pflugerville Standard Specification Item No. 401S, "Structural Excavation and Backfill."

### 470S.5 - Measurement

Accepted work as prescribed by this item shall not be measured for payment but will be subsidiary to the ramp or driveway being constructed.

**END**



ITEM NO. 501S - TUNNELING OR BORING PIPE

501S.1 - Description

This item shall govern furnishing and installing of encasement pipe by methods of jacking or boring as indicated on the Drawings and in conformity with this specification. This item shall also include, but not be limited to other constructions activities such as traffic control measures, excavation, removal of all materials encountered in jacking or boring pipe operations, disposal of all material not required in the work, grouting, end seal installation, backfilling and re-vegetation.

501S.2 - Submittals

Within 14 contract days prior to the commencement of related work, the Contractor shall electronically submit the following submittal requirements:

1. Shop drawings identifying proposed jacking or boring method complete in assembled position
2. Trench Safety Plan including pits, trenches and sheeting or bracing if necessary, and all other necessary review items identified in this section (i.e. Traffic Control Plan, Pedestrian Safety Plan, etc.)
3. Manufacturer of encasement pipe, spacers and end plugs

501S.3 - Materials

A. Pipe

Carrier pipe shall conform to Standard Specification Item No. 510, "Pipe" and shall be size, type materials, thickness and class indicated on the Drawings, unless otherwise specified.

Encasement pipe shall be smooth steel 35,000 psi yield strength with thickness according to the following table:

<b>Carrier Size (Inner Diameter, Inches)</b>	<b>Minimum Encasement Steel Casing Size (Inner Diameter)</b>	<b>Minimum Casing Thickness (Inches)</b>
6	16	0.250
8	18	0.250
10	20	0.313
12	24	0.318
14	24	0.375
15	26	0.375
16	30	0.438
18	30	0.438
20	36	0.500
24	42	0.500
27	42	0.500
30	48	0.500
33	48	0.500
36	54	0.500
39	60	0.500
42	60	0.500

Spiral welded encasement pipe shall not be used.

B. Casing Spacers

Casing spacers shall meet the requirements of the City of Pflugerville SPL Item for "Casing Spacers" or approved equivalent. Casing spacers shall be bolt-on style with a shell made in two sections of Heavy T-304 stainless steel. Connecting flanges shall be ribbed for extra strength. Casing spacers shall have runners made of ultra-high molecular weight polymer, with a minimum height of 2 inches. Wedges shall not be used between the top of the carrier pipe and the inside of the easement pipe. Casing spacers shall have a minimum of 1-inch clear distance between the runners on top of the casing spacers and the inside of the encasement pipe. Casing spacers will not be paid for directly but shall be considered subsidiary to the bid item of encasement pipe.

C. End Plugs

End plugs shall be provided as required and as specified by the pipe manufacturer.

D. Grout

Grout for void areas shall consist of 1 part Portland Cement (PC) and 4 parts fine, clean sand mixed with water.

501S.4 - Construction Methods

A. General

The Contractor is responsible for:

1. Adequacy of jacking and boring operations,
2. Installation of support systems as indicated on the Drawings,
3. Provision of encasement and carrier pipe, and
4. Execution of work involving the jacking operation, the wet or dry method of boring and the installation of encasement pipe simultaneously.

The Contractor shall have sole responsibility for the safety of the jacking and boring operations and for persons engaged in the work. The Contractor's attention is directed to the Construction Industry Occupational Safety and Health Administration (OSHA) Standards (29 FR 1926/1920) as published in U.S. Department of Labor publication OSHA 2207, latest revision, with particular attention to Subpart S. The Contractor shall conform to the requirements in accordance with Standard Specification Item No. 509S, "Excavation Safety Systems" and shall provide an appropriate Trench Safety Plan.

When the grade of the pipe at the jacking or boring end is below the ground surface, suitable pits or trenches shall be excavated to provide sufficient room to conduct the jacking or boring operations and for placement of end joints of the pipe. In order to provide a safe and stable work area, the excavated area shall be securely sheeted and braced to prevent earth caving in accordance with the Trench Safety Plan.

The location of the work pit and associated traffic control measures required for the jacking or boring operations shall conform to the requirements of the latest versions of City of Pflugerville Engineering Design Manual and the Texas Manual on Uniform Traffic Control Devices.

Where installation of pipe is required under railroad embankments, highways, streets, or other facilities by jacking or boring methods, construction shall be undertaken in such a manner that it will not interfere with operation of any railroad, street, highway, utility or other facility and shall not

weaken or damage any embankment or structure. All appropriate permits shall be acquired and fees shall be paid prior to the initiation of the work.

All carrier pipes shall be laid to the required line and grade within the specified limits through the encasement pipe. Carrier pipes shall be handled and placed in the encasement pipe by the use of proper skids, wedges, guide fails and other means approved by the City Engineer or designated representative. Care shall be taken that once the pipe is in place to line and grade, it shall not be disturbed or become displaced. Prior to inserting the carrier pipe, all water shall be pumped out of the encasement pipe to at least a point where there is no more than 2 inches of water remaining. Spacers shall be required within at least 3 feet from both openings of the encasement pipe and spaced no greater than 6 feet through the encasement pipe.

During construction operations, and until the work pits are backfilled and fill material compacted, traffic barricades and warning lights to safeguard traffic and pedestrians shall be furnished and maintained by the Contractor. The Contractor shall submit the proposed pit location and traffic control plan for review by the City Engineer or designated representative. The Review by the City Engineer or designated representative, however, will not relieve the Contractor of the responsibility to obtain specified results in a safe, professional manner.

The pipe shall be jacked or bored from the low or downstream end, if possible. Minor lateral or vertical variation in the final position of pipe from line and grade established by City Engineer or designated representative will be permitted at the discretion of City Engineer or designated representative provided that such variation is regular and occurs only in one direction and that the final grade of the flow line conforms to the specified direction.

When conforming to details indicated on the drawings, but the bottom of the work pit is unstable or excessively wet or the installation of water and wastewater pipe will result in less than 30 inches of cover, the Contractor shall notify the City Engineer or designated representative. The City Engineer or designated representative may require the Contractor to install a concrete seal, cradle, cap or encasement or other appropriate action.

Immediately after jacking or boring is complete and the encasement pipe is accurately positioned and approved for line and grade, the clear space between the pipe and the surrounding excavated material shall be completely filled by pressure grouting for entire length of installation if shown in the drawings or identified in the general construction notes in the drawings.

**[Note to specifier: Make sure grouting is shown in the drawings and/or covered in the general construction notes. Coordinate with City of Pflugerville]**

After placement of the carrier pipe is complete, the ends of the encasement pipe shall be sealed with end seals meeting City of Pflugerville SPL Item "End Seals for Encasement Pipe."

As soon as possible after the carrier pipe(s) and end seals are completed, the work pits or trenches, which are excavated to facilitate these operations, shall be backfilled. All backfill in the ROW shall be compacted to not less than 95 percent of the maximum density conforming to TxDOT Test Method Tex-114-E, "Laboratory Compaction Characteristics & Moisture-Density Relationship of Subgrade & Embankment Soil". Field density measurements will be made in accordance with TxDOT Test Method Tex-115-E, "Field Method for Determination of In-Place Density of Soils and Base Materials".

Where the characteristics of soil, size or size of proposed pipe dictate that tunneling is more satisfactory than jacking or boring, a tunneling method may be submitted for acceptance by City Engineer or designated representative.

**B. Boring**

The boring shall proceed from a work pit provided for the boring equipment and workers. Excavation for the work pits and the installation of shoring shall be as outlined in the Trench Safety Plan. The location of the pit shall be approved by the City Engineer or designated representative. The boring shall be done mechanically using either a pilot hole or the augur method.

In the pilot hole method an approximate 2 inch pilot hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit. This pilot hole shall serve as the centerline of the larger diameter hole to be bored.

When the augur method is used, a steel encasement pipe of the appropriate diameter equipped with a cutter head to mechanically perform the excavation shall be used. Augurs shall be of sufficient diameter to convey the excavated material to the work pit.

Excavated material will be removed from the working pit and disposed of properly at an approved disposal site. Upon request provide disposal site information to the City. The use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cuttings. Water jetting will not be permitted.

In unstable soil formations, a gel-forming colloidal drilling fluid, that consists of at least 10 percent of high grade carefully processed bentonite, may be used to consolidate the drill cuttings, seal the walls of the hole and furnish lubrication to facilitate removal of the cuttings from the bore.

**D. Tunneling**

Where the characteristics of the soil, the size of the proposed pipe, or the use of monolithic sewer would make the use of tunneling more satisfactory than jacking or boring; or when indicated on the drawings, a tunneling method may be used, with the approval of the City Engineer or designated representative.

**501S.5 - Measurement**

Jacking or boring pipe will be measured by the linear foot of pipe complete in place. Such measurement will be made between the ends of the pipe along the central axis as installed.

**501S.6 - Payment**

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit bid price per linear foot for "Jacking or Boring Pipe" as the case may be, of type, size and class of encasement pipe indicated on the Drawings. The price shall include full compensation for furnishing, preparing, hauling and installing required materials, encasement pipe, end seals, for grouting and for labor, tools, equipment and incidentals necessary to complete work, including excavation, backfilling and disposal of surplus material.

The Carrier pipe shall be paid at the unit price bid for Standard Specification Item No. 510, "Pipe".

Payment when included as a contract pay item, will be made under one of the following:

<b>Pay Item No. 501S-A:</b>	Jacking or Boring _____ In. Pipe, Class _____	Per Linear Foot.
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**End**

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## ITEM NO. 503S - FRAMES, GRATES, RINGS AND COVERS

### 503S.1 - Description

This item shall govern furnishing and installation of frames, grates, rings and covers for inlets, manholes and other structures indicated on the Drawings.

### 503S.2 - Submittals

Within 14 days prior to the commencement of related work, the Contractor shall electronically submit the submittal requirements for approval. The submittal requirements of this specification item include manufacturer, model number, description, painting requirements and characteristics of grade rings with a notarized certificate indicating compliance with ASTM C478, as well as manhole frames, grates and covers with a notarized certificate indicating compliance with ASTM A48, Class 30, and the nuts and bolts required for the completion of work.

### 503S.3 - Materials

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation in the Work is the kind and quality that satisfies the specified functions and quality. The City of Pflugerville Standard Products Lists (SPLs) form a part of these Specifications. Contractors may, when appropriate, elect to use products from the SPLs; however, submittal to the City Engineer or designated representative is still required. If the Contractor elects to use any materials from these lists, each product shall be completely and clearly identified by its corresponding SPL number when making the product submittal.

The purpose of the SPLs is to expedite the review by the City Engineer or designated representative of Contractor product submittals. The SPL's should not be interpreted as being a pre-approved list of products necessarily meeting the requirements for a given construction Project. Items contained in the SPL cannot be substituted for items that are shown on the Drawings, called for in the specifications, or specified in the Bidding Requirements, Contract Forms and Conditions of Contract, unless approved by the City Engineer or designated representative in conjunction with the Water and Wastewater Utility Standard Products Committee. The Standard Product List current at the time of plan approval will govern.

#### A. Welded

Steel Welded steel grates and frames shall conform to the number; size, dimensions and details indicated on the Drawings and shall be welded into an assembly in accordance with those details. Steel shall conform to the requirements of ASTM A 36/A 36M, "Specification for Structural Steel".

#### B. Castings

Castings shall be of good quality, strong, tough, even grained cast iron, smooth, free from scales, lumps, blisters, sand or blowholes or other defects of any kind. Surfaces of the castings shall be free from burnt on sand and shall be reasonably smooth. Runners, risers, fins and other cast on pieces shall be removed from the castings and such areas ground smooth. Bearing surfaces between manhole rings and covers or grates and frames shall be cast or machined with such precision that uniform bearing shall be provided throughout the perimeter area of contact. Pairs of machined castings shall be matchmarked to facilitate subsequent identification at installation with the exception of water and wastewater manhole and valve castings. These manhole and valve castings shall be



fabricated with such draft, tolerances, bolt hole spacing, etc., that all rings and covers of a particular type or class are interchangeable and match-marking will not be required.

Cast iron castings shall conform to ASTM A48, "Specification for Gray Iron Castings", Class 30B or higher and shall conform to the City of Pflugerville Standard Product List Items 24 Inch Manhole Cover Casting Sets and 32 Inch Manhole Cover Casting Sets.

Ductile Iron castings shall conform to ASTM A 536, "Specification for Ductile Iron Castings". Grade 60-40-18 (415-275-125) shall conform to the City of Pflugerville Standard Product List Items "32 Inch Manhole Cover Casting Sets".

#### C. Manhole Cover Grade Rings

Grade rings, which are used for raising standard manhole covers, shall be those models listed City of Pflugerville Standard Products List item Manhole Grade Rings, HDPE.

#### D. Nuts and Bolts

Nuts and bolts shall be hex head 5/8 " × 2.5" #11 National Coarse Thread, Type 316 stainless steel. For bolted manhole covers, a thin film of an approved "Anti-freeze" compound, approved by the City Engineer or designated representative, shall be applied to all bolts.

#### E. Mortar

Unless otherwise specified or approved by the City Engineer or designated representative, the mortar for bedding castings shall consist of one (1) part Portland Cement (PC) and three (3) parts sand and sufficient water to provide the desired consistency. The gradation of the fine aggregate shall meet the requirements for Grade No. 1, Item No. 403, "Concrete for Structures".

#### 503S.4 - Construction Methods

Frames, grates, grade rings and covers shall be constructed of the specified materials in accordance with the details indicated on the Drawings or in the City of Pflugerville Standard Details and Standard Products List. The Frames, grates, grade rings and covers shall be placed carefully to the lines or grades indicated on the Drawings or as directed by the City Engineer or designated representative.

All welding shall conform to the requirements of the ANSI/AWS Structural Welding Code D1.1.

Painting of gray iron castings will not be required, except when used in conjunction with structural steel shapes.

#### 503S.5 - Measurement and Payment

Frames, grates, rings and covers will not be measured and payment for furnishing all materials, tools, equipment, labor and incidentals to complete the Work will be included in the Bid Items which constitute the complete structures.

**END**

## ITEM NO. 504S - ADJUSTING STRUCTURES

### 504S.1 - Description

This item shall govern the removal and replacement of surfacing, furnishing of materials, adjusting and/or repositioning existing structures, valve boxes, pull boxes, survey monument boxes and water meters in accordance with these specifications to the locations or elevations indicated on the Drawings or as directed by the City Engineer or designated representative. This item shall also govern any pumping, bailing and drainage required to complete the Work and Standard Specification Item No. 509S, "Excavation Safety Systems" for trench walls when indicated on the Drawings.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text the inch-pound units are given preference followed by SI units shown within parentheses

### 504S.2 - Submittals

Within 14 days prior to the commencement of related work, the Contractor shall electronically submit the following submittal requirements:

1. Aggregate type, gradations and physical characteristics for the Portland Cement (PC) concrete mix.
2. Proposed proportioning of materials for the mortar mix.
3. Type structures and proposed adjustment technique (lowering, raising, lateral displacement).
4. Type structure, repair technique and materials to be furnished. Type of mixing plant and associated equipment including chart indicating the calibration of each cold bin.

### 504S.3 - Materials

Materials required shall conform to the details indicated on the Drawings.

1. PC Concrete. The PC Concrete shall be Class A conforming to Standard Specification Item No. 403, "Concrete for Structures".
2. Mortar Unless otherwise specified or approved by the City Engineer or designated representative, the mortar for bedding castings shall consist of one (1) part PC and three (3) parts sand, by volume based on dry materials. Sufficient water will be added to provide the desired consistency. The gradation of the fine aggregate shall meet the requirements for "Fine Aggregate" as given in Standard Specification Item No. 403, "Concrete for Structures".

### 504S.4 - Construction Methods

All adjustments shall be completed prior to the placement of the final surface.

Pull box and valve box components scheduled for reuse shall be carefully removed and the contact areas shall be cleaned of all mortar, concrete, grease and sealing compounds. Any items broken in the process of removal and cleaning shall be replaced in kind by the Contractor at its own expense.

If the adjustment involves slight lowering or raising a valve box or survey monument box, the outside shell of a slip or screw casing shall be excavated to its full length and adjusted to the proposed grade. Pipe castings shall be excavated to the depth required to cut from or weld a section to the casing as may be needed to adjust the ring to the proposed elevation. The ring shall be welded to the casing prior to pouring concrete around the casing.

If the adjustment involves a vertical (lowering or raising) or a horizontal reassignment of a water meter and the property owner's cut off valve, this work shall be completed in accordance with Standard Installation Details included in the City of Pflugerville Standard Details Series (501S-1 "Encasement Detail with Casing Spacers", 504S-3 "Gas Valve Casing Adjustment", etc.).

After the adjustments have been completed and cured, structures within the paved area shall be paved as indicated on the Drawings.

**504S.5 - Measurement**

The work performed and materials furnished as prescribed by this item as indicated shall be measured per each.

**504S.6 - Payment**

The work performed, materials furnished and measures as provided above, will be paid by the unit bid price per each. The price shall include full compensation for furnishing all materials, handling, placing, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under one of the following:

<b>Pay Item No. 504S-1WM:</b>	Adjusting Water Meters	Per Each
<b>Pay Item No. 504S-1RM:</b>	Repositioning & Adjusting Water Meters	Per Each
<b>Pay Item No. 504S-3G:</b>	Adjusting Gas Valve Boxes to Grade	Per Each
<b>Pay Item No. 504S-3S:</b>	Adjusting Survey Monument Boxes to Grade	Per Each
<b>Pay Item No. 504S-3W:</b>	Adjusting Water Valve Boxes to Grade	Per Each
<b>Pay Item No. 504S-4PB:</b>	Adjusting Pull Boxes to Grade	Per Each

**END**

## ITEM NO. 505S - CONCRETE ENCASEMENT AND ENCASEMENT PIPE

### 505S.1 - Description

This item shall govern the furnishing of materials and the methods of constructing a Portland Cement (PC) concrete encasement or encasement pipe in a trench.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

### 505S.2 - Submittals

Within 14 days prior to the commencement of related work, the Contractor shall electronically submit the following submittal requirements:

1. Type of pipe, spacers and end plugs, construction methods and sequence,
2. Aggregate types, gradations and physical characteristics for the PC concrete mix,
3. Proposed proportioning of materials for the mortar mix.

### 505S.3 - Materials

#### A. PC Concrete

The PC concrete shall conform to Class D Concrete, Item No. 403, "Concrete for Structures."

#### B. Carrier Pipe

Carrier pipe shall conform to Standard Specification Item No. 510, "Pipe" and shall be size, type materials, thickness and class indicated on the Drawings, unless otherwise specified.

#### C. Grout

Grout shall consist of not less than 6 sacks of PC per cubic yard and clean washed sand mixed with water. The grout shall have a consistency such that the grout will flow into and completely fill all voids. If allowed by the City Engineer or designated representative, an air entraining admixture may be added to facilitate placement.

### 505S.4 - Construction Methods

When indicated on the Drawings or acceptable to the City Engineer or designated representative, a concrete encasement shall be placed to protect the pipe. Pipe or bedding shall not be placed where:

- A. the top of the pipe would have less than 30 inches of cover from finish grade,
- B. the ground water invades the trench, or
- C. the trench bottom is of unstable material.

If either of these conditions is encountered, the City Engineer or designated representative shall be notified and may direct the Contractor to:

- A. encase the pipe with concrete,
- B. change pipe material, or
- C. use a higher strength class of pipe.

Concrete encasement shall extend from 6 inches below to 6 inches above the outer projections of the pipe over the entire width of the trench in accordance with the City Engineer of Pflugerville Standard Detail 501S-1, "Encasement Detail with Casing Spacers."

The ends of the encasement pipe shall be bulkheaded (Standard Specification Item No. 507S "Bulkheads") with concrete blocks or stones, dry-stacked without mortar, sufficient to prevent the intrusion of trench backfill material into the encasement, but fitted loosely enough to facilitate the escape of water from the encasement should carrier pipe leakage or failure occur.

**505S.5 - Measurement**

Concrete encasement will be measured by the lineal foot, for size of pipe being encased, complete in place. The measurement will be made between ends of the encasement, along the central axis as installed.

Encasement pipe installed by open cut will be measured by size of encasement installed, complete in place. The measurement will be made between the ends of the pipe, along the central axis as installed.

**505S.6 - Payment**

Work performed and materials furnished as prescribed by this item will be included in a unit price bid item from Standard Specification Item No. 510, "Pipe" unless included as a separate pay item in the contract. When included for payment, it shall be measured as provided under "Measurement" and will be paid at the unit bid price per lineal foot for "Concrete Encasement" or "Encasement Pipe" of the size indicated on the Drawings. The unit bid price shall include full compensation for furnishing all materials, pipe for all preparation, hauling, installation and for all labor, tools, equipment and incidentals necessary to complete the work, including bench excavation and disposal of surplus material.

Payment, when included as a contract Pay Item, will be made under one of the following:

<b>Pay Item No. 505S-A:</b>	Concrete Encasement for _____ Dia. Pipe	Per Lineal Foot.
<b>Pay Item No. 505S-B:</b>	Encasement Pipe _____ Dia., Type _____,	Per Lineal Foot.

**END**

## ITEM NO. 506 - MANHOLES

### 506.1 - Description

This item governs construction of pre-cast and cast-in-place wastewater manholes, storm water manholes, storm water junction boxes and cast-in-place wastewater junction boxes, complete in place, including excavation, installation, backfilling and surface restoration; required items including rings, covers, coatings, and appurtenances; and incidental work such as pumping and drainage necessary to complete the work. Contractor-performed acceptance testing is required for wastewater manholes.

### 506.2 - Project Submittals

#### A. Products and Materials

Within 14 days prior to the commencement of related work, the Contractor shall electronically submit the necessary submittal requirements. All materials shall be new and unused. Material's quality, manufacturing process and finished selections are subject to the inspection and approval of the City Engineer or their designated representative. Inspection may be made at the place of manufacture, at the worksite following delivery, or both. Material will be examined for compliance with ASTM specifications, the City Engineer of Pflugerville Specifications and approved Manufacturer's drawings. Additional inspection criteria shall include appearance, dimensions, blisters, cracks and soundness. Materials shall be rejected for failure to meet any Specification requirement. Rejection may occur at the place of manufacture, the work site or following installation. Rejected materials shall be marked, removed from the work site immediately and replaced by the Contractor at no cost to the City Engineer.

Should the Contractor need to interrupt flow of the existing wastewater system, the Contractor shall submit electronically to the City Engineer or designated representative, for approval, a detailed written plan of all method of flow diversion and maintenance 14 days in advance of flow interruption.

For the abandonment of existing manholes, Contractors shall submit for approval technical product literature including backfill material (source, gradation and type), select backfill material (source, gradation, plasticity index and type), flexible base (binding material, additives, source, gradation and type), equipment and all other pertinent data to illustrate conformance to the specification found within.

The City of Pflugerville Standard Products List is considered a part of the Specifications for the Work. The Contractor shall use products from the SPLs for all water and wastewater construction unless alternative products are shown on the Drawings; called for in the specifications; or specified in the Bidding Requirements, Contract Forms and Conditions of the Contract.

The products included in the Standard Products Lists current at the time of plan approval shall govern; unless a specific product or products on the lists have subsequently been removed from those SPLs because of quality or performance issues. Products and materials that are not covered by SPLs shall meet the requirements in the contract documents.

Submittals for the products and materials covered by this specification shall include manufacturer catalog sheets, technical data sheets, shop drawings, product or material test results, requirements listed below, and any other information needed to adequately describe the product or material. For products covered by SPLs, the submittal shall include a copy of the applicable SPL with the proposed product identified. An SPL by itself is not considered an adequate submittal.

Like items of materials/equipment shall be the end products on a single Manufacturer in order to provide standardization in appearance, operation, maintenance, spare parts and Manufacturer's services.

The submittal requirements of this specification item include:

1. For pre-cast manholes and junction boxes: six (6) copies of shop drawings for each structure showing, at a minimum, the Project and Contractor's name; manufacturer's name and plant location; applicable specifications; list of materials (such as adjusting rings, boots, gaskets, and pre-cast sections) by type and quantity; elevation view showing diameter or size, ring and cover size and elevation, ring type (bolted or unbolted, flared top or flared bottom) wall thickness, elevations of transitions from large diameter sections to smaller diameter sections, base width and thickness, total depth, size of openings, reinforcement, and length of each pre-cast section; concrete mix design; concrete test cylinder reports; structure identification number and station location; pipe line identification; pipe material and size; pipe flowline elevations; plan view showing azimuthal orientation (based on 360 degrees clockwise) of the pipes relative to the outflow pipe; technical data sheets covering pipe-to-manhole or pipe-to-junction box connectors, and gaskets
2. For cast-in-place manholes and junction boxes: formwork drawings sealed by a registered Professional Engineer licensed in the State of Texas with documented experience in formwork design for wall pours that exceed 4 feet in height and slabs that are not ground supported
3. For hydraulic cement concrete; mix components and proportions, material sources, materials test results
4. For mortar: mix components and proportions, material sources, materials test results
5. For non-shrink grout: technical data sheet indicating ASTM type and containing instructions on surface preparation, mixing, placing, and curing procedures
6. For wastewater manhole coatings and linings: technical data sheets that include instructions on surface preparation, mixing, placing, and curing procedures

**B. Acceptance Test Records**

Submittal of acceptance test records is required for wastewater manholes and shall include as a minimum the following items:

1. Name of the manhole manufacturer
2. Interior surface coating type and application method
3. Model and manufacturer of vacuum tester
4. Date tested/date re-tested
5. Indication of whether test passed or failed, and statement of corrective action taken if test failed
6. Test Method Used
7. Location/station of manhole
8. Type of base: Precast/cast-in-place
9. Type of repairs made to the joints
10. The test records shall also be included as part of the Project records turned in with the acceptance package.

## 506.3 - Materials

### A. Concrete

All cast-in-place concrete shall conform to City of Pflugerville Standard Specification Item No. 403S, "Concrete for Structures." Cast in place concrete shall be Class A or as specified on the Drawings. Concrete used in precast concrete manhole base sections, riser sections and appurtenances shall conform to the requirements of Texas Department of Transportation Item 421 "Hydraulic Cement Concrete" and ASTM C478. Concrete for backfill of over-excavated areas shall be City of Pflugerville Class A (City of Pflugerville Standard Specification Item 403S, "Concrete For Structures") or Controlled Low Strength Material (City of Pflugerville Standard Specification Item 402S) as indicated on the Drawings.

### B. Mortar

Mortar shall be composed of one part Portland Cement (PC), one part masonry cement (or 1/4 part hydrated lime), and sand equal to 2½ to 3 times the sum of the volumes of the cements and lime used. The sand shall meet the requirements for "Fine Aggregate" as given in Standard Specification Item No. 403S "Concrete For Structures." Mortar shall not be used for any purpose on the inside of wastewater manholes.

### C. Grout

Grout shall be the non-shrink type conforming to ASTM C 1107, Packaged, Dry, Hydraulic Cement Grout and conform with the City of Pflugerville SPL Item "Packaged Non-Shrink Grout Mix.". Grout shall be used as packaged, with the mixed ingredients requiring only the addition of water. Preparation, mixing, placing, finishing and curing shall be performed in accordance with the manufacturer's recommendation.

### D. Reinforcement

The reinforcing steel shall conform to the requirements of Standard Specification Item No. 406S, "Reinforcing Steel." Secondary, non-structural steel in cast-in-place stormwater manholes may be replaced by collated fibrillated polypropylene fibers, if approved by the City Engineer or designated representative.

### E. Rings and Covers

Rings and covers shall conform to the requirements of City of Pflugerville Standard Specification Item No. 503S, "Frames, Grates, Rings and Covers." Manhole covers shall be in accordance with the City of Pflugerville Standard Detail 511-AW-01 "Typical Gate Valve".

#### 1. Replacement Rings and Covers, 24 in Diameter Lids

This ring and cover shall be used for the replacement of broken rings and covers, minor manhole adjustment, or as otherwise directed by the City Engineer or designated representative.

#### 2. Rings and Covers, 32 in. Diameter Lids

This ring and cover shall be used for all new manhole construction, except as otherwise directed by the City Engineer or designated representative.



F. Bulkheads

Bulkheads shall meet the requirements of City of Pflugerville Standard Specification Item No. 507S "Bulkheads."

G. Precast Base Sections, Riser Sections, Flat-top Slabs and Cones

Precast concrete base sections, riser sections, flat-top slabs, and cones shall conform to the requirements of ASTM C 478. Manhole diameter shall be as shown on the Drawings, but not less than the diameter of the largest connecting pipe plus 2 feet. The width of the invert shall be specifically sized for the connecting pipes. Inverts shall be "U" shaped channels. The channel depth at the point where a pipe connects to the manhole wall, for pipes 24 inches in diameter and smaller, shall be a minimum of three fourths of the diameter of the pipe, with the top of the channel being a smooth transition between the inlet and outlet pipe connection points. For manholes connecting to pipes larger than 24 inches in diameter, the channel depth at the point where a pipe connects to the manhole wall shall be at least equal to the full pipe diameter. Changes in flow direction in the inverts of manholes shall be made by constructing smooth, long-radius sweeps to minimize splashing, turbulence, and eddies. The manhole invert grade shall 1) be a continuation of the inlet and outlet pipe grades carried through to the centerline of the manhole, or 2) have a minimum slope of 2.5 percent between the inlet and outlet pipe inverts, or 3) have a minimum difference of 0.10 feet between the inlet and outlet pipe inverts, whichever provides the maximum difference in invert elevation between the inlet and outlet pipes. In all cases, the bottom(s) of the channel(s) shall provide a smooth transition between the inlet and outlet pipes. Where wastewater lines enter a manhole above the flowline of the outlet, the invert shall be filleted to prevent splashing and solids deposition.

Precast concrete base sections, riser sections, transition top sections, flat slab tops and grade rings shall meet the following requirements:

1. Bottom slab thickness shall be 12 inches.
2. Top section shall be flat slab with a minimum clear opening of 32 & 7/8-inch diameter.
3. Base, riser and transition top sections shall have tongue and groove joints.
4. Sections shall be cured by an approved method.
5. Precast concrete sections shall be shipped after concrete has attained 3,000 psi compressive strength.
6. Design precast concrete base, riser, transition top, flat slab top and grade ring for a minimum HS-20 loading plus earth load.
7. Mark date of Manufacturer, name and trademark of Manufacturer on the inside of each precast section.
8. Provide integrally cast knock-out panels in precast concrete manhole sections at locations with sizes shown on Drawings. Knock-out panels shall have no steel reinforcing.
9. Precast concrete sections shall have lifting lugs or holes in each precast section for proper handling. Through-wall holes for lifting will not be permitted.

Joints for wastewater base sections, riser sections and cones shall conform to the requirements of ASTM C478, C76 and C443. Additionally, joint dimensions for 48-inch inside diameter wastewater

manhole sections and cones shall comply with City of Pflugerville Standard Detail 506S-13, "Wedge Seal Joint Detail, Precast Manhole Section." Joint dimensions for wastewater manhole sections and cones shall comply with City of Pflugerville Standard Detail 506S-12, "O-Ring Joint Detail Precast Manhole Section." Precast bases for 48 inch inside diameter manholes shall have pre-formed inverts.

H. Precast Junction Boxes

Precast junction boxes shall be allowed only where indicated on the Drawings or acceptable to the City Engineer or designated representative.

I. Pipe-to-Manhole and Pipe-to-Junction-Box Connectors

Resilient connectors, ring waterstops, and seals at connections of wastewater pipes to pre-cast and cast-in-place manholes and junction boxes shall be watertight, flexible, resilient and non-corrosive, conforming to ASTM C 923. Metallic mechanical devices for securing the connectors, ring waterstops, and seals in place shall be Type 304 stainless steel. The pipe may be connected to the manhole in the following ways:

1. Flexible Sleeve – Integrally cast sleeve in precast manhole section or install sleeve in a formed or cored opening. Fasten pipe to sleeve with stainless steel clamp(s). Coat stainless steel clamp(s) with bituminous material to protect from corrosion. Flexible sleeve shall be Lock Joint Flexible Manhole Sleeve, Kor-N-Seal connector, PSX Press-Seal Gasket or approved equivalent.
2. Compression Gasket – Integrally cast compression gasket in precast manhole section. Insert pipe into compression gasket. Compression gaskets shall be A-lok or approved equivalent.

J. Precast Flat-Slab Transition/Junction Box Lids

Precast slab transitions and lids shall be designed to safely resist pressures resulting from loads which might result from any combination of forces imposed by an HS-20 loading plus earth load as defined by the American Association of State Highway and Transportation Officials (AASHTO). The joints of precast slab transitions and of lids for wastewater applications shall conform to the requirements of ASTM C443.

K. Precast Grade Rings

Rings shall be reinforced Class A concrete

1. Precast Grade Rings, 24 ½ inches Inside Diameter

This adjustment ring shall be used only for adjusting existing manholes with 24 inch diameter lids and for Wastewater Access Device. Inside to outside diameter dimension of ring shall be 6 inches with a thickness of 3 inches to 6 inches.

2. Precast Grade Rings, 35 inches Inside Diameter

This adjustment ring shall be used for all new manhole construction with 32 inch diameter lids. Inside to outside diameter dimension of ring shall be 6 inches with a thickness of 2 inches to 6 inches.

L. High Density Polyethylene Grade Rings

Plastic grade (adjusting) rings shall be injection molded from high density polyethylene identified according to ASTM D4976. Reprocessable and recyclable ethylene plastic materials are allowed. Manufacturers of HDPE adjusting rings shall be listed in the SPL item "Manhole Grade Rings, HDPE."

M. Controlled Low Strength Material

Controlled low strength material (CLSM) shall meet Standard Specification Item 402S, Controlled Low Strength Material.

N. Cement Stabilized Sand

Cement stabilized sand for bedding or backfilling shall contain 2 bags of PC per cubic yard. The sand shall meet the requirements for "Fine Aggregate" in Standard Specification Item 403S, Concrete for Structures.

O. Waterproofing Joint Materials

O-rings and wedge seals for the joints of all wastewater manholes, and for stormwater manholes when indicated on the Drawings, shall conform to the requirements of ASTM C443. Cold applied preformed plastic gaskets for stormwater manholes shall be as specified in City of Pflugerville Standard Specification Item No. 510, "Pipe." Plastic seals wrapped around manholes at joints, and hydrophilic waterstops installed in joints, shall be listed in the SPL as item "Manhole Seals." PVC waterstops installed in joints and waterproofing compounds applied to the exterior surfaces of manholes and junction boxes shall be as specified in the Contract Documents. Completed joint shall withstand 15 psi internal water pressure without leakage or displacement of the gasket or sealant.

P. Interior Surface Coatings for Wastewater Manholes

Interior surface coatings for wastewater manholes shall be coated with a minimum 80 mils Raven Lining System, Sewpercoat, ARC Concrete Coating System, or approved equivalent, as designated in writing by the City Engineer or designated representative, or as included in the SPL as item "Cementitious Lining for Wastewater Manholes," which lists acceptable products, uses and applicators.

Q. Structural Lining Systems for Wastewater Manholes

Structural lining systems for wastewater manholes shall be either: as specified on the Drawings, as designated in writing by the City Engineer or designated representative, or as included in the SPL as item "Organic Lining for Wastewater Manholes" which lists acceptable products, uses and applicators.

506.4 - Construction

A. General

A minimum horizontal separation of 12 inches shall be maintained between adjacent pipes inside and outside a manhole or junction box. Pipe ends within the base section or junction box walls shall not be relied upon to support overlying manhole dead and live load weights. All wastewater branch connections to new or existing mains shall be made at manholes, with the branch pipe crown

installed at an elevation no lower than the elevation of the effluent pipe crown. Changes in flow direction in the inverts shall be made by constructing smooth, long-radius sweeps to minimize splashing, turbulence, and eddies. Where wastewater lines enter the manhole up to 24 inches above the flowline of the outlet, the invert shall be sloped upward in a U-shaped channel three-fourths of the diameter of the incoming pipe to receive the flow, thus preventing splashing or solids deposition. A drop pipe shall be provided for a wastewater pipe entering a manhole whenever the invert cannot be constructed to prevent splashing and solids deposition. Construction of extensions to existing systems shall require placement of bulkheads at locations indicated or directed by the City Engineer or designated representative.

Unless otherwise indicated on the Drawings, stormwater and wastewater manholes shall have eccentric cones. Wastewater manholes shall be in accordance with the City of Pflugerville Standard Detail 506S-6. Cast-in-place wastewater junction boxes shall be allowed only where indicated on the Drawings or where accepted by the City Engineer or designated representative.

Manholes shall be constructed such that all work is protected against flooding and flotation.

#### B. Foundation Support

Manholes shall be constructed to the dimensions shown on the Drawings and as specified herein. Manholes shall be founded at the established elevations on a bed of screened gravel 8 inches in depth unless otherwise indicated on the Drawings. The manhole base shall be set so that a maximum grade adjustment of 8 inches is required to bring the manhole frame and cover to final grade. Unstable subgrade shall be over-excavated a minimum of 12 inches and replaced with a material acceptable to the City Engineer or designated representative. A pipe section with a prefabricated tee manhole and half the length of the adjoining pipe sections on each side shall be founded on a minimum of 6-inch thick layer of unreinforced Class A concrete (City of Pflugerville Standard Specification Item No. 403S, "Concrete For Structures"). The cast-in-place concrete cradle shall be placed against undisturbed trench walls up to the pipe's springline.

#### C. Precast Concrete Manhole Sections

Set precast concrete barrel sections plumb with a 1/4 inch maximum out of plumb tolerance allowed. Allow joints to set for 14 hours before backfilling unless a shorter period is specifically approved by the City Engineer or designated representative. Backfill carefully and evenly around manhole sections.

Plug holes in the concrete barrel sections required for handling with a non-shrink grout or non-shrink grout in combination with concrete plugs. Finish flush on the inside.

Core holes in precast sections to accommodate pipes prior to setting manhole sections in place to prevent jarring which may loosen mortar joints.

#### D. Cast-in-Place Concrete

Structural concrete work shall conform to Standard Specification Item No. 410S, Concrete Structures". Forms shall be used for all slabs that are not ground supported and for all vertical surfaces above the foundation level. Formwork shall be designed according to American Concrete Institute ACI 347, Guide to Formwork for Concrete. Outside forms on vertical surfaces may be omitted where concrete can be cast against the surrounding earthen material that can be trimmed to a smooth vertical face.

#### E. Manhole Bases

Pre-cast bases shall conform to requirements in 506.3.H.

Cast-in-place bases shall have a minimum thickness of 12 inches at the invert flowline. The widths of all manhole inverts shall be specifically sized for the connecting pipes. Inverts shall be "U" shaped channels. The channel depth at the point where a pipe connects to the manhole wall, for pipes 24 inches in diameter and smaller, shall be a minimum of three-fourths of the pipe diameter, with the top of the channel being a smooth transition between the inlet and outlet pipe connection points. For manholes connecting to pipes greater than 24 inches in diameter, the channel depth at the point where a pipe connects to the manhole wall shall be equal to the full pipe diameter. The manhole invert grade shall 1) be a continuation of the inlet and outlet pipe grades carried through to the centerline of the manhole, or 2) have a minimum slope of 2.5 percent between the inlet and outlet pipe inverts, or 3) have a minimum difference of 0.10 feet between the inlet and outlet pipe inverts, whichever provides the maximum difference in invert elevation between the inlet and outlet pipes. In all cases, the bottom(s) of the channel(s) shall provide a smooth transition between the inlet and outlet pipes. Changes in flow direction in the inverts of manholes shall be made by constructing smooth, large-radius sweeps to prevent splashing, turbulence, and eddies. The lowermost riser section may be set in the PC concrete, while still plastic, after which the base shall be cured a minimum of 24 hours prior to proceeding with construction of the manhole up to 12 feet in depth. The base shall be cured an additional 24 hours prior to continuing construction above the 12-foot level.

Wastewater manholes having cast-in-place bases may be constructed over existing wastewater pipes and the top half of the pipe removed to facilitate invert construction, except where the existing pipe is PVC, in which case, the entire pipe shall be removed from inside the manhole. The manhole floor shall rise outwardly from the springline elevation of the pipe, approximately one inch for each 12 inches of run (8 percent slope). The floors of stormwater manholes, also, shall rise outwardly from the springline elevation of the pipe, approximately one inch for each 12 inches of run (8 percent slope).

Wastewater manholes with lines larger than 18 inches shall require pre-cast bases; manholes constructed over in-service mains however, may be built on cast-in-place bases if the flow cannot be interrupted.

#### F. Pipe Connections to Manholes and Junction Boxes

Wastewater pipe connections to manholes and junction boxes shall be flexible sleeves or compression gaskets acceptable to the City Engineer or designated representative, as specified in Section 506.3.J herein. The Connectors shall conform to the requirements of ASTM C-923. Any voids in the annular space between the pipe and boot connector or ring waterstop and the inside of the manhole wall shall be filled with non-shrink grout to prevent solids collection.

#### G. Pipe Connections to Existing Manholes and Junction Boxes

Wastewater pipe connections to existing manholes and junction boxes shall be made by removing the wall section by coring or alternative method approved by the City Engineer or designated representative; installing flexible sleeves or compression gaskets acceptable to the City or designated representative and conforming to the requirements of ASTM C-923; filling any voids in the annular space between the pipe and boot connector or ring waterstop and the inside of the

manhole or junction box wall with non-shrink grout; rebuilding the invert to conform to Section 506S.4.D; rehabilitating the interior walls with structural lining material listed as SPL Item "Structural Lining for Wastewater Manholes" and coating the interior of the manhole with material listed as SPL Item "Organic Lining for Wastewater Manholes."

#### H. Waterproofing

PVC waterstops, hydrophilic waterstops, joint wrapping, and waterproofing compounds shall be installed as specified. Material wrapped around manholes at joints shall be listed as SPL Item "Manhole Seals" regardless of whether installation of the material is required by the Contract for waterproofing or is volunteered by the Contractor for ensuring acceptance of the manhole joints.

#### I. Backfilling

Backfilling of manholes shall conform to the density requirements of City of Pflugerville Standard Specification Item No. 510 "Pipe". Backfilling operations shall be performed carefully and evenly around manhole sections. Manhole construction in roadways may be staged to facilitate pavement base construction. Manholes constructed to interim elevations to facilitate interim construction shall be covered with steel plates. Steel plates on wastewater manholes shall be set in mortar to minimize inflow of storm water runoff. Manholes shall be completed to finish elevation prior to placement of the roadway's finish surface except on pavement reconstruction projects, where castings may be adjusted after paving is completed. The excavation for completion of manhole construction shall be backfilled in accordance with the City of Pflugerville Standard Detail 1100S-2, "Flexible Base with Asphalt Surface Trench Repair – Existing Pavement."

#### J. Height Adjustment of Manholes

##### 1. General

All adjustments shall be completed prior to the placement of the final roadway surface except on pavement reconstruction projects, where castings may be adjusted after paving is completed. Brick shall not be used in making height adjustments to wastewater manholes. Mortar shall not be used for any purpose on the inside of wastewater manholes.

All materials shall be new and unused.

If the adjustment involves lowering the top of a manhole, a sufficient depth of pre-cast concrete rings or shall be removed to permit reconstruction. If there are brick courses, the brick shall be removed in its entirety. Existing mortar shall be cleaned from the top surface remaining in place and the manhole rebuilt to the required elevation using precast concrete or HDPE grade rings. The manhole ring and cover shall then be installed with the top surface conforming to the proposed grade.

If the adjustment involves raising the elevation of the top of the manhole in accordance with "Minor Manhole Height Adjustment," the top of the concrete ring shall be cleaned and built up vertically to the new elevation, using new concrete rings and the ring and cover installed with the top surface conforming to the proposed grade.

After rings and covers are set to grade, the inside and outside of the precast concrete grade rings shall be wiped with non-shrink grout to form a durable surface and water-tight joints. The

grouted surface shall be smooth and even with the manhole cone or riser section. Grout shall not be placed when the atmospheric temperature is at or below 40°F. If a sudden drop in temperature below 40°F occurs or temperatures below 40°F are predicted, the grouted surfaces shall be protected against freezing for at least 24 hours.

## 2. Minor Manhole Height Adjustment (New and Existing Manholes)

Minor manhole height adjustments shall be performed as indicated on City of Pflugerville Standard Detail 506S-4, "Minor Manhole Adjustment and New Manhole Construction", and shall consist of adding precast reinforced concrete rings to adjust new and existing manholes to final grade. Brick shall not be used in making height adjustments to wastewater manholes.

If the adjustment involves raising the elevation of the top of the manhole, the top of the concrete ring shall be cleaned and built up vertically to the new elevation, using new concrete or HDPE grade rings, and the ring and cover installed with the top surface conforming to the proposed grade.

For new manhole construction, the maximum allowable throat or chimney height, including the depth of the ring casting, shall be limited to 21 inches of vertical face on the interior surface. For adjustments of existing manholes that fall within the limits of overlay and street reconstruction projects, the maximum vertical allowable height, including the depth of the ring casting, shall be limited to 27 inches of vertical face on the interior surface. All other existing manholes shall have a maximum allowable throat or chimney height adjustment, including the depth of the ring casting, of 12 inches of vertical face on the interior surface. Any adjustment that will exceed these requirements shall be accomplished as indicated on City of Pflugerville Standard Detail 506S-2, "Major Manhole Adjustment" and as described below. Manholes not located in paved areas shall have bolted covers. Manholes located within paved areas (street right of way only) shall be standard non-bolted unless otherwise noted on the drawings.

## 3. Major Manhole Height Adjustment (Existing Manholes Only)

Any adjustment that exceeds the requirements of Minor Manhole Adjustments, shall be accomplished as indicated on City of Pflugerville Standard Detail 506S-2, "Major Manhole Adjustment", and shall consist of any combination of removing the concrete rings, and/or the manhole cone or riser section, and/or the straight riser section of the manhole in order to bring the manhole to final grade. Major manhole adjustments shall apply only to existing manholes. Manholes not located in paved areas shall have bolted covers. Manholes located within paved areas (street right of way only) shall be standard non-bolted unless otherwise noted on the drawings.

## K. Interior Coatings of Wastewater Manholes and Junction Boxes

The interior surfaces of all Portland cement concrete wastewater manholes and junction boxes shall be coated with products specified either on the Drawings, designated in writing by the City Engineer or representative, or listed as SPL Item "Organic Lining for Wastewater Manholes." Product selection shall conform to usage described in that SPL. Surface preparation shall follow the product manufacturer's recommended procedures contained in technical data sheets unless otherwise specified in the contract documents. The Contractor shall measure the coating thickness according to ASTM D 6132, Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Over Concrete Using an Ultrasonic Gage. Thickness measures shall be made at locations

designated by the City Engineer or designated representative. All thickness measurements shall be witnessed by the City Engineer or designated representative.

L. Structural Linings of Existing Wastewater Manholes

The interior surfaces of existing wastewater manholes and junction boxes at locations shown in the Drawings or as designated by the City Engineer or designated representative shall be strengthened by application of structural lining systems either as specified on the Drawings, directed in writing by the City Engineer or designated representative, or listed as SPL Item "Organic Lining for Wastewater Manholes." Selection of products for coating the interior of existing manholes shall be based on the condition of the manholes. Surface preparation shall follow the product manufacturer's recommended procedures contained in technical data sheets unless otherwise specified in the contract documents.

M. Abandonment of Existing Manholes

Manholes designated on the Drawings for abandonment, shall be removed in their entirety, including manhole cone ring and cover. Two-foot long sections of the inlet and outlet pipes shall be cut and removed on the outside of the manhole, the ends of the remaining pipe and the pipe sections penetrating the manhole wall shall be securely plugged, and the structure filled with material in accordance with Standard Detail 506S-15 "Manhole Abandonment" or as directed by the City Engineer or designated representative.

If the manhole is not located within a street, the Contractor shall backfill with compacted 3/8-inch F bedding material to a point 12" above the highest plugged line. Above the bedding material, the Contractor shall backfill to a point 12" below the natural ground surface with compacted select fill. The remaining 12" shall be backfilled with suitable topsoil. If the manhole is located within a street, the Contractor shall backfill with compacted 3/8-inch F bedding material to a point 12" above the highest plugged line. Above the bedding material, the Contractor shall backfill to a point 12" below the natural ground surface with compacted select fill. The remaining 12" shall be backfilled with Flexible Base in accordance with the City of Pflugerville Standard Specification 210S, "Flexible Base".

The Contractor shall provide all labor, equipment and materials necessary to maintain existing flows, including temporary diversions and all pumping of sewage that may be required to prevent backup of wastewater lines and shall immediately remove all offensive matter at his own expense. The Contractor shall not be permitted to overflow, bypass, pump or by any other means convey sewage to any stream or other water source. Should damage of any kind occur to the existing wastewater line, the Contractor shall make repairs to the satisfaction of the City Engineer or designated representative, at the Contractor's expense.

The contractor shall notify the City Engineer or designated representative immediately of any discrepancies in elevations of existing wastewater lines and manholes between those shown on the Drawings and those established during construction so that the City can make necessary modifications.

506.6 - Acceptance Testing of Wastewater Manholes



Manholes shall be tested separately and independently of the wastewater lines.

A. Test by the Vacuum Method

A vacuum test shall be performed by the Contractor prior to backfilling those manholes that fall within the right-of-way that require detouring of vehicular traffic. A second vacuum test will not be required after backfilling and compaction is complete unless there is evidence that the manhole has been damaged or disturbed subsequent to the initial vacuum test.

For manhole installations which do not require detouring of vehicular traffic, the vacuum method is recommended and may be used by the Contractor prior to backfilling the manhole to insure proper installation so that defects may be located and repaired; however, a vacuum test shall be performed after backfilling, and compaction are complete. Testing after backfill and compaction are complete will be the basis for acceptance of the manhole.

1. Equipment

- a) The manhole vacuum tester shall be a device approved for use by the City Engineer or designated representative.
- b) Pipe sealing plugs shall have a load resisting capacity equal to or greater than that required for the size of the connected pipe to be sealed.

2. Procedures - applicable to new 48-inch diameter manholes

- a) Manhole section interiors shall be carefully inspected; units found to have through-wall lift holes, or any penetration of the interior surface by inserts provided to facilitate handling, will not be accepted. Coating shall be applied after the testing unless coating is applied before installation or unless it is applied at the factory. All lift holes and exterior joints shall be plugged with an acceptable non-shrink grout. No grout shall be placed in horizontal joints. Tests shall be performed before grouting the invert or around pipe penetrations and before coating the interior surfaces of the manhole or junction box.
- b) After cleaning the interior surfaces of the manhole, the Contractor shall place and inflate pneumatic plugs in all of the connecting pipes to isolate the manhole; sealing pressure within the plugs shall be as recommended by the plug manufacturer. Plugs and the ends of pipes connected by flexible boots shall be blocked to prevent their movement during the vacuum test.
- c) The vacuum test head shall be placed on the top of the cone or riser section or, inside of the top of the manhole cone or riser section, and the compression seal band inflated to the pressure recommended by its manufacturer. The vacuum pump shall be connected to the outlet port with the valve open. When a vacuum of 10 inches of mercury (-5 psig) has been attained, the valve shall be closed and the time noted. Tampering with the test equipment will not be allowed.
- d) The manhole shall have passed the test if the vacuum does not drop below 9 inches of mercury (-4.5 psig) within 3 minutes of the time the valve was closed. The actual vacuum shall be recorded at the end of the 3 minutes during which the valve was closed.
- e) When the standard vacuum test cannot be performed because of design or material constraints (examples: T-Type manholes, T-Lock Liners, or other reasons acceptable to

the City Engineer or designated representative), testing of individual joints shall be performed as directed by the City Engineer or designated representative.

**B. Test by the Exfiltration Method**

At the discretion of the City Engineer or designated representative, the Contractor may substitute the Exfiltration Method of testing for the Vacuum test described in Section 506.6.A above. This method may only be used when ground water is not present. If ground water is present a Vacuum Test shall be used unless otherwise directed by the City Engineer or designated representative. All backfilling and compaction shall be completed prior to the commencement of testing.

The procedures for the test shall include the following:

1. Manhole section interiors shall be carefully inspected; units found to have through-wall lift holes, or any penetration of the interior surface by inserts provided to facilitate handling, will not be accepted. Coating shall be applied after the testing unless coating is applied before field assembly, or at the factory. All lift holes and exterior joints shall be plugged with an acceptable non-shrink grout. No grout shall be placed in horizontal joints. Tests shall be performed before grouting the invert or around pipe penetrations and before coating the interior surfaces of the manhole or junction box.
2. After cleaning the interior surface of the manhole, the Contractor shall place and inflate pneumatic plugs in all of the connecting pipes to isolate the manhole; sealing pressure within the plugs shall be as recommended by the plug manufacturer.
3. Concrete manholes shall be filled with water or otherwise thoroughly wetted for a period of 24 hours prior to testing.
4. At the start of the test, the manhole shall be filled to the top with water. The test time shall be 1 hour. The Construction Inspector must be present for observation during the entire time of the test. Permissible loss of water in the 1-hour test time is 0.025 gallons per diameter foot, per foot of manhole depth. For a 4-foot diameter manhole, this quantity converts to a maximum permissible drop in the water level (from the top of the manhole cone or riser) of 0.1 inches per foot of manhole depth or 1.0 inches for a 10-foot deep manhole.

**C. Failure to Pass the Test - Records of Tests**

If the manhole fails to pass the initial test method as described in (A) Test by the Vacuum Method and, if allowed, (B) Test by the Exfiltration Method, or if visible groundwater leakage into the manhole is observed, the Contractor shall locate the leak, if necessary by disassembly of the manhole. The Contractor shall check the gaskets and replace them if necessary. The Contractor may re-lubricate the joints and re-assemble the manhole, or the Contractor may install an acceptable exterior joint sealing product (see City of Pflugerville SPL Item, "Manhole Seals") on all joints and then retest the manhole. If any manhole fails the vacuum and/or exfiltration test twice, the Contractor shall consider replacing that manhole. If the Contractor chooses to attempt to repair that manhole, the manhole must be retested until it passes. In no case shall cold applied preformed plastic gaskets be used for repair. Records of all manhole testing shall be made available to the City Engineer or designated representative at the close of each working day, or as otherwise directed by the City Engineer or designated representative. Any damaged or visually defective products, or any products out of acceptable tolerance shall be removed from the site.

#### D. Inspection

The City Engineer or designated representative shall make a visual inspection of each manhole after it has passed the testing requirements and is considered to be in its final condition. The inspection shall determine the completeness of the manhole; any defects shall be corrected to the satisfaction of City Engineer or designated representative.

#### 506.7 - Measurement

A "Junction Box" and "Box Manholes" will be measured by each structure of the indicated size regardless of depth.

A "Standard Pre-cast Manhole with Pre-cast Base", "Standard Pre-cast Manhole with Cast-in-Place (CIP) Base", "Special Manhole", "Drop Manhole with Pre-cast Base", "Drop Manhole with Cast-in-Place (CIP) Base", "Centered Tee Manhole", or "Tangent Tee Manhole" will be measured by each structure of the indicated size for the first 8 feet of depth.

An "Extra Depth Manhole" will be measured by linear vertical foot of Standard Pre-cast Manhole with Pre-cast Base, Standard Pre-cast Manhole with CIP Base, Drop Manhole with Pre-cast Base, Drop Manhole with CIP Base, Special Manhole, Centered Tee Manhole, or Tangent Tee Manhole of the indicated size in excess of eight feet of depth. Manhole depth will be measured from the invert flow line to the finished surface elevation.

"Minor Manhole Height Adjustment" and "Major Manhole Height Adjustment" will be measured by each unit for the indicated size. Only existing manholes will be measured for minor or major manhole height adjustment.

"Connection to Existing Manhole or Junction Box" will be measured per each for the indicated type of structure and location.

"Structural Lining" will be measured by the linear vertical foot for the indicated structure.

New manholes constructed to interim elevations to facilitate stage construction shall be measured as one unit regardless of the number of interim elevations constructed. All labor, materials and other expenses necessary for the stage construction shall be included in the unit price bid for the completed unit. Cost of abandonment of existing manholes shall be included in the unit price bid for the completed unit, unless Pay Item No. 506 AB is indicated on the Drawings and identified in Standard Contract Bid Form 00300U.

#### 506.8 - Payment

Payment for completed junction boxes and manholes of the type indicated on the Drawings shall be made at the appropriate unit bid price. The unit bid price shall include all labor, equipment, materials, (including but not limited to frames and grates, rings and covers, adjusting rings, cone sections, riser sections, gaskets, drop piping and fittings, bases, pipe-to-manhole connectors, concrete, reinforcing steel, non-shrink grout, mortar, joint wrap where specified, and, for wastewater manholes, interior coatings), time and incidentals necessary to complete the work.

Payment for a "Junction Box" and "Box Manhole" will be made at the unit price bid for the indicated size, complete in place.

Payment for the first 8 feet of a "Standard Pre-cast Manhole with Pre-cast Base", "Standard Pre-cast Manhole with Cast-in-Place (CIP) Base", "Special Manhole", "Drop Manhole with Pre-cast Base", "Drop Manhole with Cast-in-Place (CIP) Base", "Centered Tee Manhole", or "Tangent Tee Manhole" will be made at the unit price bid for the indicated type and size, complete in place.

Payment for that portion of a Standard Pre-cast Manhole with Pre-cast Base, Standard Pre-cast Manhole with CIP Base, Drop Manhole with Pre-cast Base, Drop Manhole with CIP Base, Special Manhole, Centered Tee Manhole, or Tangent Tee Manhole in excess of 8 feet in depth will be made at the unit price bid for "Extra Depth Manhole" of the indicated type and size, complete in place.

Payment for "Minor Manhole Height Adjustment" and "Major Manhole Height Adjustment" will be made at the unit bid price, complete in place.

Payment for "Structural Lining" will be made at the unit price per linear vertical foot, which will include surface preparation, environmental adjustments, lining application, and curing, as required.

Payment for "Connection to Existing Manhole or Junction Box" shall be made at the unit price per connection and will include removing the wall section by coring or alternative method approved by the City Engineer or designated representative, rehabilitating the interior walls, rebuilding the invert, and preparing and coating the interior surfaces of the structure.

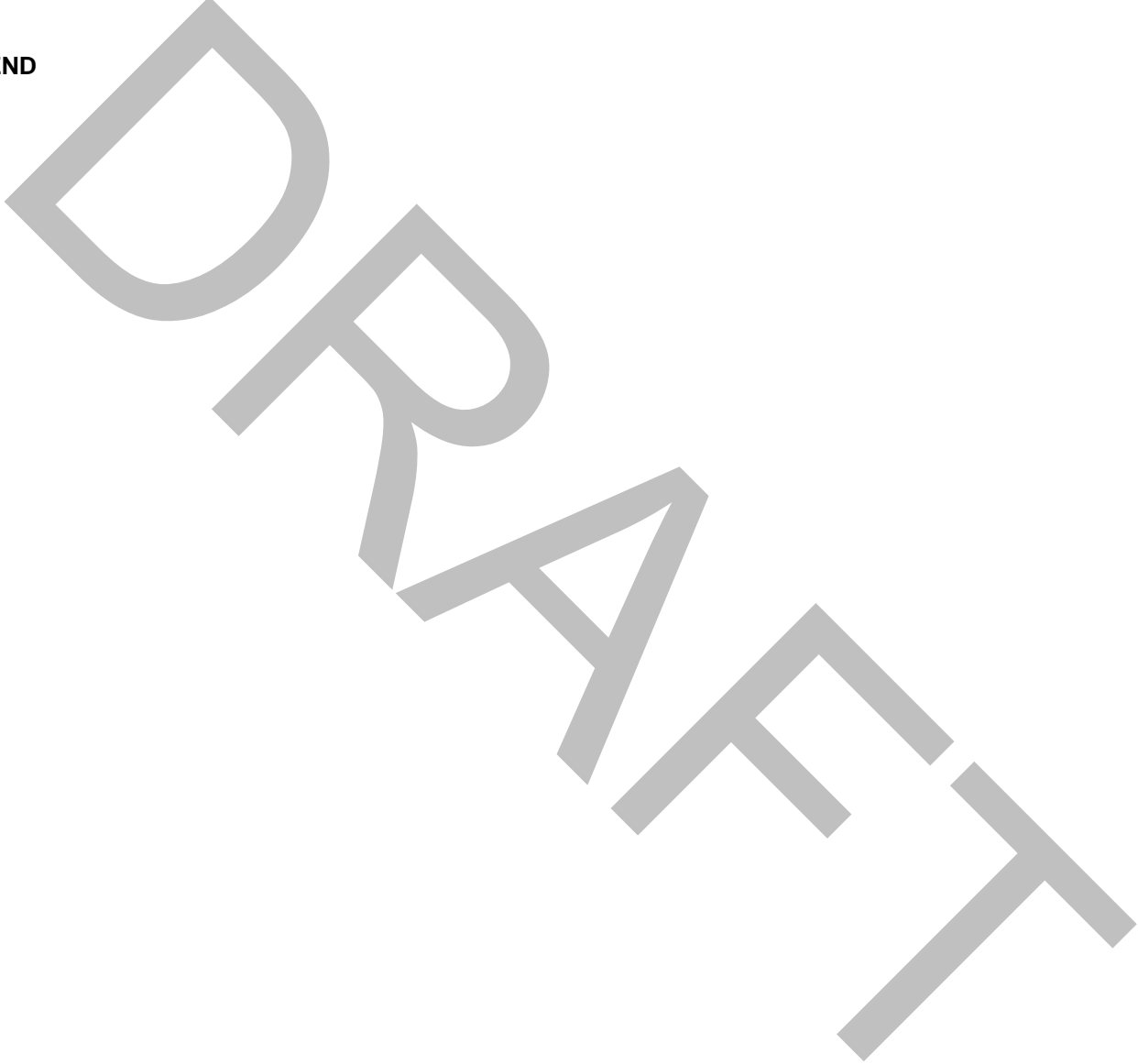
When indicated in the Drawings, abandonment of existing manholes shall be made at the unit price for abandonment.

The intended use of each item shall be designated by a two-letter code (Wastewater=WW; Stormwater=SW) in the spaces provided after the pay item number:

<b>Pay Item No. 506S-M</b> _____ :	Standard Pre-cast Manhole w/Pre-cast Base, _____ Dia.	Per Each.
<b>Pay Item No. 506S-M1</b> _____ :	Standard Pre-Cast Manhole w/CIP Base, _____ Dia.	Per Each.
<b>Pay Item No. 506S-S</b> _____ :	Special Manhole, _____ Dia.	Per Each.
<b>Pay Item No. 506S-D</b> _____ :	Drop Manhole w/Pre-cast Base, _____ Dia.	Per Each.
<b>Pay Item No. 506S-D1</b> _____ :	Drop Manhole w/CIP Base, _____ Dia.	Per Each.
<b>Pay Item No. 506S-C</b> _____ :	Centered Tee Manhole, _____ Dia. x _____ Dia.	Per Each.
<b>Pay Item No. 506S-T</b> _____ :	Tangent Tee Manhole, _____ Dia. x _____ Dia.	Per Each.
<b>Pay Item No. 506S-J</b> _____ :	Junction Box, _____ Ft. x _____ Ft.	Per Each.
<b>Pay Item No. 506S-B</b> _____ :	Box Manhole _____ Ft. x _____ Ft.	Per Each.
<b>Pay Item No. 506S-2</b> _____ :	Major Manhole Height Adjustment, _____ Dia.	Per Each.
<b>Pay Item No. 506S-4</b> _____ :	Minor Manhole Height Adjustment, _____ Dia.	Per Each.

<b>Pay Item No. 506S-AB</b> _____ :	Abandonment of existing Manholes:	Per Each.
<b>Pay Item No. 506S-EDM</b> _____ :	Extra Depth of Manhole, _____ Dia. _____	Per Linear Vert. Foot.
<b>Pay Item No. 506S-SL</b> _____ :	Structural Lining of _____ :	Per Linear Vert. Foot.
<b>Pay Item No. 506S-CN</b> _____ :	Connection to Existing _____ :	Per Each.

END



## ITEM NO. 507S - BULKHEADS

### 507S.1 - Description

This item shall govern furnishing and installing plywood or end caps as a temporary utility plug at locations indicated on the Drawings or as directed by the Engineer or designated representative. The work will be placed in conjunction with installation of a pipe where a continuation of the utility system will be performed later.

### 507S.2 - Submittals

Within 14 days of the Notice to Proceed, the Contractor shall submit to the City for approval, the required submittals. The submittal requirements of this specification item include the type (wood, plastic, rubber, etc.) and application (pipe characteristics and location) of bulkheads.

### 507S.3 - Material

Plywood shall be construction grade, 3/4 inch thick and need not be new or treated. End caps may be plastic, vitrified clay pipe, rubber or concrete.

### 507S.4 - Construction Methods

After installation of the utility requiring temporary bulkheading, an end cap or a section of plywood, having dimensions at least 6 inches in excess of the outside pipe diameter shall be attached to the exposed bell or spigot and backfilled immediately after installation. Care shall be exercised to prevent the backfill material from entering the pipe.

Bulkheads used with staged construction shall be sound, reasonably free of knots and warps and have a 3-inch nominal thickness.

### 507S.5 - Measurement and Payment

Bulkheading will not be measured and paid for separately but shall be included in the unit price bid for the item of construction in which this item is used.

**END**

## ITEM NO. 508S - MISCELLANEOUS STRUCTURES AND APPURTENANCES

### 508S.1 - Description

This item governs the construction of miscellaneous structures and appurtenances, complete in place or to the stage detailed and/or indicated in the Drawings, using the materials specified herein, including the excavation, installation, backfilling, placement of the concrete and when required, the furnishing and installation of frames, grates, rings, covers, safety end treatment and any concrete curb and gutter indicated on the Drawings.

### 508S.2 - Submittals

The submittal requirements of this specification item include:

- A. Type of structure and appurtenances (inlets, headwalls, frames, grates, energy dissipators, etc.), construction methods and sequence (precast, cast in place), materials (bolts, nuts, plates, angles, etc.)
- B. Aggregate types, gradations and physical characteristics for the Portland Cement (PC) concrete mix.
- C. Proposed proportioning of materials for the mortar mix.
- D. Analysis and thickness calculations for temporary steel covers.

### 508S.3 - Types

The various types of structures and appurtenances such as inlets, headwalls, energy dissipators, etc., are designated on the Drawings by letter or by number for the particular design of structure to be constructed in accordance with the details indicated on the Drawings. Unless otherwise indicated on the Drawings, the Contractor may have the option of furnishing cast in place or precast structures.

### 508S.4 - Materials

#### A. PC Concrete

The PC concrete shall conform to Item No. 403S, "Concrete For Structures", with the following classes:

Cast in Place Concrete Class A

Precast Concrete Class C

#### B. Mortar

Mortar shall be composed of 1 part PC and 2 parts clean, sharp mortar sand suitably graded for the purpose by conforming in other respects to the provisions of Standard Specification Item No. 403S, "Concrete for Structures" for fine aggregate. Hydrated lime or lime putty may be added to the mix, but in no case shall it exceed 10 percent by weight of the total dry mix.

#### C. Reinforcement and Steel

Reinforcing Steel shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

Structural Steel shall conform to Standard Specification Item No. 720S, "Metal for Structures".

D. Frames, Grates, Rings and Covers

Frames, grates, rings and covers shall conform to City of Pflugerville Standard Specification Item No. 503S, "Frames, Grates, Rings and Covers".

E. Safety End Treatment for Structures

The safety end treatment for structures shall conform to TxDOT Specification Item No. 467, "Safety End Treatment".

1. Bolts and Nuts. All bolts, nuts and associated hardware shall meet the specifications of ASTM A 307.
2. Plates and Angles. All plates and similar angles and brackets shall meet the specifications of ASTM A 36.
3. Pipe Runners. Pipe Runners shall conform to the requirements of ASTM A53, Grade B.
4. Galvanizing. All hardware including nuts, bolts and plates listed above shall be galvanized conforming to ASTM A 123 or A 153.

F. Miscellaneous Items

Cast iron for supports, steps and inlet units shall conform to the shape and dimensions indicated on the Drawings. The casting shall be clean and perfect, free from sand or blowholes or other defects. Cast iron castings shall meet the requirements of ASTM A 48, Class 30. Steel for temporary covers when used with stage construction shall be adequate for the loads imposed.

508S.5 - Construction Methods

All concrete work shall be performed in accordance with Standard Specification Item No. 410S, "Concrete Structures". Forms will be required for all cast-in-place concrete walls, except where the nature of the surrounding material is such that it can be trimmed to a smooth vertical face (the outside form for concrete bases). Where cast in place concrete is used in wall construction of storm sewers, the steps shall be cast into the wall when the concrete is placed.

The construction inlets shall be completed, as soon as is practicable after installation is complete of the sewer lines in the inlet. All sewer line shall be cut neatly at the inside face of the walls of the inlet and pointed up with mortar.

Bases for cast in place inlets may be placed prior to or at the Contractor's option after the storm sewer is constructed.

Bases for box storm sewers shall be cast as an integral part of the storm sewer. The manholes may be constructed prior to backfilling or if the Contractor so elects, the manhole opening may be covered temporarily with a steel plate to facilitate the compaction of backfill for the storm sewer as a whole. Thereafter, required excavation for the inlet shall be made and the inlet constructed and backfilled.

The inverts passing out or through an inlet shall be shaped and grouted across the floor of the inlet as indicated on the Drawings. This shaping may be accomplished by adding shaping mortar or concrete after the base is cast or by placing the required additional material with the base.



All miscellaneous structures shall be completed in accordance with the details indicated on the Drawings. Backfilling to original ground elevation shall be in accordance with the provisions of the appropriate items and as directed by the Engineer or designated representative.

Energy dissipators and headwalls shall be constructed in accordance with City of Pflugerville Standard Detail 508S-13 "Standard Headwall and Energy Dissipators".

**508S.6 - Measurement**

All miscellaneous structures and safety end treatments satisfactorily completed as indicated on the Drawings will be measured as completed units per each.

Concrete removal, excavation and backfill, riprap, pipe, headwalls, wing walls, collars and apron slabs will not be measured under this item but will be included in the unit price bid for the item of construction in which this item is used.

Frames, grates, rings, covers, safety end treatment and any concrete curb and gutter indicated will not be measured and paid for but shall be included in the unit price bid of one of the pay items identified in the contract bid form.

**508S.7 - Payment**

**A. Inlets**

Payment for Inlets of the type indicated in place in accordance with these specifications and measured as prescribed above will be made at the unit bid price for each Inlet, of the type specified.

**B. Energy Dissipators and Headwalls**

Payment for special complete structures will be made at the unit price bid per each.

**C. Safety End Treatment**

Payment for Safety End Treatment, complete in place, will be made at the unit bid price for each unit of the type indicated on the Drawings.

Payment will be made under one of the following:

<b>Pay Item No. 508S-E:</b>	Energy Dissipators, _____ In. Dia.	Per Each.
<b>Pay Item No. 508S-H:</b>	Headwalls, Type _____, _____ In. Dia. Pipe	Per Each.
<b>Pay Item No. 508S-IG:</b>	Inlet, Grated	Per Each.
<b>Pay Item No. 508S-SET</b>	Safety End Treatment, Type _____ Size _____	Per Each.
<b>Pay Item No. 508S-IR:</b>	Inlet (Size ____), Recessed	Per Each.
<b>Pay Item No. 508S-IS:</b>	Inlet (Size ____), Standard	Per Each.

**END**

## ITEM NO. 509S - EXCAVATION SAFETY SYSTEMS

### 509S.1 - Description

This item shall govern the designing, furnishing, installing, maintaining and removing or abandoning of temporary Excavation Safety Systems consisting of trench shields, aluminum hydraulic shoring, timber shoring, trench jacks, tied-back or braced sheeting, tied-back slurry walls, soil nailing, rock bolting, tied-back or braced soldier piles and lagging, and other systems for protecting workers in excavations. This item shall also govern the designing and constructing of sloping and benching systems for protecting workers in excavations.

At a minimum, the Excavation Safety Systems shall conform to United States Department of Labor Rules 29 CFR, Occupational Safety and Health Administration, Part 1926 Safety and Health Regulations for Construction, Subpart P, Excavation (hereinafter called OSHA).

### 509S.2 - Definitions

**COMPETENT PERSON** shall mean one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them. The **COMPETENT PERSON** shall be capable of interpreting the manufacturer's data sheets and interpreting and implementing the Excavation Safety System Plan.

An **EXCAVATION** shall mean any cut, cavity, trench, or depression in an earth surface, formed by earth removed by the Contractor. The Contractor shall provide an Excavation Safety System for all excavations except when 1) the excavation is in stable rock as determined by the Texas-licensed Professional Engineer who prepared the Contractor's Excavation Safety System Plan or 2) the excavation is less than 5 feet in depth and examination of the ground by the Contractor's competent person provides no indication of a potential cave-in.

**TRENCH (TRENCH EXCAVATION)** shall mean any narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth shall be greater than the width, but the trench (measured at the bottom) shall not be wider than 15 feet. Excavation Safety Systems for such trenches shall be defined as Trench Excavation Safety Protective Systems.

If the Contractor installs or constructs forms or other structures in an excavation such that the dimension measured from the forms or structures to the sides of the excavation is reduced to 15 feet or less (measured at the bottom of the excavation), those excavations shall also be defined as a **TRENCH** if workers must enter it. Excavation Safety Systems for such **TRENCHES** shall also be defined as **TRENCH EXCAVATION SAFETY PROTECTIVE SYSTEMS**.

### 509S.3 - Excavation Safety System Plan Submittal

- A. The Notice to Proceed with construction may be issued by the Owner before the Contractor has submitted the necessary Excavation Safety Plan(s); however, with 14 days of the Notice to Proceed, the Contractor shall submit to the City for approval, the required Excavation Safety Plan(s) for the Project.

## B. Prior to Starting Excavation

Prior to starting any Excavation, the Contractor shall submit to the Owner:

1. A certificate indicating that the Contractor's Competent Person(s) has completed training in an excavation safety program based on OSHA regulations within the past 5 years.
2. Manufacturer's tabulated data or other tabulated data for Excavation Safety Systems consisting of pre-engineered protective systems such as trench shields, aluminum hydraulic shoring, timber shoring, pneumatic shoring, or trench jacks, or benching or sloping or other protective systems that are not designed specifically for the Project.

Manufacturer's tabulated data shall meet the requirements in OSHA and shall describe the specific equipment to be used on the Project. Tabulated data must bear the seal of the licensed professional engineer who approved the data. Manufacturer's tabulated data shall be an attachment to the Contractor's Excavation Safety System Plan described below.

### 509S.4 - Excavation Safety System Plan Review

The Contractor shall prepare an Excavation Safety System Plan (hereafter called the "Plan") specifically for the Project. The Contractor shall retain a Texas-licensed Professional Engineer to prepare the Plan. On City-funded projects, the Contractor must follow qualifications-based procedures to procure the required Professional Engineering services, according to Chapter 2254 of the Texas Government Code.

The Contractor shall be responsible for obtaining geotechnical information necessary for design of the Excavation Safety System. If geotechnical information for design of the Project has been acquired by the Owner or designated representative, it shall be provided to the Contractor for information purposes.

- A. The Plan for Excavation Safety Systems consisting of pre-engineered protective systems such as trench shields, aluminum hydraulic shoring, timber shoring, pneumatic shoring, or trench jacks, or benching or sloping or other protective systems that are not designed specifically for the Project shall include:
  1. Detailed Drawings of the Excavation Safety System(s) that will provide worker protection conforming to OSHA. The Drawings shall note the required load carrying capacity, dimensions, materials, and other physical properties or characteristics in sufficient detail to describe thoroughly and completely the Excavation Safety System(s).
  2. Drawings, notes, or tables clearly detailing the specific areas of the Project in which each Excavation Safety System shall be used, the permissible size of the excavation, the length of time that the excavation shall remain open, the means of egress from the excavation, the location of material storage sites in relation to the excavation, the methods for placing/compacting bedding/backfill within the safety of the system, any excavation safety equipment restrictions and subsequent removal of the system.
  3. Recommendations and limitations for using the Excavation Safety Systems.
  4. A Certificate of Insurance of the Excavation Safety System Engineer's Professional Liability Insurance coverage. For City-funded projects, coverage meeting the requirements of Standard Contract Documents Section 00810 shall be provided. For privately funded projects the coverage shall be at least \$1,000,000.

- B. The Plan for Excavation Safety Systems consisting of tied-back or braced sheeting, tied-back or braced soldier piles and lagging, slurry walls, soil nailing, rock bolting or other protective systems that are designed specifically for the Project shall include:
1. Detailed Drawings of the Excavation Safety System(s) that will provide worker protection conforming to OSHA. The Drawings shall note the design assumptions, design criteria, factors of safety, applicable codes, dimensions, components, types of materials, and other physical properties or characteristics in sufficient detail to describe thoroughly and completely the Excavation Safety System(s).
  2. Detailed technical specifications for the Excavation Safety System addressing the properties of the materials, construction means and methods, quality control and quality assurance testing, performance monitoring, and monitoring of adjacent features, as appropriate.
  3. Drawings that clearly detail the specific areas of the Project in which each type of system shall be used and showing the Special Shoring in plan and elevation (vertical profile) views.
  4. Drawings, notes or tables clearly detailing the length of time that the excavation shall remain open, the means of egress from the excavation, the location of material storage sites in relation to the excavation, the methods for placing/compacting bedding/backfill within the safety of the system, any excavation safety equipment restrictions and subsequent removal or abandonment of the system or parts thereof.
  5. Recommendations and limitations for using the Excavation Safety Systems.
  6. A Certificate of Insurance of the Excavation Safety System Engineer's Professional Liability Insurance coverage. For City-funded projects, coverage meeting the requirements of Standard Contract Documents Section 00810 shall be provided. For privately funded projects the coverage shall be at least \$1,000,000.

#### 509S.5 - Excavation Safety System Submittal Review

Review of the Excavation Safety System submittal conducted by the Owner or designated representative shall only relate to conformance with the requirements herein. The Owner's failure to note exceptions to the submittal shall not relieve the Contractor of any or all responsibility or liability for the adequacy of the Excavation Safety System. The Contractor shall remain solely and completely responsible for all Excavation Safety Systems and for the associated means, methods, procedures, and materials.

#### 509S.6 - Contractor's Responsibility

The Contractor shall be responsible for implementing the Excavation Safety System Plan and for confirming that the Excavation Safety System(s) used on the Project meets the requirements of the Plan.

The Contractor's Competent Person(s) shall be on the Project whenever workers are in an excavation meeting the definitions of a Trench given in 509S.2.

#### 509S.7 - Construction Methods

The Contractor's Competent Person(s) shall maintain a copy of appropriate OSHA regulations on-site and shall implement OSHA excavation safety regulations at the work site. The Contractor shall perform all excavation in a safe manner and shall maintain the Excavation Safety Systems to prevent death or injury to personnel or damage to structures, utilities or property in or near excavation.

If evidence of possible cave-ins or earthen slides is apparent or an installed Excavation Safety System is damaged, the Contractor shall immediately cease work in the excavation, evacuate personnel from any potentially hazardous areas and notify the Owner. Personnel shall not be allowed to re-enter the excavation until necessary repairs or replacements are completed and are inspected and approved by the Contractor's Competent Person(s). Repair and replacement of damaged Excavation Safety System shall be at the Contractor's sole expense.

#### 509S.8 - Changed Conditions

When changed conditions require modifications to the Excavation Safety System, the Contractor shall provide to the Owner or designated representative a new design or an alternate Excavation Safety System Plan that is proposed by the Contractor's Excavation Safety System Engineer to address the changed conditions. Copies of the new design or alternate system shall be provided to the Owner or designated representative in accordance with the requirements of section 509S.3, "Excavation Safety System Plan Submittals." A copy of the most current Excavation Safety System Plan shall be maintained on site and made available to inspection and enforcement officials at all times.

Any changes to the Excavation Safety System Plan that are initiated by the Contractor for operational efficiency or as a result of changed conditions, that could be reasonably anticipated, will not be cause for contract time extension or cost adjustment. When changes to the Excavation Safety System Plan are necessitated by severe and uncharacteristic natural conditions or other conditions not reasonably within the control of the Contractor, the Contractor may make a written request to the Owner for a Change Order to address the anticipated work. The Contractor shall notify the Owner in writing within 24 hours of the occurrence of changed conditions that the Contractor anticipates the submittal of a claim for additional compensation. Under "Changed Conditions" the work deemed immediately necessary by the Contractor to protect the safety of workers and public, equipment or materials may only be accomplished until the Owner or designated representative has a reasonable opportunity to investigate the Contractor's written request for a Change Order and respond in writing to the request.

#### 509S.9 - Measurement

Trench Excavation Safety Protective Systems will only be measured and paid for those trenches that workers would reasonably be expected to enter.

Trench Excavation Safety Protective Systems for Trenches excavated to a final width (measured at the bottom of the excavation) not exceeding 15 feet shall be measured by the linear foot through manholes, bore pits, receiving pits, and other appurtenances along the centerline of the trench. This method of measurement shall apply to any and all protective systems, including but not limited to tieback or braced sheeting, tieback or braced soldier piles and lagging, slurry walls, soil nails, rock bolts, shoring, trench boxes, and sloping or benching as used to provide a Trench Excavation Safety Protective System in accordance with the Excavation Safety System Plan.

Trench Excavation Safety Protective Systems for Trenches created by installation or construction of forms or other structures in an excavation whose width is greater than 15 feet such that the dimension measured from the forms or structures to the sides of the excavation is reduced to 15 feet or less (measured at the bottom of the excavation) shall be measured by the linear foot along the centerline of the Trench. Where forms or structures create multiple Trenches in one excavation, each Trench shall be measured separately. This method of measurement shall apply to any and all protective systems, including but not limited to tieback or braced sheeting, tieback or braced soldier piles and lagging, slurry

walls, soil nails, rock bolts, shoring, trench boxes, and sloping or benching as used to provide a Trench Excavation Safety Protective System in accordance with the Excavation Safety System Plan.

509S.10 - Payment

Payment for Trench Excavation Safety Protective Systems, measured as prescribed above, will be made at unit bid price per centerline linear foot of Trench. The unit bid price shall include full compensation for designing, furnishing, installing the system; for dewatering, and for maintaining, replacing, repairing and removing the Trench Excavation Safety Protective System and for sloping, special clearing, and excavation necessary to safely implement the Excavation Safety System Plan. No payment will be made for Trench Excavation Safety Protective Systems made necessary by the Contractor's selection of an optional design or sequence of work that creates the need for the Trench Excavation Safety Protective System

Payment will be made under the following:

<b>Pay Item No. 509S-1:</b>	Trench Excavation Safety Protective Systems (all depths)	Per Linear Foot.
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**END**

## ITEM NO. 510 - PIPE

### 510.1 - Description

This item governs the furnishing and installing all pipe and/or materials for constructing pipe mains, sewers, laterals, stubs, inlet leads, service connections, culverts, temporary service lines and temporary diversion lines, including all applicable Work such as excavating, bedding, jointing, backfilling materials, tests, concrete trench cap, concrete cap and encasement, etc., prescribed under this item in accordance with the provisions of the Edwards Aquifer Protection Ordinance, when applicable, and City of Pflugerville Engineering Design Criteria Manual. The pipe shall be of the sizes, types, class and dimensions indicated or as designated by the City and shall include all joints or connections to new or existing mains, pipes, sewers, manholes, inlets, structures, etc., as may be required to complete the Work in accordance with specifications and published standard practices of the trade associations for the material specified and to the lines and grades indicated. This item shall include any pumping, bailing, and drainage when indicated or applicable. Unless otherwise provided, this item shall consist of the removal and disposition of trees, stumps and other obstructions, old structures or portions thereof such as house foundations, old sewers, masonry or concrete walls, the plugging of the ends of abandoned piped utilities cut and left in place and the restoration of existing utilities damaged in the process of excavation, cutting and restoration of pavement and base courses, the furnishing and placing of select bedding, backfilling and cement or lime stabilized backfill, the hauling and disposition of surplus materials, bridging of trenches and other provisions for maintenance of traffic or access as indicated.

### 510.2 - Materials

Within 14 days of the Notice to Proceed, the Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation into the Work are of the kind and quality that satisfies the specified functions and quality. The City of Pflugerville Standard Products Lists (SPL) form a part of the Specifications. Contractors may, when appropriate, elect to use products from the SPL; however, submittal to the City is still required. The purpose of the SPL's is to expedite review, by the City, The SPL's shall not be considered as being a pre-approved list of products necessarily meeting the requirements of the Project. Items contained in the SPL cannot be substituted for items shown on the Drawings, or called for in the specifications, or specified in the Bidding Requirements, Contract Forms and Conditions of Contract, unless approved by the City. The Standard Product List current at the time of plan approval will govern.

- 1) Concrete  
Concrete shall conform to Specification Item No. 403S, "Concrete for Structures".
- 2) Coarse Aggregate  
Coarse aggregate shall conform to Specification Item No. 403S, "Concrete for Structures" or one of the following:
  - a) Pipe Bedding Stone  
Pipe bedding stone shall be clean gravel, crushed gravel or crushed limestone, free of mud, clay, vegetation or other debris, conforming to ASTM C 33 for stone quality. Size gradation shall conform to ASTM C-33 No. 57 or No. 67 or the following Table:

<b>Sieve Size</b>	<b>3/8" F (% Retained)</b>	<b>1/2" D (% Retained)</b>	<b>Washed Gravel (% Retained)</b>
1/2"	0	0	0
3/8"	0-2	5-25	--
4m	40-85	80-100	--
10m	95-100	96-100	--
3/4"	--	--	100

Sand will not be allowed as acceptable embedment material.

b) Foundation Rock  
Foundation rock shall be well graded coarse aggregate ranging in size from 2 to 8 inches.

c) Flexible Base  
Flexible base shall conform to Specification Item No. 210S, "Flexible Base".

3) Fine Aggregate

a) Concrete and Mortar Sand  
Fine aggregate shall conform to Specification Item No. 403S, "Concrete for Structures".

4) Controlled Low Strength Material

Controlled Low Strength Material (CLSM) shall conform to Specification Item 402S, "Controlled Low Strength Material".

5) Pea Gravel

Pea gravel bedding shall be clean washed material, hard and insoluble in water, free of mud, clay, silt, vegetation or other debris. Stone quality shall meet ASTM C 33. Size gradation shall be as follows:

SIEVE SIZE	% RETAINED BY WEIGHT
¾"	0
½"	0—25
¼"	90—100

6) Select Backfill or Borrow

This material shall consist of borrow or suitable material excavated from the trench. It shall be free of stones or rocks over 8 inches and shall have a plasticity index of less than 20. The moisture content at the time of compaction shall be within 3 percent of optimum as determined by TxDOT Test Method Tex-114-E. If approved by the City, good, sound earth may be used as select material for backfill over the pipe. Good, sound earth is defined as gravel, sandy loam or loam free from excessive clay and having a Plasticity Index less than 20.

All suitable materials from excavation operations not required for backfilling the trench may be placed in embankments, if applicable. All unsuitable materials that cannot be made suitable shall be considered surplus excavated materials as described in Specification Section 510.3(13). The Contractor may, if approved by the City or designated representative, modify unsuitable materials to make them suitable for use. Modification may include drying, removal or crushing of over-size material, and lime or cement treatment.

7) Cement Stabilized Backfill

When indicated or directed by the City, all backfill shall be with cement-stabilized backfill rather than the usual materials. Unless otherwise indicated, cement stabilized backfill material shall consist of a mixture of the dry constituents described for Class J Concrete. The cement and aggregates shall be thoroughly dry mixed with no water added to the mixture except as may be directed by the City.

8) Pipe

General

Fire line leads and fire hydrant leads shall be ductile iron (DI). Domestic water services shall not be supplied from fire service leads, unless the domestic and fire connections are on separately valved branches with an approved backflow prevention device in the fire service branch. All wastewater force mains shall be constructed of ductile iron pipe Pressure Class 250 minimum for 16-inch size pipe and greater, and Pressure Class 350 for pipe 12-inch size and smaller as defines by AWWA C150. Flanged D.I. Pipe shall be Special Thickness Class 53 meeting AWWA C115. Wastewater pipe shall be in accordance with the City of Pflugerville Standard Products List (SPL) Item "Ductile Iron Wastewater Pipe" and shall have an approved corrosion resistant interior lining acceptable to the City.

All water pipe within utility easements on private property shall be Ductile Iron Pipe, Pressure Class 350 minimum for pipe 12-inch size and smaller and Pressure Class 250 minimum for pipe 16-inch size and greater, wrapped as indicated. Acceptable sizes are 4", 6" 8", 12", 14" (for repairs only), 16", 18" (for repairs only), 20", 24" and 30" and multiples of 6" in larger sizes. For pipe larger than 24" diameter, the manufacturer must provide one of the following with PROJECT submittal:



- a. Evidence of current ISO registration,
- b. Evidence of current City of Pflugerville approved quality control program,
- c. Evidence of current City of Pflugerville approved independent, third party firm that will test and inspect pipe produced for the City of Pflugerville.

Approved service/tapping clamps or saddles shall be used when tapping ductile iron pipe 12 inch size and smaller. All service tubing (½ inch thru 2 inches) installed in utility easements on private property shall be 150 psi annealed seamless Type K copper tubing meeting ASTM B88 bearing NSF/ANSI Standard 61 approval with no sweat or soldered joints and shall meet the requirements of the City of Pflugerville SPL Item “Seamless Copper Tubing.”

All reclaimed water mains shall be constructed of ductile iron pipe, Pressure Class 350 minimum for pipe 12-inch size and smaller and pressure class 250 for pipe size 16-inch and greater. For mains 12-inch size and smaller, PVC pipe, conforming to the requirements of AWWA C-900, DR 14 shall be acceptable. Reclaimed water pipe shall be manufactured purple, painted purple, or wrapped in purple polyethylene film wrap.

The quality of materials, the process of manufacture and the finished pipe shall be subject to inspection and approval by the City at the pipe manufacturing plant and at the project site prior to and during installation. Plant inspections shall be conducted at the discretion of the City Representative. Only manufacturers having a quality control program of the type described above will be considered as approved providers of concrete pipe and pipe products as listed in the SPL.

All water distribution pipe and fittings shall be listed in the Fire Protection Equipment Directory published by the Underwriter's Laboratories, Inc., or shall be Factory Mutual approved for fire service. All water pipe and related products shall be registered by the National Sanitation Foundation as having been certified to meet NSF/ANSI Standard 61.

- (a) Reserved
- (b) Iron Pipe

All DI pipe and fittings shall be from a single Manufacturer. All DI pipe to be installed under this Contract may be inspected at the foundry for compliance with these specifications by an independent testing laboratory provided by the City. The Contractor shall require the Manufacturer's cooperation in these inspections. The cost of foundry inspection of all pipe approved for this Contract, plus the cost of inspection of disapproved pipe, will be borne by the Contractor.

Inspections of the pipe may also be made by the City or designated representative after delivery to the project site. The pipe shall be subject to rejection at any time on account of failure to meet any of the specification requirements, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job site immediately

Iron pipe shall be ductile iron pipe as described in the City of Pflugerville SPL Item “Ductile Iron Pipe & Fittings” and meet all requirements of standards as follows:

- For push-on and mechanical joint pipe: AWWA C-151
- For flanged pipe: Special Thickness Class 53 meeting AWWA C-115

Barrels shall have a nominal thickness required by Table 1 of AWWA C-115, which thickness corresponds to Special Class 53 in sizes through 54 inch, and Class 350 in 60 and 64-inch sizes. Flanges shall be ductile iron (gray iron is not acceptable); they shall be as shown in ANSI/AWWA C115/A21.15 and shall conform to dimensions shown in Table 2 and Figure 1 of AWWA C115. These flanges are the same in all respects as flanges shown in ANSI/AWWA C110/A21.10 for fittings and are standard for all flanges used with pipe, valve, and equipment units in the City of Pflugerville water distribution and wastewater force main systems. Flanges shall be fabricated and attached to the pipe barrels by U.S. fabricators using flanges and pipe barrels of U.S. manufacture. If fabrication is to be by other than the pipe barrel manufacturer, a complete product submittal and approval by the City will be required. Additionally, such fabricator shall furnish certification that each fabricated joint has been satisfactorily tested hydrostatically at a minimum pressure of 300 psi.

- Linings and Coating:

Interior surfaces of all iron potable or reclaimed water pipe shall be cement-mortar lined and seal coated as required by AWWA C104. Interior surfaces of all iron wastewater line and force main pipe shall be coated with a non-corrosive lining material meeting the minimum requirements of the City of Pflugerville Standard Products List SPL Item "Ductile Iron Pipe & Fittings." Pipe exteriors shall be coated as required by the applicable pipe specification. The type and brand of interior lining shall be clearly marked on the outside of the pipe and fittings. Except as authorized by the E/A, only one type and brand of pipe lining shall be used on a given project.

Except as described above for flanged pipe (Thickness Class 53) and where not otherwise indicated, ductile iron pipe shall be minimum Class 250 as defined by ANSI/AWWA C150/A21.50-current; all ductile iron pipe and flanges shall meet the following minimum physical requirements:

Grade 60-42-10:

- Minimum tensile strength: 60,000 psi (414 mPa).
- Minimum yield strength: 42,000 psi (290 mPa).
- Minimum elongation: 10 percent.

The flanges for AWWA C115 pipe may be also be made from:

Grade 70-50-05:

- Minimum tensile strength: 70,000 psi (483 mPa).
- Minimum yield strength: 50,000 psi (345 mPa).
- Minimum elongation: 5 percent.

1. Ductile Iron Fittings:

Fittings shall be push-on, flanged or mechanical joint as indicated or approved and shall meet all requirements of standards as follows:

- Sizes 4 inch through 30 inch or greater: AWWA C-110 or AWWA C-153
- Sizes larger than 24 inch: AWWA C-110.

-Lining and Coating:

Interior surfaces of all iron potable/reclaimed water pipe fittings shall be lined with cement-mortar and seal coated as required by AWWA C104. Interior surfaces of all iron wastewater and force main fittings shall be coated with a non-corrosive lining material acceptable to Owner. Fitting exteriors shall be coated as required by the applicable pipe specification. Alternately, the fittings may be fusion-bonded epoxy lined and coated according to AWWA C116.

Exterior – All pipe fittings shall have a bituminous outside coating in accordance with AAWA C151 and C110.

2. Joint Materials

Gaskets for mechanical joints shall conform to ANSI/AWWA A21.11/C-111.

Joining of slip joint iron pipe shall, without exception, be accomplished with the natural or synthetic rubber gaskets laid in the bell end of the manufacturer of that particular pipe being used. A joint lubricant shall be used and applicable recommendations of the manufacturer shall be followed.

Gaskets for flanged joints shall be continuous full face gaskets, of 1/8 inch minimum thickness of natural or synthetic rubber, cloth-reinforced rubber or neoprene material, preferably of deformed cross section design and shall meet all applicable requirements of ANSI/AWWA A21.11/C-111 for gaskets. They shall be manufactured by, or satisfy all recommendations of, the manufacturer of the pipe/fittings being used and be fabricated for use with Class 125 ANSI B16.1 flanges.

Mechanical joints shall be made in accordance with Appendix "A" of AWWA C111 and the manufacturer's instructions.

Tee-head bolts, nuts and washers for mechanical joints shall be high strength, low alloy, corrosion resistant steel stock equal to "COR-TEN A" having UNC Class 2 rolled threads or alloyed ductile iron conforming to ASTM A 536; either shall be fabricated in accordance with ANSI/AWWA A21.11/C-111. Bolts shall be tightened to the specified torque.

Hex head bolts and nuts shall satisfy the chemical and mechanical requirements of ASTM A449 SAE Grade 5 plain, and shall be fabricated in accordance with ASTM B 18.2 with UNC Class 2 rolled threads.

Either Tee-Head or Hex-Head bolts, nuts and washers as required, shall be protected with bonded fluoro-polymer corrosion resistant coating where specifically required by the E/A.

All threaded fasteners shall be marked with a readily visible symbol cast, forged or stamped on each nut and bolt, which will identify the fastener material and grade. The producer and the supplier shall provide adequate literature to facilitate such identification; painted markings are not acceptable.

### 3. Polyethylene Film Wrap

All iron pipe, fittings and accessories shall be wrapped with standard 8 mil (minimum), Type I, Grade E-1 low density polyethylene film, conforming to AWWA C105 and meeting the requirements of the City of Pflugerville SPL Item "Polyethylene Encasement for Ductile Iron Pipe." All edges of wrap shall be overlapped and taped securely with duct tape to provide a continuous wrap to prevent contact between the piping and the surrounding backfill. Repair all punctures of the polyethylene, including those caused in the placement of bedding aggregates, with duct tape to restore the continuous protective wrap before backfilling. Polyethylene film wrap for reclaimed water pipe shall be purple.

The following classes shall be used:

1. Class A – Natural color where exposure to weather (including sunlight) is less than 48 hours total before burial.
2. Class B – Black where exposure to weather (including sunlight) may be more than 48 hours total before burial.

Exposure to weather shall be kept to a minimum, and in no case shall it exceed 10 days. The Class of polyethylene encasement used shall be approved by the City.

### 4. Marking

Each pipe joint and fitting shall be marked as required by the applicable AWWA specification. This includes in all cases: Manufacturer's identification, Country where cast, year of casting, and "DUCTILE" or "DI". Barrels of flanged pipe shall show thickness class; others shall show pressure class. The flanges of pipe sections shall be stamped with the fabricators identification; fittings shall show pressure rating, the nominal diameter of openings and the number of degrees for bends. Painted markings are not acceptable.

### 5. Warning Tape

Warning tape shall be placed on top of pipe for identifying restrained joint pipe and fittings shall be yellow and shall have black lettering at least 2 inches high that reads "Restrained Joint / Junta de Restriction" at intervals not exceeding 24 inches. The warning tape shall be polypropylene having a minimum thickness of 2 mils, a minimum width of 3 inches, and adhesive backing on the side opposite the lettering.

### 6. Concrete and Blocking

2,500 psi concrete shall be placed for blocking at each change in direction in the pipeline in such a manner as will substantially brace the pipe against undisturbed trench walls. Concrete blocking made from Type I cement shall have been in place for 4 days prior to testing the pipelines. Tests may be made in 2 days after the completion of blocking if Type III cement is used.

At all points where wet connections are made to existing lines, the existing lines shall be adequately blocked and the tapping connection fittings shall be supported by blocking up to the spring line with 2,500 psi concrete.

(c) Concrete

1. General

Pipe shall conform to ASTM C 76 for Circular Pipe. Concrete pipe smaller than 12 inches in diameter shall conform to ASTM C 14, Extra Strength. All pipe shall be machine made or cast by a process which will provide uniform placement of the concrete in the form and compaction by mechanical devices, which will assure a dense concrete. Concrete shall be mixed in a central batch plant or other approved batching facility from which the quality and uniformity of the concrete can be assured. Transit mixed concrete shall not be acceptable for use in precast pipe. The pipe shall be Class III or the class indicated. Storm sewer pipe shall be of the tongue and groove or O-ring joint design.

2. Marking

Each joint of pipe shall be marked with the pipe class, the date of manufacture, the manufacturer's name or trade mark, diameter of pipe and orientation, if required.

Pipe marking shall be waterproof and conform to ASTM C 76.

3. Minimum Age for Shipment

Pipe shall be considered ready for shipment when it conforms to the tests specified in ASTM C 76.

4. Joint Materials

When installing storm sewers (or storm drains), the Contractor shall have the option of using joints with preformed flexible joint sealants or with rubber gaskets. Preformed flexible joint sealants for storm drain joints shall comply with ASTM C990, and rubber gaskets for storm drain joints shall comply with ASTM C 1619. Mortar shall not be used to seal prefabricated joints. Pipe manufacturer shall be responsible for submitting to the Owner a detailed design of the joint upon request. The pipe manufacturer shall be responsible for submitting to the Owner a complete list of joint sizes showing the minimum size of material to be used with each size joint, along with complete instructions on recommended installation procedures. Quality control testing at the manufacturing plant shall be in accordance with Texas Department of Transportation (TxDOT) Departmental Materials Specifications (DMS) 7310, "Reinforced Concrete Pipe And Machine-Made Precast Concrete Box Culvert Fabrication And Plant Qualification". The pipe manufacturer shall be verified as compliant with TxDOT DMS 7310 at time of pipe delivery to the jobsite.

a. Mortar

Mortar for joints shall meet the requirements set forth below in "Mortar".

b. Cold Applied Preformed Plastic Gaskets

Cold Applied Plastic Gaskets shall be suitable for sealing joints of tongue and groove concrete pipe. The gasket sealing the joint shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler and shall contain no solvents, irritating fumes or obnoxious odors. The gasket joint sealer shall not depend on oxidizing, evaporating or chemical action for its adhesive or cohesive strength and shall be supplied in extruded rope form of suitable cross section. The size of the plastic gasket joint sealer shall be in accordance with the manufacturer's recommendations and sufficient to obtain squeeze-out around the joint. The gasket joint sealer shall be protected by a suitable removable wrapper that may be removed longitudinally without disturbing the joint sealer to facilitate application.

The chemical composition of the gasket joint sealing compound as shipped shall meet the following requirements:

Composition (% by weight)	Test Method	Typical Analysis
Bitumen (petroleum plastic content)	ASTM D 4	50-70
Ash-inert Mineral Water	Tex-526-C	30-50
Volatile Matter (at 325 F)	Tex-506-C	2.0 Maximum

The gasket joint sealing compound when immersed for 30 days at ambient room temperature separately in 5 percent solution of caustic potash, a mixture of 5 percent hydrochloric acid, a 5 percent solution of sulfuric acid and a saturated H<sub>2</sub>S solution shall show no visible deterioration.

The physical properties of the gasket joint sealing compound as shipped shall meet the following requirements:

Property	Test Method	Typical Analysis	
		Minimum	Maximum
Specific Gravity at 77 F	ASTM D 71	1.20	1.35
Ductility at 77F (cm) Minimum	Tex-503-C	5.0	
Softening point	Tex-505-C	275 F	
Penetration:			
32 F (300 g) 60 sec	Tex-502-C	75	
77 F (150 g) 5 sec	Tex-502-C	50	120
115 F (150 g) 5 sec	Tex-502-C		150
Flashpoint C.O.C. F	Tex-504-C	600 F	
Fire Point C.O.C. F	Tex-504-C	625 F	

#### 5. Bends

When horizontal or vertical angles in the alignment of storm sewers are indicated, the bend or angle shall be constructed by cutting on a bias one or both pipes as may be required for the alignment indicated. The pipe cut shall be sufficiently long to allow exposing the reinforcement, which shall be bent, welded and incorporated into the pipe bend and reinforced concrete collar to maintain the structural integrity. The collar shall be 6 inches minimum, reinforced with #4 bars on a 1 foot center both directions. Builder's hardware cloth may be used on the outside of the joint to aid in holding cementing materials in place. Plywood, fiberboard or other materials placed on the inside of the pipe as formwork shall be removed as soon as the joint materials have obtained initial set, after which the inside surface of the pipe joint shall be finished smooth and true to the line and grade established. The Contractor may use prefabricated bends meeting the specification requirements in lieu of field fabricated bends. All bends shall be watertight, have a smooth flow line and be equal or greater in strength to the adjacent pipe.

Horizontal or vertical changes in alignment in wastewater lines shall be accomplished by use of manholes. With the E/A's approval, horizontal changes in alignment may be made by the "Joint Deflection" method. Joint deflection is limited by regulations of the Texas Commission on Environmental Quality (TCEQ) to 80 percent of the maximum recommended by the manufacturer; such deflection may not exceed 5 degrees at any joint. Changes in alignment using pipe flexure shall not be allowed.

(d) Polyethylene Tubing

1. General

All polyethylene (PE) tubing shall meet the minimum requirements of the City of Pflugerville SPL Item "Polyethylene Tubing for Low Pressure Sewers". PE tubing shall be high density, high molecular weight plastic tubing meeting ASTM D2737, CTS-OD 1" through 2", made of PE 4710. PE tubing shall be solid green exterior and clear interior or solid green wall with contrasting-color heat-indented printline. Polyethylene tubing for reclaimed service lines shall be purple.

Only compression fittings recommended by the manufacturer may be used and only with stainless steel insert stiffeners.

2. Materials

Polyethylene plastics shall be Designation PE3408 (Grade P34 with hydrostatic design stress of 800 psi).

3. Markings

Permanent marking on the tubing shall include the following at intervals of not more than 5 feet:

Material

Nominal tubing size

Pressure rating for water

Dimension Ratio (SDR)

ASTM designation D2737

Manufacturer's name or trademark and code

Tubing test company

Date of manufacture (recognizable as a date)

Manufacturer's production code (including resin source, manufacturing location and extrusion line)

4. Tube Size

PE tubing shall be standard copper tube size outside diameter, with Standard Dimension Ratio (SDR) of 9.

(e) Copper Tubing

All copper service tubing shall be annealed seamless Type K water tube meeting ASTM B88 bearing a NSF/ANSI Standard 61 approval and rated at 150 psi working pressure. The tubing shall be homogenous throughout and free from cracks, holes, crimping, foreign inclusions or other defects. It shall be uniform in density and other physical properties. Copper tubing for reclaimed water shall be wrapped in purple polyethylene film wrap. Acceptable pipe manufacturers shall be listed on the City of Pflugerville SPL Item "Seamless Copper Tubing."

(f) Service Connection Fittings

All fittings used in customer service connection - tapping mains, connecting meters, etc. - must be currently listed on the applicable City of Pflugerville SPL Item, or called for in the City of Pflugerville Standard Details (520 - series).

(g) Brass Goods

All brass valves, couplings, bends, connections, nipples and miscellaneous brass pipe fittings and accessories used in meter connections, service lines, air release piping assemblies, and wherever

needed in the water distribution system, shall conform to the City of Pflugerville Standards, SPL Item "Brass Goods," and AWWA C-800, except as herein modified or supplemented.

Effective January 1, 2013, all brass goods purchased for the City shall be "lead free" and marked by stamping, etching, or casting "NL" in the main body or by the other methods acceptable to the City.

Exposed threads shall be covered with plastic caps or sheeting to protect the threads.

Brass goods of each type and class shall be compatible with other fittings in common usage for similar purposes. Where not otherwise indicated, all such materials shall meet the following requirements:

Inlet threads of corporation valves shall be AWWA iron pipe (IP) thread (male); outlets of service saddles shall be tapped with AWWA IP thread (female). AWWA IP threads shall conform to ANSI/ASME B1.20.1 as required by AWWA C800 for "General Purpose (Inch) Pipe Threads". For ¾" and 1" sizes only, corporation valve inlet threads, and the internal threads of saddles may be the AWWA taper thread conforming to AWWA C800 Figure 1 and Table 6. External threads of corporation valve inlet must be compatible with internal threads of the service saddle.

Connections of all new tubing, and of tubing repairs wherever possible, shall be made with approved grip type compression fittings. Compression connections shall be designed to provide a seal and to retain the tubing, without slippage, at a working water pressure of 150 psig.

Flanges shall conform to ANSI B16.1, Class 125, as to dimensions, drillings, etc. Copper tubing, when used, shall be Type K tubing having dimensions and weights given in Table A.1 of AWWA C800.

Brass pipe shall conform to the weights and dimensions for Extra Strong pipe given in Table A.2 of AWWA C800.

All fittings shall be suitable for use at hydrostatic working pressures up to 150 psig (hydrostatic testing of installed systems is at 200 psig).

(h) Polyethylene Encased Ductile Iron/Reclaimed Water Pipe

1. General

All ductile iron pipe for reclaimed water shall have linear low-density polyethylene (LLDPE) encasement meeting all the requirements of AWWA C105.

2. Applicable Specifications

Except as modified or supplemented herein, reclaimed water pipe shall meet the following standards:

AWWA C105

3. Material Requirements

All ductile iron pipe with polyethylene encasement shall meet the minimum requirements of the City of Pflugerville SPL Items "Ductile Iron Pipe & Fittings." Polyethylene encasement shall be a minimum thickness of 0.008 inches (8 mils) and be purple for reclaimed water.

4. Marking

Permanent marking on each joint of pipe shall include the following at intervals of not more than 5 feet:

- a) "Warning – Corrosion Protection – Repair any Damage,"
- b) Type of material (LLDPE is required),
- c) Minimum film thickness (0.008 inches or 8 mils is required)
- d) Year of manufacture,
- e) ANSI/AWWA/C105/A21.5,
- f) Applicable range of nominal pipe diameter sizes
- g) Manufacturer's name or trademark .

(i) Polyvinyl Chloride (PVC) Pipe (Nonpressure) and Fittings

1. General

All PVC pipe and fittings shall be from a single Manufacturer. The supplier shall be responsible for the provisions of all test requirements specified in ASTM D3034 or ASTM F789 and/or ASTM F758 as applicable. In addition, all PVC pipe to be installed under this Contract may be inspected at the plant for compliance with these specifications by an independent testing laboratory provided by the City. The Contractor shall require the Manufacturer's cooperation in these inspections. The cost of plant inspection of all pipe approved for this Contract, plus the cost of inspection of disapproved pipe, will be borne by the Contractor.

Inspections of the pipe may also be made by the City or designated representative after delivery to the project site. The pipe shall be subject to rejection at any time on account of failure to meet any of the specification requirements, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job site immediately.

Pipe and fittings shall be Type PSM, PVC SDR 26 with full diameter dimensions and shall conform to ASTM D3034, or Type PS-46 PVC conforming to ASTM F789, for sizes 4- through 15-inch, and conforming to ASTM F679 for sizes 18- through 27-inch. Straight pipe shall be furnished in lengths of not more than 13 feet and wyes shall be furnished in lengths no of not more than 3 feet. Saddle Wye will not be allowed. Pipe stiffness shall be at least 115 psi as determined by ASTM D 2412. Pipe manufacturers shall be on the City of Pflugerville SPL Item "PVC Gravity Sewer Pipe (6 to 27 inch Diameter)", and fitting manufacturers shall be on SPL Item "PVC Wastewater Line Fittings."

2. Joints

PVC pipe and fittings shall have bell and spigot push-on joints. The bell shall consist of an integral wall section with a solid cross-section elastomeric gasket securely locked in place to prevent displacement during assembly.

PVC pipe and fitting shall have elastomeric gasket joints conforming to ASTM D 3212. Gaskets shall conform to ASTM F 477.

3. Pipe Markings

Pipe meeting ASTM D 3034 shall have permanent marking on the pipe that includes the following at intervals of not more than 5 feet:

- a) Manufacturer's name and/or trademark and code.
- b) Nominal pipe size.
- c) The legend "SDR-\_\_ PVC Sewer Pipe" (SDR 26, 23.5. or less is required)
- d) The designation "ASTM D 3034"
- e) Pipe meeting ASTM F 679 shall have permanent marking that includes the following at intervals of not more than 5 feet:
- f) Manufacturer's name or trademark and code
- g) Nominal pipe size
- h) PVC cell classification per ASTM D 1784
- i) Pipe stiffness designation "PS \_\_ PVC Sewer Pipe" (PS of at least 72 is required)
- j) The designation "ASTM F 679"

4. Fitting Markings

- a) Fittings meeting ASTM D 3034 shall have permanent marking that includes the following:
- b) Manufacturer's name or trademark
- c) Nominal size
- d) The material designation "PVC"
- e) The designation, "ASTM F 679"
- f) Fittings meeting ASTM F 679 shall have permanent marking that includes the following:
- g) Manufacturer's name or trademark and code
- h) Nominal size
- i) The material designation "PVC"
- j) The designation "ASTM F 679"



## 5. Tracer Tape

Inductive Tracer Detection Tape shall be placed directly above the centerline of all non-metallic pipe a minimum of 12 inches below subgrade or, in areas outside the limits of pavement, a minimum of 18 inches below finished grade. The tracer tape shall be encased in a protective, inert, plastic jacket and color coded according to American Public Works Association Uniform Color Code. Except for minimum depth of cover, the tracer tape shall be placed according to manufacturer's recommendations. Manufacturers must be listed on SPL WW-597.

### 510.3 - Construction Methods

#### 1) General

Prior to commencing this Work, all erosion control and tree protection measures required shall be in place and all utilities located and protected as set forth in the City of Pflugerville Tree Technical Manual: Standards & Specifications and/or in the Drawings. Clearing the site shall conform to Item No. 102S, "Clearing and Grubbing". Maintenance of environmental quality protection shall comply with all requirements of Specification Item No. 601S, "Salvaging and Placing Topsoil".

The Contractor shall work such that a reasonable minimum of disturbance to existing utilities will result. Particular care shall be exercised to avoid the cutting or breakage of all existing utilities. If at any time the Contractor's operations damage the utilities in place, the Contractor shall immediately notify the owner of the utility to make the necessary repairs. Where existing utilities are damaged, they shall be replaced with material equal to or better than the existing material. When active wastewater sewer lines are cut in the trenching operations, the Contractor shall provide all labor, equipment and materials necessary to maintain existing flows, including temporary diversion and all pumping of sewage that may be require to prevent backing up of the wastewater lines, and shall immediately remove all offensive material at his/her own expense. A detailed written plan of all methods of flow maintenance shall be submitted to the City 10 days in advance of flow interruption. The Contractor shall not be permitted to overflow, bypass, pump or by any other means convey sewage to any stream or water course.

The Contractor shall inform utility owners sufficiently in advance of the Contractor's operations to enable such utility owners to reroute, provide temporary detours or to make other adjustments to utility lines in order that the Contractor may Work with a minimum of delay and expense. The Contractor shall cooperate with all utility owners concerned in effecting any utility adjustments necessary and shall not hold the City liable for any expense due to delay or additional Work because of conflicts arising from existing utilities.

The Contractor shall do all trenching in accordance with the provisions and the directions of the City as to the amount of trench left unfilled at any time. All excavation and backfilling shall be accomplished as indicated and in compliance with State Statutes.

Where excavation for a pipe line is required in an existing City street, a street cut permit is required and control of traffic shall be as indicated in accordance with the Texas Manual on Uniform Traffic Control Devices.

Wherever existing utility branch connections, sewers, drains, conduits, ducts, pipes or structures present obstructions to the grade and alignment of the pipe, they shall be permanently supported, removed, relocated or reconstructed by the Contractor through cooperation with the owner of the utility, structure or obstruction involved. In those instances where their relocation or reconstruction is impractical, a deviation from line and grade will be ordered by the City and the change shall be made in the manner directed.

Adequate temporary support, protection and maintenance of all underground and surface utility structures, drains, sewers and other obstructions encountered in the progress of the Work shall be furnished by, and at the expense of, the Contractor and as approved by the City.

Where traffic must cross open trenches, the Contractor shall provide suitable bridges in conformance with Standard Detail 804S-4. Adequate provisions shall be made for the flow of sewers; drains and watercourses encountered during construction and any structures, which may have been disturbed, shall be satisfactorily restored upon completion of Work.

When rainfall or runoff is occurring or is forecast by the U.S. Weather Service, the Contractor shall not perform or attempt any excavation or other earth moving Work in or near the flood plain of any stream or watercourse or on slopes subject to erosion or runoff, unless given specific approval by the City. When

such conditions delay the Work, an extension of time for working day contracts will be allowed in accordance with "General Conditions".

2) Water Line/New Wastewater Line Separation

Water lines shall maintain a minimum of 18 inches vertical separation from all other utilities. When 18 inches separation is not attainable, encasement of water lines is required.

The separation between wastewater mains and other utilities shall be in accordance with the Rules adopted by the Texas Commission on Environmental Quality.

Crossings of water, reclaimed water, and wastewater lines shall conform to details in the Drawings.

Wastewater manholes within 9 feet of water and reclaimed water lines shall be made watertight according to details in the Drawings.

3) Utility and Storm Sewer Crossings

When the Contractor installs a pipe that crosses under a utility or storm sewer structure and the top of the pipe is within 18 inches of the bottom of the structure, the pipe shall be backfilled as shown in the Drawings. When the Contractor installs a pipe that crosses under a utility or storm sewer structure that is not shown in the Drawings, the pipe shall be backfilled as directed by the City. Payment for backfilling pipe at utility or storm sewer structures not shown in the Drawings shall be by Change Order.

4) Trench Excavation

Excavation in a paved street shall be preceded by saw cutting completely through any asphaltic cement concrete or Portland cement concrete surface, base, or subbase to the underlying subgrade to a width 2 feet wider than the trench itself.

Underground piped utilities shall be constructed in an open cut in accordance with Federal regulations, applicable State Statutes conforming to Specification Item No. 509S, "Excavation Safety Systems" and with a trench width and depth described below. The sides of all excavation shall be cut as nearly vertical as possible. When pipe is to be constructed in fill above the natural ground, Contractor shall construct embankment to an elevation not less than one foot above the top of the pipe, after which trench is excavated. Required vertical sides shall be sheeted and braced as indicated to maintain the sides of the required vertical excavation throughout the construction period. Adequacy of the design of sheeting and bracing shall be the responsibility of the Contractor's design professional. The Contractor shall be responsible for installation as indicated. After the pipe has been laid and the backfill placed and compacted to 12 inches above the top of the pipe, any sheeting, shoring and bracing required may be removed with special care to insure that the pipe is not disturbed. As each piece of sheeting is removed, the space left by its removal must be thoroughly filled and compacted with screened material and the screened material shall be re-compacted to provide uniform support for the pipe. As each piece of sheeting is removed, provisions made to prevent the sides of the trench from caving until the backfill has been completed. Any sheeting left in place will not be paid for and shall be included in the unit price bid for pipe.

5) Trench Width

Trenches for water, reclaimed, and wastewater lines shall have a clear width on each side beyond the outside surfaces of the pipe not less than 18 inches plus the outside diameter of the pipe, and the maximum width shall be not more than 24 inches plus the outside diameter of the pipe, measured at an elevation in the trench which is 12" above the top of pipe when it is laid to grade.

Trenches for Storm Sewers up to 42 inches shall have a width of 1 foot on each side beyond the outside surfaces of the pipe. Pipes more than 42 inches shall have a trench width not to exceed 18 inches on each side beyond the outside surfaces of the pipe.

If the trench width within the pipe zone exceeds this maximum, the Contractor shall use class embedment or encasement required by the City to provide load carrying capacity for the trench width as actually cut, and the additional cost incurred will be borne by the Contractor. Excavation along curves and bends shall be so oriented that the trench and pipe are approximately centered on the centerline of the curve, using short lengths of pipe and/or bend fittings if necessary.

For all utilities to be constructed in fill above natural ground, the embankment shall first be constructed to an elevation not less than 1 foot above the top of the utility after which excavation for the utility shall be made.

6) Trench Depth and Depth of Cover

All pipe and in-line appurtenances shall be laid to the grades indicated. The depth of cover shall be measured from the established finish grade, natural ground surface, subgrade for staged construction, street or other permanent surface to the top or uppermost projection of the pipe.

(a) Where not otherwise indicated, all potable/reclaimed water piping shall be laid to the following minimum depths:

- Potable/reclaimed water piping installed in undisturbed ground in easements of undeveloped areas, which are not within existing or planned streets, roads or other traffic areas shall be laid with at least 42 inches of cover.
- Potable/reclaimed water piping shall be laid with at least 42 inches of cover below finish grade and measured from either the top of the pipe or valve actuating nut (whichever is applicable) to the finished ground surface.
- Unless approved by the City, installation of potable/reclaimed water piping in proposed new streets will not be permitted until paving and drainage plans have been approved and the roadway traffic areas excavated to the specified or standard paving subgrade, with all parkways and sidewalk areas graded according to any applicable provisions of the drainage plans or sloped upward from the curb line to the right-of-way line at a minimum slope of ¼ inch per foot. Piping and appurtenances installed in such proposed streets shall be laid with at least 48 inches of cover below the actual subgrade.

(b) Where not otherwise indicated, all wastewater piping shall be laid to the following minimum depths:

- Wastewater piping shall be laid with at least 48 inches of cover below actual subgrade.

7) Classification of Excavation

Excavation will not be considered or paid for as a separate item of Work, so excavated material will not be classified as to type or measured as to quantity. Full payment for all excavation required for the construction shall be included in the various unit or lump sum Contract prices for the various items of Work installed, complete in place. No extra compensation, special treatment or other consideration will be allowed due to rock, pavement, caving, sheeting and bracing, falling or rising water, working under and in the proximity of trees or any other handicaps to excavation.

8) Dewatering Excavation

Underground piped utilities shall not be constructed, or the pipe laid, in the presence of water. All water shall be removed from the excavation prior to the pipe placing operation to ensure a dry firm granular bed on which to place the underground piped utilities and shall be maintained in such unwatered condition until all concrete and mortar is set. Removal of water may be accomplished by bailing, pumping or by a well-point installation as conditions warrant. Provisions shall be made for the satisfactory disposal of surface water pumped, so as to prevent damage to public or private property. The Contractor shall be responsible for maintaining safe working conditions and suitable construction techniques.

In the event that the excavation cannot be dewatered to the point where the pipe bedding is free of mud, a seal shall be used in the bottom of the excavation. Such seal shall consist of Class B concrete, conforming to Item No. 403, "Concrete for Structures", with a minimum depth of 3 inches.

9) Trench Conditions

Before attempting to lay pipe, all water, slush, debris, loose material, etc., encountered in the trench must be pumped or bailed out and the trench must be kept clean and dry while the pipe is laid and backfilled. Where needed, sump pits shall be dug adjoining the trench and pumped as necessary to keep the excavation dewatered.

Backfilling shall closely follow pipe laying so that no pipe is left exposed and unattended after initial assembly. All open ends, outlets or other openings in the pipe shall be protected from damage and shall

be properly plugged and blocked watertight to prevent the entrance of trench water, dirt, etc. The interior of the pipeline shall at all times be kept clean, dry and unobstructed.

Where the soil encountered at established footing grade is a quicksand, saturated or unstable material, the following procedure shall be used unless other methods are indicated:

Unsuitable material shall be removed to such a depth that a stable foundation is achieved by replacing the unsuitable material with tamped gravel, brought to the bottom of bedding. Gravel used shall be washed gravel or crushed stone and may fit any gradation of size up to 3 inches in accordance with Section 510S.3(14) herein. The particular gradation shall take into consideration the actual field conditions. Gravel shall be placed across the entire trench width in uniform layers not to exceed 6 inches, loose measure and compacted by mechanical tamping or other means which shall provide a stable foundation for the utility.

Forms, sheathing and bracing, pumping, additional excavation and backfill required in unstable trench conditions shall be included in the unit price bid for pipe.

10) Blasting

Blasting is not permitted.

11) Removing Old Structures

When out of service masonry structures or foundations are encountered in the excavation, such obstructions shall be removed for the full width of the trench and to a depth of 1 foot below the bottom of the trench. When abandoned inlets or manholes are encountered and no plan provision is made for adjustment or connection to the new sewers, such manholes and inlets within the construction limits shall be removed completely to a depth 1 foot below the bottom of the trench. In each instance, the bottom of the trench shall be restored to grade by backfilling and compacting by the methods provided above. Where the trench cuts through storm or wastewater sewers which are known to be abandoned, these sewers shall be cut flush with the sides of the trench and blocked with a concrete plug in a manner satisfactory to the E/A. When old structures are encountered, which are not visible from the existing surface and are still in service, they shall be protected and adjusted as required to the finished grade.

12) Lines and Grades

Grades, lines and levels shall conform to the General Conditions and/or "Grades, Lines and Levels". Any damage to the above by the Contractor shall be re-established at the Contractor's expense. The Contractor shall furnish copies of all field notes and "cut sheets" to the City.

The location of the lines and grades indicated may be changed only by direction of the City. It is understood that the Contractor will be paid for Work actually performed on the basis of the unit Contract prices and that the Contractor shall make no claim for damages or loss of anticipated profits due to the change of location or grade.

All necessary batter boards or electronic devices for controlling the Work shall be furnished by, and at the expense of, the Contractor. Batter boards shall be of adequate size material and shall be supported substantially. The boards and all location stakes must be protected from possible damage or change of location. The Contractor shall furnish good, sound twilled lines for use in achieving lines and grades and the necessary plummets and graduated poles.

Within 14 days of the Notice to Proceed, the Contractor shall submit to the City at least 6 copies of any layout Drawings from the pipe manufacturer for review and approval. The Contractor shall submit the layout Drawings at least 30 days in advance of any actual construction of the project. The City will forward all comments of the review to the Contractor for revision. Revisions shall be made and forwarded to the City for acceptance. Prior to commencement of the Project, reviewed layout Drawings will be sent to the Contractor marked for construction.

Should the Contractor's procedures not produce a finished pipe placed to grade and alignment, the pipe shall be removed and relaid and the Contractor's procedures modified to the satisfaction of the E/A. No additional compensation shall be paid for the removal and relaying of pipe required above.

13) Surplus Excavated Materials

Excess material or material which cannot be made suitable for use in embankments will be declared surplus by the City and shall become the property of the Contractor to dispose of off-site at a permitted fill site, without liability to the City or any individual. Such surplus material shall be removed from the Work site promptly following the completion of the portion of the utility involved.

14) Pipe Bedding Envelope

Pipe shall be installed in a continuous bedding envelope of the type shown on the drawings or as described herein. All embedment material shall be free from grass, roots, vegetation, and other deleterious materials. The bedding shall be placed evenly on each side of the pipe to mid-diameter and hand tools shall be used to force the bedding under the haunches of the pipe and into the bell holes to give a firm continuous support for the pipe. The envelope shall extend the full trench width, to a depth of at least 6 inches below the pipe and to a depth of the springline of storm water pipe and at least 12 inches above water, reclaimed, and wastewater pipe.

(a) Standard Bedding Materials

Sieve Size	3/8" F (% Retained)	1/2" D (% Retained)	Washed Gravel (% Retained)
1/2"	0	0	0
3/8"	0-2	5-25	--
4m	40-85	80-100	--
10m	95-100	96-100	--
3/4"	--	--	100

(b) General requirements and limitations governing bedding selection.

- (1) Crushed gravel or crushed stone shall not be used with polyethylene tubing or polyethylene film wrap.
- (2) Uncrushed gravel may be used with polyethylene film wrap in trenches up to 6 feet deep and in deeper trenches where ample trench width, a tremmie, or conditions will allow controlled placement of the gravel without damaging the polyethylene wrap.
- (3) Bedding shall be placed in lifts not exceeding 8 inches loose thickness and compacted thoroughly with hand tamping to provide uniform support for the pipe barrel and to fill all voids around the pipe.

(c) Requirements to prevent particle migration.

Bedding material shall be compatible with the materials in the trench bottom, walls and backfill so that particle migration from, into or through the bedding is minimized. The City may require one or more of the following measures to minimize particle migration: use of impervious cut-off collars; selected bedding materials; filter fabric envelopment of the bedding; cement stabilized backfill; or other approved materials or methods. Measures to minimize particle migration will be shown on the Drawings or designated by the City, and, unless provisions for payment are provided in the contract documents, the cost of these measures shall be agreed by change order. The following limitations shall apply.

- (1) Sand, alone, shall not be used.
- (2) Pea gravel or bedding stone, alone, shall not be used in the street right-of-way within 5 feet of subgrade elevation in trenches that are 3 feet or wider.
- (3) Each gravel or bedding stone, alone, shall not be used where the trench bottom, sides, or backfill is composed of non-cementitious, silty or sandy soils having plasticity indices less than 20, as determined by the City.
- (4) For concrete storm water pipe, uncrushed gravel, crushed gravel, crushed stone, or combination thereof is used for pipe bedding material, a geotextile filter fabric shall be placed around the perimeter of the joint.

15) Laying Pipe

Care shall be taken in loading, transporting and unloading to prevent injury to the pipe, lining or coatings. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying and no piece shall be installed which is found to be defective. Any damage to the pipe linings or coatings shall be repaired as directed by the City. Handling and laying of pipe and fittings shall be in accordance with the Manufacturer's instruction and as specified herein.

No pipe shall be installed in the trench until excavation has been completed, the bottom of the trench graded, and the trench completed as indicated.

No debris shall remain in the drainways or drainage structures.

All recommendations of the manufacturer shall be carefully observed during handling and installation of each material. Unless otherwise indicated, all materials shall be delivered to the project by the manufacturer or agent and unloaded as directed by the Contractor. Each piece shall be placed facing the proper direction near to where it will be installed.

The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times and stored in a manner that will protect them from damage. Stockpiled materials shall be stacked so as to minimize entrance of foreign matter. The interior of all pipeline components shall be clean, dry and unobstructed when installed. When laying is not in progress, including lunch time, the open ends of the pipe shall be closed by watertight plugs or other approved means.

Piping materials shall not be skidded or rolled against other pipe, etc. and under no circumstances shall pipe, fittings or other accessories be dropped or jolted.

During handling and placement, materials shall be carefully observed and inspected, and any damaged, defective or unsound materials shall be marked, rejected and removed from the job site. The City or designated representative may examine the bell and spigot end to determine whether any preformed joint has been damaged prior to installation. Minor damage shall be marked and repaired in a manner satisfactory to the City. Any pipe or fittings discovered to be defective after laying shall be removed and replaced with a sound piece. Joints, which have been placed, but not joined, backfilled, etc., shall be protected in a manner satisfactory to the City.

#### 16) Assembling of Pipe

No single piece of pipe shall be laid unless it is generally straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16-inch per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the Site and the cost shall be borne by the Contractor. Laying instructions of the manufacturer shall be explicitly followed.

Before any joint is made, the pipe shall be checked to assure that a close joint with the next adjoining pipe has been maintained and that the inverts are matched to conform to the required grade. The pipe shall not be driven down by striking it.

Joints shall not be "pulled" or "cramped." Angular spacing of all joints shall meet the manufacturer's recommendations for the pipe and accessories being used. Side outlets shall be rotated so that the operating stems of valves shall be vertical when the valves are installed. Pressure pipe shall be laid with bell ends facing the direction of pipe installation. Pipe end bells shall be placed upgrade for all wastewater lines.

Orientation marks, when applicable, shall be in their proper position before pipe is seated.

Before joining any pipe, all foreign matter, lumps, blisters, excess coal tar coating, oil or grease shall be removed from the ends of each pipe and the pipe ends shall then be wire brushed and wiped clean and dry. Pipe ends shall be kept clean until joints are made.

Every precaution shall be taken to prevent foreign material from entering the pipe during installation. No debris, tools, clothing or other materials shall be placed in the pipe.

#### 17) Joints

Pipes shall be jointed in accordance with recommendations of the latest ASTM Standards and detailed instructions of the manufacturer.

(a) Mortar (Storm Drain joints only)

Pipe ends shall be clean, free of asphalt or other contaminants, which will inhibit the bond of the mortar to the pipe. The pipe ends shall be moistened immediately prior to placing the mortar in the joint.

(b) Cold Applied Preformed Plastic Gaskets (Storm Drain joints only)

The pipe ends shall be clean and the joint material applied to the dry pipe. In cold weather, the joint material shall be heated to facilitate the seal of the joint.

(c) O-Ring and Push-on Joints

Pipe shall be laid with bell ends in the direction of trenching. A rubber gasket shall be inserted in the groove of the bell end of the pipe, and the joint surfaces cleaned and lubricated. The plain end of the pipe to be laid shall then be aligned and inserted in the bell of the pipe to which it is to be joined and pushed home with a jack or by other means. After joining the pipe, a metal feeler shall be used to make certain that the rubber gasket is correctly located.

Pipe shall be laid with bell ends in the direction of trenching. Just before making a joint the ends of the pipe shall be clean, dry, free of any foreign matter, lump blisters, excessive coal tar coating and grease or oil and shall be wire brushed. The gasket and the inside surface of the bell shall be lubricated with a light film of soft vegetable soap compound (Flax Soap) to facilitate telescoping the joints. The rubber gasket if not factory installed shall be stretched uniformly as it is placed in the spigot groove to insure a uniform volume of rubber around the circumference of the groove. The plain end of the pipe to be laid shall then be aligned and inserted in the bell of the pipe to which it is to be joined and pushed home with a jack or by other means. After joining the pipe, a metal feeler shall be used to make certain that the rubber gasket is correctly located. material shall be placed and tamped against pipe to secure the joint. Care should be taken to prevent dirt or foreign matter from entering the joint space.

Push-on joints for DI pipe shall be made in accordance with AWWA C111 and the Manufacturer's instructions.

(d) Bolted Joints

All flanged, mechanical or other bolted joints shall be joined with nuts and bolts and be coated as indicated above in Iron Pipe.

(e) Storm Drain Joints

Storm drain joints sealed with preformed flexible joint sealants shall be provided and installed in compliance with ASTM C990. Storm drain joints sealed with rubber gaskets shall comply with ASTM C443 Install joint sealants in accordance with the pipe and joint sealant manufacturers' recommendations. Place the joint sealer so that no dirt or other deleterious materials come in contact with the joint sealing material. Pull or push home the pipe with enough force to properly seal the joint with the final joint opening (gap) on the inside of the installed pipe being less than or equal to the pipe manufacturer's recommended dimensions. Protrusion of joint material greater than 1/8 " into the interior of the pipe will not be accepted. Excess joint material will be removed to within 1/8 "of pipe surface. Observe joint sealant manufacturer's recommendations for installation temperature of the joint sealant. Apply joint sealant to pipe joint immediately before placing pipe in trench, and then connect pipe to previously laid pipe.

If inspection (video or other means) reveal C-990 joints that show signs of backfill infiltration, or where joints or conduits exhibit excessive joint gap or are otherwise defective, then the contractor has the following options:

1. Conduits less than 36-inches in any dimension: pour a concrete collar around the joint or wrap joint with a wrap meeting requirements of ASTM C-877 or approved equal.
2. Conduits greater than or equal to 36-inches in all dimensions: repair joints using joint repair techniques recommended by the manufacturer to achieve a completed system that meets all Contract requirements.

18) Placing Pipe in Tunnels

Piping installed as a carrier pipe in a tunnel, encasement pipe, etc., shall have uniform alignment, grade, bearing and conform to the reviewed Shop Drawings. All necessary casing spacers, bedding material, grout cradle or paving, bracing, blocking, etc., as stipulated by the Contract or as may be required to provide and maintain the required pipe alignment and grade, shall be provided by the Contractor at no cost except as provided by the Bid Items. This shall include casing spacers acceptable to the Owner attached to the carrier pipe in accordance with the manufacturer's recommendations. The insertion pushing forces shall not exceed the pipe manufacturer's recommendation. Such carrier piping shall have flexible bolted or gasketed push-on joints or Concrete Steel Cylinder pipe installed as follows:

(a) 21 Inch Pipe and Smaller

Prior to placing the pipe in the tunnel, the inside joint recess at the bell shall be buttered with cement mortar.

After the joint is engaged, the excess mortar shall be smoothed by pulling a tight fitting swab through the joint. Cement mortar protection shall then be placed in the normal manner to the exterior of the joint and allowed to harden sufficiently to avoid dislodgment during installation. If time is of the essence, a quick setting compound may be used.

(b) 24 Inch Pipe and Larger

Each length of pipe shall be pushed into the tunnel as single units. A flexible mastic sealer shall be applied to the exterior of the joint prior to joint engagement. The surfaces receiving the mastic sealer shall be cleaned and primed in accordance with the manufacturer's recommendation. Sufficient quantities of the mastic sealer shall be applied to assure complete protection of all steel in the joint area. The interior of the joint shall be filled with cement mortar in the normal manner after the pipe is in its final position within the tunnel.

19) Temporary Pipe Plugs, Caps, Bulkheads and Trench Caps

Temporary plugs, caps or plywood bulkheads shall be installed to close all openings of the pipe and fittings when pipeline construction is not in progress.

All temporary end plugs or caps shall be secured to the pipe as provided under Item No. 507, "Bulkheads".

The City may require a trench cap to be installed where 42-inch minimum cover cannot be obtained, or due to potential surface loading. Trench caps shall have a compressive strength of 2,000 psi at 28 days.

20) Corrosion Control

(a) Protective Covering

Unless otherwise indicated, all flanges, nuts, bolts, threaded outlets and all other iron or steel components buried and in contact with earth or backfill shall be wrapped with 8-mil (minimum) polyethylene film meeting ANSI/AWWA C-105 to provide a continuous wrap.

21) Pipe Anchorage, Support and Protection

Pressure pipeline tees, plugs, caps and bends exceeding 22½ degrees; other bends as directed shall be securely anchored by suitable concrete thrust blocking or by approved metal harness. Unless otherwise indicated, on 24 inch or larger piping, all bends greater than 11 ¼ degrees shall be anchored as described herein.

Storm sewers on steep grades shall be lugged as indicated.

(a) Concrete Thrust Blocking

Concrete for use as reaction or thrust blocking shall be Class B (2,500 psi) conforming to Item No. 403, "Concrete for Structures".

Concrete blocking shall be placed at each change in direction in the pipeline, in a manner as will substantially brace the pipe against undisturbed trench walls with adequate space and bearing area for the concrete. Concrete blocking shall be placed between solid ground and the fitting to be anchored. The area of bearing on the pipe and on the ground shall be as indicated on the Drawings or as directed by the City. In no event shall the concrete blocking be less than those shown in the



Drawings. The blocking shall, unless otherwise indicated, be so placed that the pipe, fittings and joints will be accessible for repair.

At all points where wet connections are made to existing lines, the existing lines shall be adequately blocked and the tapping connection fittings shall be supported by blocking up to the spring line with Class B concrete.

Concrete blocking made from Type I cement shall have been in place for 4 days prior to testing the pipeline as herein specified. Tests may be made two days after completion of blocking if Type III cement is used.

The pipe and fittings shall be adequately weighted and laterally braced to prevent floating, shifting or straining of the pipeline while the concrete is being placed and taking initial set. The Contractor shall be solely responsible for the sufficiency of such restraints.

(b) Metal Thrust Restraint

Fabricated thrust restraint systems such as those described below may be approved for use instead of concrete blocking. To obtain approval, the project Drawings must include sufficient drawings, notes, schedules, etc., to assure that the proposed restraints as installed will be adequate to prevent undesirable movement of the piping components. Such restraint systems may only be used where and as specifically detailed and scheduled on approved Project Drawings.

1. Thrust Harness

A metal thrust harness of tie rods, pipe clamps or lugs, turnbuckles, etc., may be approved. All carbon steel components of such systems, including nuts and washers, shall be hot-dip galvanized; all other members shall be cast ductile iron. After installation, the entire assembly shall be wrapped with 8-mil polyethylene film, overlapped and taped in place with duct tape to form a continuous protective wrap.

2. Restrained Joints

Piping or fitting systems utilizing integral mechanically restrained joints may be approved for DI pipe sizes 4 inch through 16 inch or for 4 inch through 12 inch PVC (AWWA C900) pipe. Mechanically restrained joint devices shall be one of the following:

- a) Wedge-action lug type mechanical joint (MJ) retainer glands,
- b) Split, full-circle grip-ring type with High Strength Low Alloy (HSLA) threaded thrust rods and nuts and stainless steel clamping bolts and nuts, or
- c) Single-piece, solid-body, bolt-through type.

Manufacturers of pipe with restrained joints integral to the pipe shall be listed on the City of Pflugerville SPL Items "Joint Restraint Devices, 4 Inch through 16 Inch Diameter" and "Joint Restraint Gaskets for Ductile Iron Pipe (4 Inch through 16 Inch)." All pipe and fitting systems with restrained joints shall be identified by applying an adhesive-backed warning tape to the top of the pipe and for the full length of the pipe, regardless of the type of pipe. For plastic pipes the warning tape shall be applied directly to the top of the pipe. For metal pipes and fittings the warning tape shall be applied to the top of the polyethylene film wrap. The warning tape shall conform to 510.2(8)(b)5.

For PVC applications, restraint devices shall have the working pressure rating that equals or exceeds the pressure of the pipe, fittings or valves on which they are used. For DI pipe applications, restraint devices shall be suitable for 250 psi working pressure and be fabricated of heavy section ductile iron casting, and bolts and nuts shall be low carbon steel conforming to ASTM, Grade B.

Location, configuration and description of such products shall be specifically detailed on the Drawings. (Add-on attachments such as retainer glands, all-thread rods, etc., are not acceptable.)

(c) Concrete Encasement, Cradles, Caps and Seals

When trench foundation is excessively wet or unstable or installation of water or wastewater pipe will result in less than 42 inches of cover, Contractor shall notify the City. The City may require Contractor to install a concrete seal, cradle, cap, encasement or other appropriate action.

All concrete cap, etc., shall be continuous and begin and end within 6 inches of pipe joints. Concrete cap, cradle and encasement shall conform to City of Pflugerville Standard No. 510S-1, "Concrete Trench Cap". The pipe shall be well secured to prevent shifting or flotation while the concrete is being placed.

Concrete embedment and encasement and cap shall have a minimum compressive strength of 2,000 pounds per square inch at 28 days.

Dry mix will not be permitted. The concrete cushion portion of the embedment or encasement will be mixed moist or damp to give a slump of not more than one (1) inch. Concrete for the sides and top, if specified, shall be mixed to obtain a slump of not less than one (1) inch or more than three (3) inches.

After pipe joints are completed, the voids at the joints in the embedment section shall be filled with concrete, and the embedment shall be brought up to proper grade. Where concrete is placed over or along the pipe, it shall be placed in such a manner as not to damage or injure the joints or displace the pipe. Care shall be taken in the placement of concrete to assure that a uniform pad, free of voids and of specified thickness, is constructed under the entire pipe section.

A cleavage line between the base concrete and the side embedment concrete will not be allowed. Backfilling shall be done in a careful manner and at such time, after concrete embedment or encasement has been placed, as not to damage the concrete in any way.

(d) Anchorage Bulkheads

Concrete bulkheads keyed into the undisturbed earth shall be placed as indicated to support and anchor the pipe and/or backfill against end thrust, slippage on slopes, etc. Concrete material and placement shall be Class A, Item No. 403, "Concrete for Structures".

22) Wastewater Connections

(a) Connections to Mains 12 Inches and Smaller

All branch connections of new main lines shall be made by use of manholes.

Service stubs shall be installed as indicated. Minimum grade shall be 0.33% percent downward to main and minimum cover shall be 4½ feet at the curb. Standard plugs shall be installed in the dead end before backfilling.

Where a service connection to a main 12 inches or smaller is indicated, a wye, tee or double wye shall be installed.

Where water pressures are determined to be above 80 psi, service connections shall incorporate individual pressure reducing valves (PRV).

Where a service connection to a main 15 inches or larger is indicated, a field tap may be made with the pipes installed crown to crown. The tap should be made conforming to the pipe manufacturer's recommendations with the City's approval.

Where not otherwise indicated, (wastewater) service connections shall be installed so that the outlet is at an angle of not more than 45 degrees above horizontal at the main line.

(b) Connections to the Existing System

Unless otherwise specified by the City, all connections made to existing mains shall be made at manholes with the crown of the inlet pipe installed at the same elevation as the crown of the existing pipe. Service stubs installed on the existing system shall be installed by use of tapping saddles unless otherwise approved by the City. Extreme care shall be exercised to prevent material from depositing in the existing pipe as the taps are being made.

When connections to existing mains are made, a temporary plug approved by the City must be installed downstream in the manhole to prevent water and debris from entering the existing system before Final Completion. These plugs shall be removed after the castings are adjusted to finish grade or prior to Final Completion. The Contractor shall supply all materials, equipment and labor required for plugging existing wastewater lines. Should damage of any kind occur to the existing

wastewater line, the Contractor shall, at his/her own expense, make repairs to the satisfaction of the City.

The Contractor shall provide all labor, equipment and materials necessary to maintain existing flows, including temporary diversions and all pumping of sewage that may be required to prevent backup of wastewater lines and shall immediately remove all offensive matter at his/her expense. The Contractor shall not be permitted to overflow, bypass, pump or by any other means convey sewage into any stream or other water course. All procedures for maintaining flows must meet the approval of the City. The Contractor shall be required to submit to the City, for approval, a detailed plan of all method of flow maintenance 10 days in advance of flow interruption.

The Contractor shall notify the City of any discrepancies in elevations of the existing wastewater lines and manholes between those shown on the Drawings and those established during construction so that the City can make the necessary modifications.

(c) Connecting Existing Services to New Mains

Where wastewater services currently exist and are being replaced from the main to the property line, those services shall be physically located at the property line prior to installing any new mains into which the services will be connected. Where wastewater services currently exist but are not being replaced to the property line, those services shall be physically located at the point of connection between the new and existing pipes prior to installing any new mains into which the services will be connected.

23) Potable Water System Connections

All necessary connections of new piping or accessories to the existing potable or reclaimed water system shall be made by, and at the expense of, the Contractor. To minimize any inconvenience from outages, the Contractor shall schedule all such connections in advance and such schedule must be approved by the City before beginning any Work. In each case, when work is started, it shall be prosecuted expeditiously and continuously until completed.

(a) Shutoffs

The City will make all shutoffs on existing potable water mains. The Contractor shall be required to notify the Owner's Representative in writing a least twenty five (25) Calendar Days prior to the anticipated date for a wet-connection. The Owner's Representative is defined as the City Inspector. The Owner's Representative will notify any affected utility customers at least 48 hours prior to the shutoff. The City of Pflugerville Water Department will make the shutoff after ensuring that all appropriate measures have been taken to protect the potable water system, customers and employees.

The City will operate all valves to fill existing mains. Where a newly constructed main has not been placed in service and has only one connection to the potable or reclaimed system, the Contractor may operate one valve to fill the main after approval has been obtained from AW. The operation of the valve is to be conducted under the immediate supervision of the Owner's Representative.

(b) Wet Connections to Existing Potable Water System

The Contractor shall make all wet connections called for by the Contract or required to complete the Work. Two connections to an existing line performed during the same shutout, at the same time and at a distance less than 50 linear feet apart, will be considered one wet connection. Two connections to an existing line performed during the same shutout, at the same time and at a distance equal to, or greater than 50 linear feet will be considered two wet connections. A wet connection shall include draining and cutting into existing piping and connecting a new pipeline or other extension into the existing pressure piping, forming an addition to the potable water transmission and distribution network.

To prevent contamination of the potable water system from stagnant water in dead end potable water service lines (e.g., private fire systems, private fire mains, sections for future use, etc.), the installation of an approved backflow prevention assembly is required on the private side of the City water meter. If the dead end potable water service line is unmetered, then an approved detector backflow prevention assembly is required at a point on the dead end potable water service line where no more than 100 gallons of water volume in the service line is reached. The 100 gallon threshold is determined by calculating the volume of water that would be contained in the service line as

measured from the connection to the City's water main and the location of the approved backflow prevention assembly.

The Contract price for wet connections shall be full payment for all necessary shutoffs, excavation, removing plugs and fittings, pumping water to drain the lines, cutting in new fittings, blocking and anchoring piping, bedding and backfilling, placing the lines and service and all site cleanup.

No water containing detectable amounts of chlorine may be drained, released or discharged until specific planning and appropriate preparations to handle, dilute and dispose of such chlorinated water are approved in advance by the City and the disposal operations will be witnessed by an authorized representative from the City.

(c) Pressure Taps to Existing Potable Water System

The Contractor shall make all pressure taps called for by the Contract Documents or required to complete the Work. A pressure tap shall consist of connecting new piping to the existing potable water system by drilling into the existing pipe while it is carrying water under normal pressure without taking the existing piping out of service.

Unless otherwise provided by the Contract, the Contractor shall, at the Contractor's expense, perform all necessary excavation, furnish and install the tapping sleeve, valve and accessories, provide the tapping machine, drill the tap and shall block, anchor and backfill the piping, valve and all accessories, place the new piping in service and perform all site cleanup. When the City makes the tap, City forces are not obligated or expected to perform any Work except to provide tapping machine and drill the actual hole. If City crews are to make the tap, fiscal arrangements must be made in advance at the Taps Office, Waller Creek Center, 625 East 10th Street.

If a private Contractor makes the tap, a City Inspector or designated representative must be present. "Size on size" taps will not be permitted, unless made by use of an approved full bodied mechanical joint tapping sleeve. Concrete blocking shall be placed behind and under all tap sleeves 24 hours prior to making the wet tap.

(d) Service Connections

Service connection taps into PVC or DI pipe 12 inches or smaller shall be made using either a service clamp or saddle or a tapping sleeve as recommended by the pipe manufacturer and as approved by the City. Direct tapping of these pipes will not be permitted.

All potable water service connections shall be installed so that the outlet is at an angle of not more than 45 degrees above horizontal at the main line.

Precautions should be taken to ensure that the tapping saddle or sleeve is placed on the pipe straight to prevent any binding or deformation of the PVC pipe. The mounting chain or U-bolt strap must be tight.

Tapping shall be performed with a sharp shell type cutter so designed that it will smoothly penetrate heavy walled PVC DR14 and 200 psi AC and will retain and extract the coupon from the pipe.

24) Backfilling

(a) General

Special emphasis is placed upon the need to obtain uniform density throughout the backfill material. The maximum lift of backfill shall be determined by the compaction equipment selected and in no case shall it exceed 18 inches, loose measurement.

No heavy equipment, which might damage pipe, will be allowed over the pipe until it has been completely backfilled to finished grade. All internal pipe bracing installed or recommended by the manufacturer shall be kept in place until the pipe bedding and trench backfill have been completed over the braced pipe section. Testing of the completed backfill in streets and under and around structures shall meet the specified density requirements. Initial testing shall not be at Contractor's expense and shall conform to the "General Conditions."

(b) Backfill Materials

Unless otherwise shown on the Drawings, select material shall be used for backfill. Select materials shall be placed over the top of embedment/encasement material, where designated on the Drawings and as specified herein. Select material shall consist of a free-flowing material like sand or mixed sand and gravel, free from lumps, large stones, clay, debris and organic matter. Select backfill may also include rock cuttings from a ditching machine (preferably wheel-type), provided that the largest chips shall have an average dimension in one place less than 1 inch, and no dimensions greater than 2 inches.

If approved by the City, good, sound earth may be used as select material for backfill over the pipe. Good, sound earth is defined as gravel, sandy loam or loam, free from excessive clay and having a Plasticity Index less than 20.

Select backfill shall be compacted to 95% of TEX 114E at optimum moisture content to 3% above optimum moisture content.

It shall be the full responsibility of the Contractor to explore the project and subsurface materials to determine if the trench excavation will be suitable for use as select materials and to follow as closely as possible to this Specification to insure a good, sound pipeline when completed.

(c) Backfill in Non-Paved Areas

After the pipe and embedment or encasement have been placed in trenches under non-paved areas, the remainder of the trench shall then be filled with select material. Mechanical tamping in six (6) inch maximum lifts shall be used. Select Backfill material shall be compacted to 95% density TEX 114E.

After the trench has been refilled, topsoil shall be replaced to the extent that rock excavated from the trench will be completely covered or removed and the area is returned to its original condition, except that in cultivated areas a minimum of six (6) inches of topsoil shall be replaced.

(d) Backfill in Street Right of Way

All trenches under proposed or existing concrete roadways, driveways and sidewalks, paved waterways, brick roadways, asphaltic roadways with concrete base, gravel roadways, and roadways with gravel base and asphalt surface, shall be backfilled by hand or mechanically tamping selected materials in six (6) to eight (8) inch layers to a minimum compaction of 95% TEX 114E at optimum moisture density. Jetting with water will not be permitted.

After each layer of backfill is complete, tests may be made by the City or designated representative. If the material fails to meet the density indicated, the course shall be reworked as necessary to obtain the indicated compaction and the compaction method shall be altered on subsequent Work to obtain indicated density.

At any time, the City or designated representative may order proof rolling to test the uniformity of compaction of the backfill layers. All irregularities, depressions, weak or soft spots that develop shall be corrected immediately by the Contractor.

Should the backfill, due to any reason, lose the required stability, density or finish before the pavement structure is placed, it shall be re-compacted and refinished at the sole expense of the Contractor. Excessive loss of moisture in the subgrade shall be prevented by sprinkling, sealing or covering with a subsequent backfill layer or granular material. Excessive loss of moisture shall be construed to exist when the subgrade soil moisture content is more than 4 percent below the optimum of compaction ratio density. Backfill shall be placed from the top of the bedding material to the existing grade, base course, subgrade or as indicated. The remainder of the street backfill shall be Flexible Base, Concrete or Hot Mix Asphalt Concrete as indicated or to be replaced in kind to the surface removed to construct the pipe.

(e) Backfill in County Street or State Highway Right of Way

All Work within the right-of-way shall meet the requirements of (d) above, as a minimum and shall meet the requirements of the permit issued by the County when their requirements are more stringent. Prior to the start of construction, the Contractor shall be responsible for contacting the appropriate TxDOT office or County Commissioner's Precinct Office and following the operating procedures in effect for utility cut permits and pavement repair under their jurisdiction. Approval for all completed Work in the State or County right-of-way shall be obtained from the appropriate Official prior to final payment by the Owner.

(f) Backfill in Railroad Right-of-Way

All Work within the railroad right-of-way shall meet the requirements of (d) above, as a minimum and shall meet the requirements of the permit issued by the Railroad Owner when their requirements are more stringent. Approval for all completed Work in the railroad right of way shall be obtained from the Railroad prior to Final Completion.

(g) Backfill in Easements

Where not otherwise indicated, Contractor may select whatever methods and procedures may be necessary to restore entire Work area to a safe, useful and geologically stable condition with a minimum density of 85 percent or a density superior to that prior to construction.

In and near flood plain of all streams and watercourses, under or adjacent to utilities, structures, etc. all backfill shall be compacted to a density of not less than 95 percent conforming to TxDOT Test Method Tex-114-E, unless otherwise directed by the City.

All soil areas disturbed by construction shall be covered with topsoil and seeded conforming to Item No. 604, "Seeding for Erosion Control". All turf, drainways and drainage structures shall be constructed or replaced to their original condition or better. No debris shall remain in the drainways or drainage structures.

(h) Temporary Trench Repair/Surfacing

If details of temporary trench repair/surfacing are not provided in the contract documents, the Contractor shall submit for approval of the City (1) a plan for temporary trench repair for areas that will be open to traffic but will be excavated later for full depth repair, and (2) a proposed method for covering trenches to maintain access to properties. The temporary surfacing shall afford a smooth riding surface and shall be maintained by the Contractor the entire time the temporary surface is in place.

(i) Permanent Trench Repair

The Contractor shall install permanent trench repairs conforming to details in the drawings.

25) Quality Testing for Installed Pipe

(a) Wastewater Pipe Acceptance Testing

The entire length of the installed gravity line and the force main shall be field tested for water tightness. Gravity wastewater lines shall be video taped by camera.

Hydrostatic pressure and leakage (exfiltration and infiltration) tests shall be made on all pressure pipelines carrying wastewater.

All labor and equipment, including, but not limited to test pump with regulated by-pass meters and gauges required for conducting pipeline tests, shall be furnished by the Contractor. The Contractor shall furnish equipment and necessary piping as required to transport water used in testing from source to test location.

Time and sequence of testing shall be scheduled by the Contractor, subject to observation and approval by the City. The Contractor shall provide adequate labor, tools and equipment to operate valves and to locate and repair any leaks discovered during the initial filling of the pipeline prior to actual testing or during the course of the tests.

The Contractor, at his expense, shall perform quality testing for all wastewater pipe installed and pressure pipe hydrostatic testing of all water lines constructed and shall provide equipment included pumps, gauges, supplies, and labor necessary to perform the tests. Quality and pressure testing shall be monitored by City of Pflugerville personnel. Water samples will be collected by the City of Pflugerville to verify each treated line has attained an initial chlorine concentration of 50 ppm.

The Contractor shall coordinate testing with the City of Pflugerville and provide no less than 24 hour notice prior to performing sterilization, quality testing or pressure testing.

The City will certify that all required pressure and leakage tests have been successfully completed before the pipeline is accepted.

(b) Exfiltration or Infiltration Test

Preparation: Seal ends of line section being tested with water tight plugs, equipped with pipe riser inserted and braced in the inlet of the manholes. Fill section with water 24-hours prior to start of test. Fill slowly from downstream manhole in test section so that no air is trapped in the line. Leave outlets of stacks and service lines exposed and unplugged until after exfiltration test has been made. Outlets terminating below level of test water surface to be temporarily extended upward by installing additional lengths of pipe. After completion of satisfactory test, remove lengths of pipe added for test.

Duration of Test: Test for 24-hours. Minimum head of either two (2) feet measured above the crown, inside pipe at upper end of section or four (4) feet measured above trench water table, whichever is higher, so that a net positive of two (2) feet TCEQ is used for testing.

Allowable Leakage: Allowable leakage or exfiltration in any individual section under construction shall not exceed 10 gallons per inch of inside diameter per mile of pipe per 24 hours.

No pipe installation will be accepted until all known leaks have been repaired whether or not leakage is within allowable limits. Remove and replace or make approved corrective repairs to any section of wastewater line which has leakage that exceeds above amounts. Repair any individual leaks that may appear whether or not overall section meets leakage requirements. Individual leaks will ordinarily be revealed by looking through sewer with a light while groundwater level is over sewer, during water tamping operations or immediately after water leakage is emptied from sewer. Wastewater lines failing to meet requirements of leakage test will, after repair by Contractor, be tested again for leakage. No sewer or manhole will be accepted until leakage is less than allowable amount. Locating and repairing of leaks shall be performed by the Contractor at no additional cost to the City.

(c) Pipeline Settlement Test

During the infiltration test or after the exfiltration test, the pipe will be TV inspected for possible settlement. When air testing has been used, water shall be flowed into the pipe to permit meaningful observations. Any pipe settlement which causes excessive ponding of water in the pipe shall be cause for rejection. Excessive ponding shall be defined as a golf ball (1 5/8 " dia.) submerged at any point along the line.

(d) Low Pressure Air Test of Gravity Flow Wastewater Lines

Preparation: Clean pipe to be tested by propelling snug fitting inflated rubber ball through the pipe with water or by use of water jet cleaning equipment. After manhole to manhole reach of pipe has been backfilled and cleaned, pneumatic plugs shall be placed in the line at each manhole and inflated to 25 psig. Add air slowly to the section under test until the internal pressure of 4.0 psig is obtained. Allow at least two (2) minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.

Duration of Test and Allowable Leakage: Decrease pressure to 3.5 psig and start stopwatch. Determine the time in seconds that is required for the internal air pressure to reach 2.5 psig. Minimum permissible pressure holding times are indicated in seconds and shall be computed by the following equation:

$$T = (0.085 \times D \times K) / Q$$

Where,

T = time for pressure to drop 1.0 pound per square inch gauge in seconds

K = 0.000419xDxL, but not less than 1.0

D = average inside diameter in inches

L = length of line of same pipe size being tested, in feet

Q = rate of loss assume 0.0015 cubic feet per minute per square foot internal surface shall be used

Since K value of less than 1.0 shall not be used, there are minimum times for each pipe diameter as outlined below:

Pipe Diameter	Minimum Time	Length for Minimum Time	Time for Longer Length
(inches)	(seconds)	(feet)	(seconds)
6	340	398	0.855(L)
8	454	298	1.520(L)

Pipe Diameter	Minimum Time	Length for Minimum Time	Time for Longer Length
10	567	239	2.374(L)
12	680	199	3.419(L)
15	850	159	5.342(L)
18	1020	133	7.693(L)
21	1190	114	10.471(L)
24	1360	100	13.676(L)
27	1530	88	17.309(L)
30	1700	80	21.369(L)
33	1870	72	25.856(L)
36	2040	66	30.771(L)

The test may be stopped if no pressure loss has occurred during the first 25% of the calculated testing time. If any pressure loss or leakage has occurred during the first 25% of the testing period, then the test shall continue for the entire test duration as outlined above or until failure. Lines with a 27-inch average inside diameter and larger may be air tested at each joint. If the joint test is used, a visual inspection of the joint shall be performed immediately after testing. The pipe is to be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure has stabilized, the minimum time allowable for the pressure to drop from 3.5 psi gauge to 2.5 psi gauge shall be 10 seconds.

(e) Deflection Test

Deflection tests shall be performed on all flexible pipes. For pipes with inside diameters less than 27-inches, a rigid mandrel shall be used to measure deflection. For pipelines with an inside diameter of 27-inches and greater, the Contractor shall submit to the Engineer the proposed method, with which shall provide a precision of  $\pm$  two tenths of one percent (0.2%) deflection, for review and approval by the Texas Natural Resource Conservation Commission. The test shall be conducted after final backfill has been in place at least 30 days in the presence of a representative of the City's Utilities Department. No pipe shall exceed a deflection of five percent (5%). If a pipe should fail to pass the deflection test, the problem shall be corrected and a second test shall be conducted after the final backfill has been in place an additional 30 days. Test shall be performed without mechanical pulling devices.

Mandrel Sizing: The rigid mandrel shall have an outside diameter (O.D.) equal to 95% 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 of the pipe minus two minimum wall thickness for O.D. controlled pipe and the average inside diameter for the I.D. Controlled pipe, all dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.

Mandrel Design: The rigid mandrel shall be constructed of a metal or rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more "runners" or "legs" as long as the total number of legs is an odd number. The barrel section of the mandrel shall have a length of at least 75% of the inside diameter of the pipe. A proving ring shall be provided and used for each size mandrel in use.

Method Options: Adjustable or flexible mandrels are prohibited. A television inspection is not a substitute for the deflection test. A deflectometer may be approved provided the Contractor notifies the Engineer in a timely manner and submits adequate information for the Engineer to submit to the Texas Natural Resource Conservation Commission for review and approval. Mandrels with removable legs or runners may also be approved provided the Contractor notifies the Engineer in a timely manner and submits adequate information for the Engineer to submit to the Texas Natural Resource Conservation Commission for review and approval.

(f) Inspection of Installed Storm Drain Conduits

(1) General



All storm drain conduits (pipe and box culvert) shall be inspected for conformance to the requirements of this specification. Smart Housing, low/moderate income housing, and projects that are 100-percent privately funded are exempt from the cost of the initial video inspection. All deficiencies revealed by inspection shall be corrected. Video re-inspection meeting the requirements of this specification shall be provided at the Contractor's expense to show that deficiencies have been corrected satisfactorily. Further, the contractor shall provide video in complete segments (manhole to manhole) versus specific deficiency locations.

Projects that are not exempt from the cost of the initial video inspection are also subject to the following constraints:

All inspectors utilized by the Contractor for video inspection shall be NASSCO-PACP certified for a minimum of 3 years.

The Contractor will be required to inspect, assess, and record the condition of the storm drain pipe using National Association of Sewer Service Companies (NASSCOs) Pipeline Assessment Certification Program (PACP) coding standards.

(2) Video Inspection of Installed Storm Drain Conduits

Contractor shall provide all labor, equipment, material and supplies and perform all operations required to conduct internal closed-circuit television and video recording of all storm drain conduits. Video recording of each storm drain conduit section shall be conducted after the trench has been backfilled and prior to placement of permanent pavement repairs or permanent pavement reconstruction. The video recording shall be provided to the Owner for review. Contractor shall not place permanent pavement repairs or permanent pavement reconstruction over the storm drain conduit until Owner has reviewed the video and agrees that there are no defects in the storm drain conduit installation shown in the video submitted by the Contractor or shown in any video acquired by the Owner through other means. Placement of permanent pavement repair or permanent pavement reconstruction over the installed storm drain conduit before the Owner acknowledges no defects shall be at the Contractor's risk. Any defects revealed by the video inspection shall be corrected at the Contractor's expense and a new video submitted to the Owner for review prior to acceptance of the conduit.

All video work shall be conducted under the direct full-time supervision of a NASSCO-PACP certified operator.

The conduit inspection camera shall have the capability of panning plus/minus 275 degrees and rotating 360 degrees. The television camera shall be specifically designed and constructed for such use. The camera shall be operative in 100% humidity conditions. Camera shall have an accurate footage counter that displays on the monitor the exact distance of the camera (to the nearest tenth of a foot) from the centerline of the starting manhole or access point. Camera shall have height adjustment so that the camera lens is always centered within plus/minus 10% of the center axis of the conduit being videoed. Camera shall provide a minimum of 460 lines of horizontal resolution and 400 lines of vertical resolution. Camera shall be equipped with a remote iris to control the illumination range for an acceptable picture. Geometrical distortion of the image shall not exceed one percent (1%). The video image produced by each camera shall be calibrated using a Marconi Resolution Chart No. 1 or equivalent.

Lighting for the camera shall be sufficient to allow a clear picture of the entire periphery of the conduit without loss of contrast, flare out of picture or shadowing. A reflector in front of the camera may be required to enhance lighting in dark or large sized conduit. The video camera shall be capable of showing on the digital display the Owner's name, Project name, Contractor name, date, line size and material, conduit identification, and ongoing footage counter. The camera, television monitor, and other components of the video system shall be capable of producing a picture quality satisfactory to the satisfaction of the Owner. The recording of the internal condition of the storm drain conduit shall be clear, accurate, focused and in color. If the recording fails to meet these requirements, the equipment shall be removed and replaced with equipment that is suitable. No payment will be made for an unsatisfactory recording.

If during video inspection, water is encountered inside the conduit, the conduit shall be dewatered by the Contractor. The storm drain section must be dry. Video recording conducted while the camera is floating is not acceptable unless approved by the Owner.

If during video inspection, debris is encountered that prohibits a proper inspection of the conduit, the Contractor shall remove the debris before proceeding.

All video shall be documented using a data logger and reporting system that are PACP compliant and which use codes as established by the National Association of Sewer Service Companies (NASSCO)s - Pipeline Assessment and Certification Program (PACP).

Computer printed location records shall be kept by the Contractor and shall clearly show the location and orientation of all points of significance such as joints, conduit connections, connections at manholes and inlets, and defects. Copy of all records shall be supplied to the Owner. Noted defects shall be documented as color digital files and color hard copy print-outs. Photo logs shall accompany each photo submitted.

The video recording shall supply a visual and audio record of the storm drain conduits that may be replayed. Video recordings shall include an audio track recorded by the video technician during the actual video work describing the parameters of the storm drain conduit being videoed (i.e. location, depth, diameter, pipe material), as well as describing connections, defects and unusual conditions observed during the video work. Video recording playback shall be at the same speed that it was recorded. Slow motion or stop-motion playback features may be supplied at the option of the Contractor. Once videoed, the CDs/DVDs shall be labeled and become the property of the Owner. The Contractor shall have all video and necessary playback equipment readily accessible for review by the Owner while the project is under construction.

Post-installation video shall not be completed until all work is completed on a section of storm drain conduit. Post-installation video work shall be completed by the Contractor in the presence of the Owner. The post-installation video work shall be completed to confirm that the storm drain conduits are free of defects. Provide a color video showing the completed work. Prepare and submit video logs providing location of storm drain conduit along with location of any defects. Manhole and inlet work shall be complete prior to post-installation video work.

For post-installation video, exercise the full capabilities of the camera equipment to document the completion and conformance of the storm drain installation work with the Contract Documents. Provide a full 360-degree view of conduit, all joints, and all connections. The camera shall be moved through the storm drain conduit in either direction at a moderate rate, stopping and slowly panning when necessary to permit proper documentation of the conduit condition at each pipe connection, joint, and defect. In no case shall the camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the storm drain conditions shall be used to move the camera through the storm drain conduit. When manually operated winches are used to pull the camera through the conduit, telephones or other suitable means of communication shall be set up between the two access points of the conduit being videoed to insure good communication between members of the video crew.

Distance measurements shall be provided to an accuracy of one tenth of a foot.

Video shall be continuous for each storm drain conduit segment. Do not show a single segment on more than one CD/DVD, unless specifically allowed by the Owner.

Contractor shall submit to Owner the following:

- A. National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) certification of operators who will be performing video work.
- B. Compact Disc (CD) or Digital Video Disc (DVD) of recording of storm drain conduits (concrete storm water pipe or box culvert).
  - a. The color CD or DVD shall include a digital color key map in a format acceptable to the Owner with each segment of storm drain conduit labeled with the appropriate inspection ID on the map.

- b. The file folder for each segment of the storm drain conduit shall have a unique name based on the Owner's approved inspection naming convention and shall contain the following:
  - i. Video files
  - ii. Video inspection logs with information coded in accordance with the PACP
  - iii. Photo logs
  - iv. A report summarizing the results of the video inspection
  - v. A proposed method of repair for any defects discovered.

- (3) Time commitments from City for projects that are exempt from the cost of the initial video inspection

Projects that are exempt from the cost of the initial video inspection are afforded the following time commitments from the City.

- A. Initial inspection - contractor must inform the City of Pflugerville construction inspector assigned to the project in writing that all stormdrain infrastructure for the project has been completed according to the permit and is ready for inspection. The inspector will then notify the Watershed Protection Department (WPD) in writing that all of the stormdrain infrastructure for the project has been completed and is ready for inspection. The WPD is allowed 15-days to complete inspection from written notification by the inspector. The outcome of this item does not impact the one-year warranty requirements.
- B. Video re-inspection by the contractor for deficient installed stormdrain infrastructure. The contractor must submit the video inspection data as defined in this specification to the City of Pflugerville construction inspector assigned to the project along with a written letter of transmittal certified by a professional engineer stating that all identified stormdrain infrastructure installation deficiencies for the project have been corrected. The inspector will then notify the Watershed Protection Department (WPD) in writing and convey the video inspection data to the WPD. The WPD is allowed 15-days to complete review of the data from the date of delivery by the inspector.

## 26) Pressure Pipe Hydrostatic Testing

### a) General

After the pipe has been laid and backfilled and the backfill has been otherwise consolidated, all newly laid pipe, or any valved section thereof, shall be subjected to the hydrostatic pressure specified below for that particular type of pipe. The duration of the hydrostatic test shall be at least two (2) hours. Unless otherwise specified or noted on the Plans. All meters, fixtures, devices or appliances which are connected to the pipeline system and which might be damaged if subjected to the specified test pressure shall be disconnected and the ends of the branch lines plugged or capped during the testing procedures.

Each valved (capped or plugged) section of pipe shall be filled slowly with water and all air shall be expelled. If permanent air vents are not located at all high points, the Contractor shall install, at his own expense, corporation or blow-off cocks at such points so that air can be expelled as filling takes place. After verification that all air has been expelled, the cocks shall be closed and the pipe kept filled until tested. All exposed pipe, fittings, valves, hydrants and joints shall be examined while under test pressure and all visible leaks shall be stopped. Any cracked or defective pipe, fittings, valves or hydrants discovered during testing shall be removed and replaced by the Contractor. Replacement shall be with sound material and the test shall be repeated until satisfactory to the City.

- b) Special Requirements: Where any section of pipeline is provided with concrete reaction blocking, the hydrostatic pressure shall not be made until at least five (5) days have elapsed after installation of the blocking. However, if high-early-strength cement is used in the concrete, two (2) days shall have elapsed prior to testing.
- c) Leakage Test: A Leakage Test will be conducted on each valved section over the entire Project. The leakage test shall be at 150 psi for at least four (4) hours.
- d) Allowable Leakage
  - 1. The allowable hydrostatic leakage rate shall be based on the following formula:

$$L = \frac{SD \sqrt{P}}{133,200}$$

L = testing allowance 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 hydrostatic test in pounds per square inch (gauge)

Table 6A

Hydrostatic testing allowance per 1,000 ft of pipeline\* - *gph*†

Avg. Test Pressure <i>psi</i>	Nominal Pipe Diameter – in.																	
	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54	60	64
450	.48	.64	.95	1.27	1.59	1.91	2.23	2.55	2.87	3.18	3.82	4.78	5.73	6.69	7.64	8.60	9.56	10.19
400	.45	.60	.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.60	4.50	5.41	6.31	7.21	8.11	9.01	9.61
350	.42	.56	.84	1.12	1.40	1.69	1.97	2.25	2.53	2.81	3.37	4.21	5.06	5.90	6.74	7.58	8.43	8.99
300	.39	.52	.78	1.04	1.30	1.56	1.82	2.08	2.34	2.60	3.12	3.90	4.68	5.46	6.24	7.02	7.80	8.32
275	.37	.50	.75	1.00	1.24	1.49	1.74	1.99	2.24	2.49	2.99	3.73	4.48	5.23	5.98	6.72	7.47	7.97
250	.36	.47	.71	.95	1.19	1.42	1.66	1.90	2.14	2.37	2.85	3.56	4.27	4.99	5.70	6.41	7.12	7.60
225	.34	.45	.68	.90	1.13	1.35	1.58	1.80	2.03	2.25	2.70	3.38	4.05	4.73	5.41	6.03	6.76	7.21
200	.32	.43	.64	.85	1.06	1.28	1.48	1.70	1.91	2.12	2.55	3.19	3.82	4.46	5.09	5.73	6.37	6.80
175	.30	.40	.59	.80	.99	1.19	1.39	1.59	1.79	1.98	2.38	2.98	3.58	4.17	4.77	5.36	5.96	6.36
150	.28	.37	.55	.74	.92	1.10	1.29	1.47	1.66	1.84	2.21	2.76	3.31	3.86	4.41	4.97	5.52	5.88
125	.25	.34	.50	.67	.84	1.01	1.18	1.34	1.51	1.68	2.01	2.52	3.02	3.53	4.03	4.53	5.04	5.37
100	.23	.30	.45	.60	.75	.90	1.05	1.20	1.35	1.50	1.80	2.25	2.70	3.15	3.60	4.05	4.50	4.80

\* If the pipeline under test contains sections of various diameters, the testing allowance will be the sum of the testing allowance for each size.

† Calculated on the basis of Eq. 1.

- a. These formulas are based on a testing allowance of 11.65 gpd/mi/in. of nominal diameter at a pressure of 150 psi.
- b. 5.2.1.6.1 Testing allowance at various pressures is shown in Tables 6A and 6B.
- c. 5.2.1.6.2 When testing against closed metal-seated valves, an additional testing allowance per closed valve of 0.0078 gal/h/in. (1.2 mL/h/mm) of nominal valve size shall be allowed.
- d. 5.2.1.6.3 When hydrants are in the test section, the test shall be made against the main valve in the hydrant.
- e. 5.2.1.7 Acceptance of installation. Acceptance shall be determined on the basis of testing allowance. If any test of laid pipe discloses a testing allowance greater than that specified in Sec. 5.2.1.6, repairs or replacements shall be accomplished in accordance with the specifications.
- f. 5.2.1.7.1 All visible leaks are to be repaired regardless of the allowance used for testing.  
If such testing discloses leakage in excess of this specified allowable, the Contractor, at his expense, shall locate and correct all defects in the pipeline until the leakage is within the specified allowance. All known leaks, irregardless of this test, shall be repaired.

e) Pressure Test: After satisfactorily completing the leakage test, each valved section over the entire project, shall be tested at 200 psi for a sufficient period (approximately 10 min) to discover all leaking or defective materials and/or workmanship.

27) Service Charges for Testing

No separate payment will be made for work completed in accordance with this specification, and the cost thereof will be included in appropriate items of the Proposal and Bid Schedule.

28) Disinfection of Potable Water Lines

(1) The Contractor shall disinfect all water mains before the new facilities are placed into service. Disinfection must be performed in accordance with AWWA C651, latest revision and water samples must be submitted to a laboratory approved by the Texas Department of Health. Sample must be collected by the Contractor or his representative in the presence of the City or his representative. The Contractor shall be responsible for delivering the samples to an approved laboratory for testing. Sample results must indicate the facility is free of microbiological contamination before it is placed into service. It shall be the Contractor's responsibility to obtain a current copy of AWWA C651 to determine the correct forms of chlorine for disinfection, the basic disinfection procedure, preventive and corrective measures during construction, methods of chlorination, final flushing procedures, procedures for bacteriological tests, procedures for re-disinfection and disinfection procedures when cutting into existing mains. The Contractor, at its expense, will supply the concentrated chlorine disinfecting material, the City's personnel will supervise and direct the overall sterilization procedure. The Contractor, at his own expense, shall provide all other equipment, supplies and necessary labor to perform the sterilization under general supervision by the City.

- A. All valves shall be arranged to prevent the strong disinfecting dosage from flowing back into the existing water supply piping. The new pipeline shall then be completely filled with disinfecting solution by feeding the concentrated chlorine and approved water from the existing system uniformly into the new piping in such proportions that every part of the line has a minimum concentration of chlorine as prescribed in AWWA C651.
- B. Unless otherwise identified, all quantities called for herein refer to measurements by the testing procedures in the current edition of "Standard Methods of Examination of Water and Wastewater". The chlorine concentration of each step in the sterilization procedure shall be verified by chlorine residual determinations. This disinfecting solution shall be retained in the piping for at least twenty-four (24) hours, and all valves, hydrants, etc., shall be operated to disinfect all their parts. After this retention period, the water shall contain no less than the chlorine residual prescribed in AWWA C651 throughout the treated section of the pipeline.
- C. This heavily chlorinated water shall then be carefully flushed from the line until the chlorine concentration is not higher than the residual generally prevailing in the existing distribution system, or approximately 1.0 parts per million. Proper planning and appropriate preparations to handle, dilute and dispose of this strong chlorine solution without causing injury or damage to the public, the water system, the environment must be approved by the City before flushing of the line may begin, and the flushing shall be witnessed by an authorized representative of the City.

(2) Bacteriological Testing

- A. After final flushing of the strong disinfecting solution, water samples from the line shall be tested for bacteriological quality, at the Contractor's expense, and must be found free of coliform organisms before the pipeline may be placed in service. One (1) test sample shall be drawn from the end of the main and additional samples collected at intervals of not more than one-thousand (1,000) feet along the pipeline. A minimum of three (3) samples must be collected.
- B. The Contractor, at his own expense, shall install sufficient sampling taps at proper locations along the pipeline. Each sampling tap shall consist of a standard corporation cock installed in the line and extended with a copper tubing gooseneck assembly. After samples have been collected, the gooseneck assembly shall be removed and retained for future use.
- C. Samples for bacteriological analysis shall be collected only from suitable taps, in sterile bottles. Collection of the test samples shall be made in the presence of City personnel. If the initial disinfection fails to produce acceptable sample tests, the disinfection procedure shall be repeated (without extra compensation) until satisfactory test results have been obtained, before the piping may be placed in service.

29) Cleanup and Restoration

It shall be the Contractor's responsibility to keep the construction site neat, clean and orderly at all times. Cleanup shall be vigorous and continuous to minimize traffic hazards or obstructions along the streets and to driveways. Trenching, backfill, pavement repair (as necessary), and cleanup shall be coordinated as directed by the City. The E/A will regulate the amount of open ditch and may halt additional trenching if cleanup is not adequate to allow for orderly traffic flow and access.

Materials at the site shall be stored in a neat and orderly manner so as not to obstruct pedestrian or vehicular traffic. All damaged material shall be removed from the construction site immediately and disposed of in a proper manner. During excavation, all materials shall be piled adjacent to the Work to be used for backfilling as required. Where required on the Drawings or when otherwise specified, desirable topsoil shall be piled separately in a careful manner and replaced in its original position. All surplus excavated materials shall become the property of the Contractor for disposal at the Contractor's expense. After trenching, the Contractor shall immediately remove all excavated materials unsuitable for or in excess of, backfill requirements. Immediately following the pipe laying Work as it progresses, the Contractor shall backfill, grade and compact all excavations as provided elsewhere. The backfill placed at that time shall meet all compaction test requirements. The Contractor shall immediately clean up and remove all unused soil, waste and debris and restore all surfaces and improvements to a condition equal or superior to that before construction began and to an appearance which complements the surroundings. The Contractor shall grade and dress the top 6 inches of earth surfaces with soil or other material similar and equal to the surrounding, fill and smooth any visible tracks or ruts, replace and re-establish all damaged or disturbed turf or other vegetation and otherwise make every effort to encourage the return of the entire surface and all improvements to a pleasant appearance and useful condition appropriate and complementary to the surroundings and equal or similar to that before construction began.

Placement of the final lift of permanent pavement, if a pavement is required, shall begin immediately after all testing of each segment of piping is satisfactorily completed.

30) Valve Turn Walk-through

As part of the acceptance of Water pressure pipe, a Valve Walk-through will be performed after an initial inspection by the Owner's Representative to identify any deficient items. If deficient items are present during the AW Valve Walk-Through and the project fails acceptance, a re-inspection fee will apply and must be paid before a re-inspection is scheduled to confirm correction of deficient items. See AW Fee Schedule for the current Distribution Walk-Through Re-inspection Fee.

31) 2-inch Jumper Hose

During connections to the water distribution system, the Contractor may be required to install a temporary jumper hose between the unpressurized water segment and an adjacent pressurized water segment for the purpose of maintaining water service to customers who can't operate without water service during the connection. The jumper shall include an approved backflow preventer and be of adequate size and pressure rating to maintain service to the customer. It shall be polyethylene tubing meeting the requirements of the City of Pflugerville SPL Item "Polyethylene Tubing for Low Pressure Sewers.". The jumper hose and other components in the temporary service shall be disinfected, and bacteriological samples will be taken and pass before the temporary service is provided to the customer. Contractor shall provide adequate protection for the jumper hose in vehicular traffic areas at all times during use.

#### 510.4 - Measurement

Pipe will be measured complete in place by the linear foot along the centerline for the various types, sizes and classes installed. Parallel lines will be measured individually.

Where a line ties into an existing system, the length of the new line will be measured from the visible end of the existing system at the completed joint. Unless otherwise indicated, the length of water, reclaimed, and wastewater lines will be measured along pipe horizontal centerline stationing through fittings, valves, manholes, and other appurtenances.

Ductile iron fittings, whether standard mechanical joint or integral factory restrained joint type, will be measured by the ton and paid for in accordance with the schedule in Standard Products List WW-27C. Bolts, glands and gaskets will not be measured for payment. Steel cylinder concrete pipe fittings and welded steel pipe fittings will not be measured separately and are included in the unit price for the respective pipe bid items.

Factory restrained joint pipe meeting the requirements of Standard Products List Item, "Restrained Joint Ductile Iron Pipe and Fittings" will be measured by the linear foot. The estimated quantity on the bid form is only for restrained joint pipe having integral mechanically restrained joints.

Connecting a new water, wastewater, or reclaimed water service to an existing, comparable type of private service will be measured by each connection. Service pipe from the main to the service connection will be measured by the linear foot.

The Contractor shall be responsible for removing and treating all ground water and surface water flowing into a trench.

Adjustment of elevations during construction resulting in changes in flow line elevations of plus or minus two feet or less will not be considered for credit or additional compensation and no measurement for payment will be made.

Stormwater pipe will be measured along the slope of the pipe. Where drainage pipe ties into inlets, headwalls, catch basins, manholes, junction boxes or other structures that length of pipe tying into the structure wall will be included for measurement, but no other portion of the structure length or width will be so included.

Excavation and backfill, when included as pipe installation will not be measured as such but shall be included in the unit price bid for constructing pipe and measured as pipe complete in place including excavation and backfill.

When pay items are provided for the other components of the system, measurement will be made as addressed hereunder.

Video inspection of newly installed box culverts and storm drain pipe will be measured per linear foot of pipe videoed.

Jumper hose will be measured per linear foot of hose installed, including all depths, excavation and backfill, complete, and in place.

#### 510.5 - Payment

Payment for pipe, measured as prescribed above, will be made at the unit price bid per linear foot for the various sizes of pipe, of the materials and type indicated, unless unstable material is encountered or trench excavation and backfill is bid as a separate item.

The concrete seal, foundation rock or coarse aggregate when used as directed in unstable material will be paid for at the unit price bid per cubic yard, which shall be full payment for all excavation and removal of unsuitable material and furnishing, placing and compacting the foundation rock, coarse aggregate or other approved material all complete in place.

Excavation and backfill, when included as a separate pay item, will be paid for by Pay Item No. 510-E or 510-F.

No separate payment will be made for dewatering a trench.

(1) Pipe

Payment for pipe, measured as prescribed above, will be made at the unit price bid per linear foot complete-in-place as designed and represented in the Drawings and other Contract documents. Restrained joint pipe meeting the requirements of Item, "Restrained Joint Ductile Iron Pipe and Fittings" will be paid for separately at the unit price bid per linear foot. Unless otherwise provided herein, as separate pay item(s), the bid price per linear foot of pipe shall include the following:

- a. clearing
- b. constructing any necessary embankment
- c. excavation
- d. disposal of surplus or unusable excavated material
- e. furnishing, hauling and placing pipe
- f. field constructed joints, collars, temporary plugs, caps or bulkheads
- g. all necessary lugs, rods or braces
- h. pipe coatings and protection
- i. connections to existing systems or structures, concrete blocking and thrust blocks and restrained joints
- j. preparing, shaping, pumping for dewatering, and shoring of trenches
- k. bedding materials
- l. backfill materials
- m. hauling, placing and preparing bedding materials
- n. particle migration measures
- o. hauling, moving, placing and compacting backfill materials
- p. temporary and permanent pavement repairs and maintenance
- q. temporary removal and replacement of pavement, curb, drainage structures, driveways, sidewalks and any other improvements damaged or removed during construction
- r. cleanup
- s. vertical stack on deep wastewater services
- t. all other incidentals necessary to complete the pipe installation as indicated.
- u. pipe joint restraint devices, where specified or allowed, meeting Standard Products List Item "Joint Restraint Devices, 4 Inch through 16 Inch Diameter."

No separate payment will be made for thrust restraint measures.

Steel cylinder concrete pipe fittings will not be paid for separately. These will be included in the unit price bid for the bid item Pipe.

(2) Concrete Cradles and Seals

When called for in the Bid, concrete cradles and seals will be paid for at the unit Contract price bid per linear foot for the size of pipe specified, complete in place.

(3) Concrete Retards

When called for in the Bid, Concrete retards will be paid under Item No. 593S, Concrete Retards."

(4) Boring or Jacking.

When called for in the Bid, boring or jacking will be paid under Item 501S, "Jacking or Boring Pipe.

(5) Wet Connections to Potable or Reclaimed Water Mains



When called for in the bid, wet connections will be paid at the unit price bid per each, complete in place, according to the size of the main that is in service and shall be full compensation for all Work required to make the connection and place the pipe in service. (See subsection 510.3 'Construction Methods' part (24) (b) 'Wet Connections to Existing Water System').

(6) Fittings

Ductile iron fittings, furnished in accordance with these specifications, will be paid for at the unit price bid per ton, complete in place, according to the schedule of weights in Standard Products List Item "Ductile Iron Pipe & Fittings." Bolts, glands, and gaskets will not be paid for separately and shall be included in the contract unit price for fittings.

(7) Concrete Trench Cap and Encasement

Where the distance between the top of the concrete encasement and the top of the trench cap is less than 36 inches, the concrete cap and encasement shall be poured as one unit and paid for under this bid item at the Contract price bid per linear foot. When the distance above is greater than 36 inches or when the trench cap is placed separately, the trench cap shall be paid for as a separate item, per linear foot, complete in place.

(8) Cement-Stabilized Backfill

Cement-stabilized backfill will be paid for at the unit price bid per linear foot and shall be full payment to the Contractor for furnishing and installing the required material, mixed, placed and cured complete in place.

(9) Concrete Encasement

When called for in the Bid, Concrete Pipe Encasement will be paid under Item No. 505S, "Encasement and Encasement Pipe".

(10) Pressure Taps

Pressure taps will be paid for at the unit price bid, complete in place, according to the size tap made and the size main tapped and shall be full payment for furnishing all necessary materials, including tapping sleeve and valve, making the tap, testing and placing the connection in service.

(11) Excavation Safety Systems

When called for in Bid, Trench Safety Systems shall conform to Item No. 509S, "Excavation Safety Systems."

(12) Connecting a New Water, Wastewater, or Reclaimed Water Service to an existing, comparable type of private service will be paid for at the unit price bid, complete in place, according to the size of new service and size of existing private service, and shall be full payment for furnishing and installing all necessary materials, such as cleanouts, pipe, couplings, and fittings, and including excavation and backfill.

(13) Video Inspection

Video Inspection of Newly Installed Box Culverts and Storm Drain Pipe will be paid for at the unit price bid per linear foot and shall be full payment for all labor, equipment, and materials required for video inspection per this specification, including all submittals of CD/DVD as required.

(14) Jumper Hose

Jumper Hose will be paid at the unit bid price, complete and in place, including installation and removal of all materials necessary to provide a fully functional jumper hose. This item shall also include adequate protection for the jumper hose within vehicular traffic areas.

Payment, when included as a Contract pay item, will be made under one of the following:

<b>Pay Item No. 510-AR</b> _____ <b>Dia.:</b>	Pipe, _____ Dia. _____ Type (all depths), including Excavation and Backfill	Per Linear Foot.
<b>Pay Item No. 510-ARRJ</b> _____ <b>Dia.:</b>	Factory Restrained Joint Pipe, _____ Dia., Class _____ Ductile Iron, (all depths) including Excavation and Backfill	Per Linear Foot.
<b>Pay Item No. 510-BR</b> _____ x _____ <b>Dia.:</b>	Connecting New _____ Service to Existing Private Service ( _____ Dia. New Service to _____ Dia. Private Service)	Per Each.
<b>Pay Item No. 510-CR:</b>	Pipe Excavation, _____ Ft. Width	Per Linear Foot.
<b>Pay Item No. 510-DR:</b>	Pipe Trench Backfill, _____ Ft. Width	Per Linear Foot.
<b>Pay Item No. 510-ER:</b>	Concrete Seal or Cradle, _____ Dia. Pipe	Per Linear Foot.
<b>Pay Item No. 510-FR:</b>	Concrete Trench Cap, _____ Ft. Width	Per Linear Foot.
<b>Pay Item No. 510-GR:</b>	Concrete Cap and Encasement, _____ Dia. Pipe	Per Linear Foot.
<b>Pay Item No. 510-HR:</b>	Cement Stabilized Backfill, _____ Dia. Pipe	Per Linear Foot.
<b>Pay Item No. 510-IR:</b> _____ x _____ <b>Dia.:</b>	Pressure Taps, _____ Dia. x _____ Dia.	Per Each.
<b>Pay Item No. 510-JR:</b> _____ x _____ <b>Dia.:</b>	Wet Connections, _____ Dia. x _____ Dia.	Per Each.

<b>Pay Item No. 510-KR:</b>	Ductile Iron Fittings	Per Ton.
<b>Pay Item No. 510-ASD _____ Dia.:</b>	Pipe, _____ Dia. (all depths), including excavation and backfill	Per Linear Foot.
<b>Pay Item No. 510-CSD:</b>	Pipe Excavation, _____ Ft. Width	Per Linear Foot.
<b>Pay Item No. 510-DSD:</b>	Pipe Trench Backfill, _____ Ft. Width	Per Linear Foot.
<b>Pay Item No. 510-ESD:</b>	Concrete Seal or Cradle, _____ Dia. Pipe	Per Linear Foot.
<b>Pay Item No. 510-FSD:</b>	Concrete Trench Cap, _____ Ft. Width	Per Linear Foot.
<b>Pay Item No. 510-GSD:</b>	Concrete Cap and Encasement, _____ Dia. Pipe	Per Linear Foot.
<b>Pay Item No. 510-HSD:</b>	Cement Stabilized Backfill, _____ Dia. Pipe	Per Linear Foot.
<b>Pay Item No. 510-AW _____ Dia.:</b>	Pipe, _____ Dia. _____ Type (all depths), including excavation and backfill	Per Linear Foot
<b>Pay Item No. 510-AWRJ _____ Dia.:</b>	Factory Restrained Joint Pipe, _____ Dia., Class Ductile Iron, (all depths) including Excavation and Backfill	Per Linear Foot.
<b>Pay Item No. 510-BW _____ x _____ Dia.:</b>	Connecting New _____ Service to Existing Private Service ( _____ Dia. New Service to _____ Dia. Private Service)	Per Each.
<b>Pay Item No. 510-CW:</b>	Pipe Excavation, _____ Ft. Width	Per Linear

		Foot.
<b>Pay Item No. 510-DW:</b>	Pipe Trench Backfill, _____ Ft. Width	Per Linear Foot.
<b>Pay Item No. 510-EW:</b>	Concrete Seal or Cradle, _____ Dia. Pipe	Per Linear Foot.
<b>Pay Item No. 510-FW:</b>	Concrete Trench Cap, _____ Ft. Width	Per Linear Foot.
<b>Pay Item No. 510-GW:</b>	Concrete Cap and Encasement, _____ Dia. Pipe	Per Linear Foot.
<b>Pay Item No. 510-HW:</b>	Cement Stabilized Backfill, _____ Dia. Pipe	Per Linear Foot.
<b>Pay Item No. 510-IW:</b> _____ x _____ Dia.:	Pressure Taps, _____ Dia. x _____ Dia.	Per Each.
<b>Pay Item No. 510-JW:</b> _____ x _____ Dia.:	Wet Connections, _____ Dia. x _____ Dia.	Per Each.
<b>Pay Item No. 510-KW:</b>	Ductile Iron Fittings	Per Ton.
<b>Pay Item No. 510-AWW:</b> _____ Dia.:	Pipe, _____ Dia. _____ Type (all depths), including Excavation and Backfill	Per Linear Foot.
<b>Pay Item No. 510-AWWRJ</b> _____ Dia.:	Factory Restrained Joint Pipe, _____ Dia., Class ductile Iron, (all depths) including Excavation and Backfill	Per Linear Foot.
<b>Pay Item No. 510-BWW</b> _____ x _____ Dia.:	Connecting New _____ Service to Existing Private Service ( _____ Dia. New Service to _____ Dia. Private Service)	Per Each.
<b>Pay Item No. 510-CWW:</b>	Pipe Excavation, _____ Ft. Width	Per Linear

		Foot.
<b>Pay Item No. 510-DWW:</b>	Pipe Trench Backfill, _____ Ft. Width	Per Linear Foot.
<b>Pay Item No. 510-EWW:</b>	Concrete Seal or Cradle, _____ Dia. Pipe	Per Linear Foot.
<b>Pay Item No. 510-FWW:</b>	Concrete Trench Cap, _____ Ft. Width	Per Linear Foot.
<b>Pay Item No. 510-GWW:</b>	Concrete Cap and Encasement, _____ Dia. Pipe	Per Linear Foot.
<b>Pay Item No. 510-HWW:</b>	Cement Stabilized Backfill, _____ Dia. Pipe	Per Linear Foot.
<b>Pay Item No. 510-KWW:</b>	Ductile Iron Fittings	Per Ton.
<b>Pay Item No. 510-VIDEO</b>	Video Inspection of Newly Installed Box Culverts and Storm Drain Pipe	Per Linear Foot.
<b>Pay Item No. 510-JH</b>	2-inch Jumper Hose	Per Linear Foot.

An "R" after the pay item indicates the use for reclaimed water.

An "SD" after the pay item indicates the use for storm drain.

A "W" after the pay item indicates the use for water.

A "WW" after the pay item indicates the use for wastewater.

**END**

## ITEM NO. 511S - WATER VALVES

### 511S.1 - Description

This item shall govern the valves furnished and installed as indicated on the Drawings. Unless otherwise indicated on the Drawings, all valves 4 inches and larger shall be AWWA-type valves of suitable design and fully equipped for service buried in the earth, without need for further modification and shall be wrapped with 8-mil polyethylene film with all edges and laps securely taped to provide a continuous wrap. For reclaimed water piping, the polyethylene film shall be purple. Unless otherwise indicated on the Drawings, all valve stems shall be adjusted to situate the operating nut not more than 24 inches below the proposed ground or paving surface of the finished project. Laydown valves shall not be used unless called out on the Drawings. Standard details shall not be used as an indicator of available options.

All valves shall open counterclockwise.

Valves shall have the name of the maker, nominal size, flow directional arrows, working pressure for which they are designed and standard to which they are manufactured cast in raised letters on some appropriate part of the body.

Unless otherwise noted, valves shall have a minimum working pressure of 200 psi or be of the same working pressure as the pipe they connect to, whichever is higher, and suitable for the pressures noted where they are installed.

Valves shall be of the same nominal diameter as the pipe or fittings they are connected to. Except as otherwise notes, joints shall be mechanical joints, with joint restraint where the adjacent piping is required to be restrained.

### 511S.2 - Submittals

Within 14 days of the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including Manufacturer's literature, illustrations, specifications and engineering data which includes dimensions, size, materials of construction, weight, protection coating, and all other pertinent data to illustrate conformance to the specification found within. The Contractor shall also submit four (4) copies of all certified shop test results specified herein, complete operation and maintenance manuals including all copies of all approved shop drawings, and certificates of compliance where required by referenced standards: For each valve specified to be manufactured and/or installed in accordance with AWWA and other standards, submit an affidavit of compliance with the appropriate standards, including certified results of required tests, and certification of proper installation.

Each submittal shall be accompanied by:

1. Complete data covering:
  - a. the operator, including type and size, model number, etc.,
  - b. the name and address of the manufacturer's nearest service facility,
  - c. the number of turns to fully open or close the valve.
2. detailed instructions for calibrating the limit stops for open and closed positions, and
3. any other information, that may be necessary to operate and maintain the operator.
4. Complete dimensional data and installation instructions for the valve assembly as it is to be installed, including the operator.
5. Complete replacement parts lists and drawings, identifying every part for both the valve and operator.

Contractor's/manufacturer's submittal for valves larger than 24" diameter, when approved for use, shall include catalogue drawings and assembly (shop) drawings specific to valves required for the project.

As far as possible, equipment of the same type shall be identical and from one manufacturer. All valves must be "lead free" and marked by stamping, etching, or casting "NL" in the main body or by other methods acceptable to the City.

### 511S.3 - Materials

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation in the Work is of the kind and quality that satisfies the specified functions and quality. The City of Pflugerville Standard Products Lists (SPL) are considered to form a part of these Specifications. Contractors may, when appropriate, elect to use products from the SPL; however, submittal to the City is still required. If the Contractor elects to use any materials from these lists, each product shall be completely and clearly identified by its corresponding SPL number when making the product submittal. This will expedite the review process in which the City.

The SPL's should not be interpreted as being a pre-approved list of products necessarily meeting the requirements for a given construction Project. Items contained in the SPL cannot be substituted for items shown on the Drawings, or called for in the specifications, or specified in the Bidding Requirements, Contract Forms and Conditions of Contract, unless approved by the City. The Standard Product List current at the time of plan approval will govern.

#### A. Samples, Inspection and Testing Requirements

All tests and inspections called for by the applicable standards shall be performed by the manufacturer. Upon request, results of these tests shall be made available to the purchaser.

The interior ferrous metal surfaces, except finished or bearing surfaces, shall be blast cleaned in accordance with SSPC SP-6 (NACE No. 3) and painted with 2 coats of an approved 2 component coal tar epoxy coating specifically formulated for potable water use. The coating used must appear on the current edition of the United States Environmental Protection Agency's list entitled "Accepted Categories and Subcategories of Coatings, Liners and Paints for Potable Water Usage."

### 511S.3 - Valves

#### A. Resilient Seated Gate Valves

Gate valves furnished under these specifications shall be of the solid wedge, resilient seat type with cast iron/ductile iron body and bronze stem for 250 psi working pressure. All gate valves shall be tested hydrostatically to 400 psi. Wedges shall be totally encapsulated with rubber. All units shall be UL and FM approved.

Resilient-seated gate valves for potable or reclaimed service, including tapping valves, shall conform to AWWA C-509 and shall conform to the latest ASTM A-126 and the City of Pflugerville Standard Products List Item "Resilient Seated Gate Valves, AAWA C509."

Reduced-wall, resilient-seated gate valves for potable or reclaimed service, including tapping valves, shall conform to AWWA C-515 and Standard Products List Item "Resilient-Seated Gate Valves, AWWA C515."

1. Stem Seals: All valves shall have a minimum of 2 approved O-ring type stem seals. At least two O-rings shall be in contact with the valve stem where it penetrates the valve body.
2. Operation: All valves shall have non-rising stems with gaskets, glands, bolts etc. as requisitioned. Copper alloy parts (bronze or brass) shall contain not over 16 percent zinc. Copper alloy UNS No. shall be shown on permanent external marking in addition to markings required by AWWA C509. Valve stems shall turn clockwise to close.
3. Gearing: Gate valves in 24-inch (610 mm) and larger sizes shall be geared and, when necessary for proper bury depth and cover, shall be the horizontal bevel-geared type enclosed in a lubricated gear case.
4. Seats: The seat shall be made of Styrene Butadiene rubber and provide a positive watertight seal. The seat shall be permanently bonded or mechanically attached to the wedge with stainless steel screws. Non-rising stem gate valves shall be equipped with "O" ring type packing gland consisting of at least two (2) "O" rings. The thrust collar shall work in an "O" ring seal lubricant

reservoir or against bearings or washers, above and below constructed of Delrin or approved equal material. Gate valve stems shall be fabricated from solid bronze rod having a tensile strength of not less than 60,000 pounds per square inch, and a minimum yield strength of 30,000 pounds per square inch.

5. Valve Body: Cast iron body shall be of iron with an even grain and shall possess a tensile strength of not less than 32,000 pounds per square inch. All bronze castings, except the stem, shall have a tensile strength of not less than 30,000 pounds per square inch. The entire internal valve body surfaces shall be coated with a factory applied two (2) component epoxy system or approved equal. The seating surface shall be machined or otherwise constructed to provide a smooth, even surface for the resilient seat. All valves shall open left (counterclockwise) and have a two (2) inch square wrench nut unless specified otherwise.
6. Bonnet and gland bolts and nuts shall be either fabricated from a low alloy-steel for corrosion resistance or electroplated with zinc or cadmium. The hot-dip process in accordance with ASTM A153 is not acceptable.

All gate valves shall be provided with extension shafts (where the operating nut is greater than 5 feet below grade), operating nuts and valve boxes as follows:

1. Extension shafts shall be steel, and the operating nut shall be two 2 inches square. Shafts shall be designed to provide a factor of safety of not less than 4. Operating nuts shall be pinned to the shafts.
2. Valve boxes shall be a heavy-pattern cast iron, 3 piece, telescoping type box with dome base suitable for installation on the buried valves. Inside diameter shall be at least 5¼-inches. Barrel length shall be adapted to the depth of cover, with a lap of at least 6 inches when in the most extended position. Covers shall be cast iron with integrally-cast direction-to-open arrow and "WATER" shall be cast in the cover when used on a water line or "SEWER" when used on a wastewater force main. Aluminum or plastic are not acceptable. A means of lateral support for the valve extension shafts shall be provided in the top portion of the valve box. The valve box lid shall be furnished with a pentagon-head bolt for locking.
3. The upper section of each box shall have a bottom flange of sufficient bearing area to prevent settling. The bottom of the lower section shall enclose the stuffing box and operating nut of the valve and shall be oval.
4. An approved operating key or wrench shall be provided.
5. All fasteners shall be Type 304 stainless steel.

#### B. Ball Valves

Ball valves for curb stops shall comply with the minimum requirements of the City of Pflugerville SPL Item "Ball Valves for Curb Stops."

#### C. Air-Vacuum Release Valves

Air-vacuum release valves shall comply with the minimum standards in AWWA C512 and SPL Items "Air Release / Vacuum Relief Valves for Potable Water," and "Air Release / Vacuum Relief Valves for Reclaimed Water."

The air-vacuum release valves shall be installed as shown on the Drawings. The valve body shall be of cast iron ASTM A126-B; the floats, float guide, and stem shall be of Type 316 stainless steel. The resilient seat shall be of Buna N. The valve shall be suitable for 150 psig working pressure. Valve shall have standard NPT inlets and outlet ports with diameters as indicated on the Plans. Valve shall be Model 200A Series by APCO Valve and Primer Corporation, Schaumburg, IL, or approved equal.

#### D. Check Valves

Controlled closing swing check valves shall meet the minimum requirements of AWWA C508, the City of Pflugerville SPL Item "Swing Check Valves, AWWA C508" and the following:

1. Check valves shall be of the controlled closing swing type. The controlled closing swing check valves shall be guaranteed to operate under severe conditions as check valves. The valve shall be



designed to open smoothly, provide full pipe line flow, permit minimum head loss and close at a controlled rate of speed for the final predetermined portion of its stroke. All bolts and nuts used in the assembly shall be steel, commercial.

2. The valve body shall be Cast Iron ASTM A126-B/ductile iron ASTM A536. The disc arm and chamber level shall be of heavy steel construction and keyed to the hinge shaft. The hinge shaft shall be of 18-8 stainless steel and of adequate diameter to withstand a complete hydraulic unbalance pressure of 125 psi on the valve disc. A single cushioning device mounted on the external side of the valve shall control the valve closure by way of the interchange of oil to and from an oil reservoir. The use of air or gas pressurized oil reservoir shall not be permitted. The oil plunger assembly shall be rigidly attached to the valve body by shoulder bolts or dowel pins to prevent fretting.
3. The Manufacturer, if required by the Engineer or the City, shall submit design calculations of principle component stresses to substantiate the integrity of the valve for the working pressure involved.
4. The valve when closed shall be tight seating by way of a resilient replaceable seat against a bronze seat ring in the body.
5. Valves shall be as manufactured by GA Industries or Series 6000 as manufactured by APCO. The City reserves the right to inspect all valves before shipment is made. Any failure of valves to operate satisfactorily during the first year of installation due to faulty workmanship or defective material shall be replaced and made good by the Manufacturer. Under these specifications, any valve stuffing box that leaks for any reason or because of excessive wear or deterioration of packing, shall be reason for classification as defective material.

Slanted/Tilted check valves shall meet following requirements:

1. Slanted or tilted check valves shall be furnished and installed where shown on the Plans.
2. The body of the valve shall be ductile iron or cast iron with access ports to the disc. The disc shall be cast iron. The seat and disc rings shall be bronze. Pivot pins and bushings shall be bronze or stainless steel. The valve shall include a localized indicator of the position of the valve.
3. The valves shall include a top mounted oil dash pot to prevent slamming of the disc. The dash pot shall control the last 10% of closure of the disc. The speed of closure within this 10% shall be adjustable.
4. Valves shall be APCO Slanting Disc, Valmatic or Golden Anderson Tilted Disc or approved equal.

E. Tapping Sleeves and Tapping Valves

Tapping sleeves shall conform to the applicable City of Pflugerville SPL Items including:

1. Cutting-In Sleeves
2. Tapping Sleeves: Iron Full-Body MJ (4 Inch & Larger)
3. Tapping Sleeves: Iron Full-Body for CSC Pipe
4. Tapping Sleeves: Iron Full-Body for Line Stops on CSC Pipe
5. Tapping Sleeves: Iron Full-Body for Line Stops
6. Tapping Sleeves: Iron Full-Body MJ (16 Inch & Larger)

F. Fire Hydrants

All fire hydrants shall be Dry Barrel, Traffic Model (break-away), Post Type having Compression Type Main Valves with 5 ¼" (133 mm) opening, closing with line pressure. Approved models are listed on SPL Item "Fire Hydrants" of the City of Pflugerville Standard Products List and shall meet the requirements of AAWA C502.

All fire hydrants shall have manufacturer's name, initial, insignia, or abbreviations in common usage, designated size of main valve and year of manufacture cast into upper barrel.

All fire hydrants shall meet the following requirements:

1. Fire hydrants shall be dry-barrel type conforming to the requirements of the latest revision of AWWA C502. Hydrants shall be designed such that the hydrant valve closes with line pressure preventing loss of water and consequent flooding in the event of traffic damage.
2. Hydrants shall have six (6)-inch mechanical joint inlet connections, two 2½-inch hose connections and one 5¼-inch pumper connection. Threads for the hose and pumper connections shall be in accordance with National Standard Thread. Hydrants shall be according to Manufacturer's standard pattern. Hydrants shall be equipped with "O" ring packing. Each nozzle cap shall be provided with a Buna-N rubber washer.
3. Hydrants shall be so arranged that the direction of outlets may be turned 90 degrees without interference with the drip mechanism or obstructing the discharge from any outlet. The body of the hydrant shall be equipped with a breakable flange, or breakable cast iron flange bolts, just above the grade line.
4. A bronze or rustproof steel nut and check nut shall be provided to hold the main hydrant valve on its stem.
5. Hydrant valve opening shall have an area at least equal to that area of a 5¼-inch minimum diameter circle and be obstructed only by the valve rod. Each hydrant shall be able to deliver 500 gallons minimum through its two 2½-inch hose nozzles when opened together with a loss of not more than 2 psi in the hydrant.
6. Hydrants shall be designed for installation in a trench that will provide minimum cover as noted on Drawings and for the flange to be 3 1/2-inches above ground surface. Hydrant extensions shall be as manufactured by the company furnishing the hydrants and of a style appropriate for the hydrants as furnished.
7. Hydrants shall be provided with an automatic and positively operating, non-corrodible drain or drip valve so as to drain the hydrant completely when the main valve is shut. A drain valve operating by springs or gravity is not acceptable.
8. Operating stems whose threads are located in the barrel or waterway shall be of manganese bronze, everdur, or other high-quality non-corrodible metal, and all working parts in the waterway shall be bronze to bronze.
9. Hydrants shall open by turning operating nut to left (counter-clockwise) and shall be marked with a raised arrow and the word "open" to indicate the direction to turn stem to open hydrant.
10. Hydrants shall be furnished with caps, double galvanized steel hose cap chain, galvanized steel pumper hose cap chain, a galvanized steel chain holder and any other hooks and/or appurtenances required for proper use.
11. Hydrant operating nut shall be AWWA Standard pentagonal type measuring 1½-inch point to flat.
12. Hydrants shall be hydrostatically tested as specified in AWWA C502.
13. M. Hydrants shall be of the following:
  - (a) Mueller Company – FH85
  - (b) American Flow Contril – B84B
  - (c) CLOW Corporation – F2545
14. All iron work to be set below ground, after being thoroughly cleaned, shall be painted with two (2) coats of asphalt varnish specified in AWWA C502. Iron work to be left above ground shall be factory primed and painted silver using a high grade enamel paint of quality and color to correspond to the present standard of the City.
15. Fire hydrants shall be installed on the same side of the street or roadway as the water main and shall be installed plumb and true.
16. Heel and thrust blocks shall be placed in undisturbed soil as shown in the details of the Drawings.
17. Double blue reflector "HYE – LITES" brand as manufactured by pavement markers ink shall be installed at the centerline of the street or roadway perpendicular to the hydrant.

#### G. Pressure/Flow Control Valves

All control valves to regulate pressure, flow, etc., in City lines shall be models listed in the City of Pflugerville Standard Products List (SPL) Item "Pressure Reducing Valves."

H. Drain Valves

Drain valve materials and installation shall conform to City of Pflugerville Standard Detail No. 511S-9.

I. Valve Stem Extensions:

Valve stem extensions shall consist of a single piece of the required length with a socket on one end and a nut on the other.

J. Flanges:

Flanges shall be cast solid and faced accurately at right angles to the axis of the casting. Dimensions and drilling of flanges shall be in accordance with the American Standard Association for a working pressure of 125 pounds per square inch. Special drilling shall be provided where necessary.

K. Corporation Stops:

Corporation stops shall be brass, not less than 1-inch in diameter and shall be installed where shown, specified or required and shall comply with the City of Pflugerville SPL Item "Brass Goods." All corporation stops shall have a 2" square operating nut.

Provide corporation stops as manufactured by the following:

1. Ford Company
2. Mueller
3. A.Y. McDonald Mfg. Co.

511S.4 - Construction Methods

A. Delivery, Storage and Handling

Deliver materials to the site to ensure uninterrupted progress of the work.

Protect threads and seats from corrosion and damage. Rising stems and exposed stem valves shall be coated with a protective oil film which shall be maintained until time of use.

Provide covers for all openings.

1. All valves three (3) inches and larger shall be shipped and stored on site until time of use with wood or plywood covers on each valve end.
2. All valves smaller than three (3) inches shall be shipped and stored as above except that heavy card board covers may be furnished instead of wood.

Store equipment to permit easy access for inspection and identification. Any corrosion in evidence at the time of City acceptance shall be removed, or the valve shall be removed from the job. Store all equipment in covered storage off the ground.

B. Setting Valves, Tapping Sleeves, Drains and Air Releases

Unless otherwise indicated, main line valves, drain valves and piping, air and vacuum release assemblies and other miscellaneous accessories shall be set and jointed in the manner described for cleaning, laying, and jointing pipe. During Installation of all valves and appurtenances, the Contractor shall verify that all items are clean, free of defect in material and workmanship, and function properly. All valves shall be closed and kept closed until otherwise directed by the City.

Unless otherwise indicated, valves shall be set at the locations shown on the Drawings and such that their location does not conflict with other appurtenances such as curb ramps. Valves shall be cleaned and manually operated before installation. Buried valves and valve boxes shall be set with the stem vertically aligned in the center of the valve box. Valves shall be installed so that the tops of operating

stems will be at the proper elevation required for the piping at the location indicated above; the top of the box or casing approximately 6 inches below the standard street subgrade in streets which are excavated for paving construction or where such excavation is scheduled or elsewhere as directed by the City or designated representative.

Valves shall be set on a firm foundation and supported by tamping pipe bedding material under the sides of the valve. The valve box shall be supported during backfilling and maintained in vertical alignment with the top flush with finish grade. The valve box shall be set so as not to transmit traffic loads to the valve. Before backfilling, all exposed portions of any bolts shall be coated with two (2) coats of bituminous paint.

Drainage branches or air blowoffs shall not be connected to any sanitary sewer or submerged in any stream or be installed in any other manner that will permit back siphonage into the distribution system (see City of Pflugerville "Standard Detail Drawings- Series 500/500S"). Every drain line and every air release line shall have a full-sized independent gate valve flanged directly to the main. Flap-valves, shear gates, etc., will not be accepted.

The City of Pflugerville shall be contacted, and their permission granted, prior to tapping a line. The required procedures and timetable shall be followed exactly. Installation shall be made under pressure and flow shall be maintained. The diameters of the tap shall be a minimum of 1/4-inch less than the inside diameter of the branch line. The entire operation shall be conducted by workers experienced in the installation of tapping sleeves and valves. The tapping machine shall be furnished by the Contractor. Determine the location of the line to be tapped to confirm that the proposed location will be satisfactory and that no interference will be encountered such as joints or fittings. No tap or sleeve will be made closer than three (3) feet from a pipe joint.

A tapping sleeve and valve with boxes shall be set squarely centered on the line to be tapped. Adequate support shall be provided under the sleeve and valve during the tapping operation. Thrust blocks or other permanent restraint acceptable to the City shall be provided behind all tapping sleeves. Proper tamping of supporting pipe bedding material around and under the valve and sleeve is mandatory for buried installations.

After completing the tap, the valve shall be flushed to ensure that the valve seat is clean. All proper regulatory procedures (including disinfection) shall be followed exactly.

Conduct a functional field test of each valve, including actuators and valve control equipment, in presence of Engineer or the Representative of the City to demonstrate that each part and all components together function correctly. All testing equipment required shall be provided by the Contractor at his/her sole expense.

### C. Setting Fire Hydrants

Fire hydrants shall be set at the locations as shown on the Plans and bedded on a firm foundation. Hydrants and connecting pipe shall have at least the same depth of cover as the distributing pipe. A drainage pit as detailed on the Plans shall be filled with 3/4-inch washed rock gravel and compacted. The hydrants shall be set upon a slab of concrete not less than four (4)-inches thick and 15-inches square. During backfilling, additional screened gravel shall be brought up around and six (6) inches over the drain port. Each hydrant shall be set in true vertical alignment and properly braced.

2,500 psi concrete thrust blocks shall be placed between the back of the hydrant inlet and undisturbed soil at the end of the trench. Minimum bearing area shall be as shown on the Plans. Eight (8) mil. Polyethylene film shall be placed around the hydrant elbow before placing concrete. CARE SHALL BE TAKEN TO ENSURE THAT CONCRETE DOES NOT PLUG THE DRAIN PORTS.

All connections from the main to the fire hydrants shall be anchoring mechanical joints designed to prevent movement due to thrust or pressure.

The hydrant shall be tied to the pipe with suitable rods or clamps and shall be coated with Koppers 300 or approved equal at a minimum of 8 mil. thick. Bolts shall have a zinc bolt cover per AWWA. Hydrant paint shall be touched up as required after installation.

Fire hydrants shall be factory primed and painted silver using a high-grade enamel.

D. Pressure Taps: Refer to Section 510.3 (24) of Standard Specification Item Number 510, "Pipe."

E. Plugging Dead Ends

Standard plugs shall be inserted into the bells of all dead ends of pipes, tees or crosses and spigot ends shall be capped. All end plugs or caps shall be secured to the pipe conforming to Section 510.3 (22) of Standard Specification Item Number 510, "Pipe."

F. Protective Covering

Unless otherwise indicated, all flanges, nuts, bolts, threaded outlets and all other steel component shall be coal tar coated and shall be wrapped with standard minimum 8-mil low density polyethylene film, with all edges and laps taped securely to provide a continuous and watertight wrap. Repair all punctures of the polyethylene, including those caused in the placement of bedding aggregates, with duct tape to restore the continuous protective wrap before backfilling. For reclaimed water piping, the polyethylene shall be purple.

G. Valve Box, Casing and Cover

Stems of all buried valves shall be protected by valve box assemblies. Valve box castings shall conform to ASTM A 48, Class 30B. Testing shall be verified by the manufacturer at the time of shipment. Each casting shall have cast upon it a distinct mark identifying the manufacturer and the country of origin. Valve boxes and covers for potable water shall be round. Valve boxes and covers for reclaimed water piping shall be square and shall have "Reclaimed Water" indicated on the lid.

H. Drain Valve Installations

Refer to City of Pflugerville Standards 511S-9A.

I. Air Release Assemblies

Refer to City of Pflugerville Standards 511S-1A, 511S-1B, 511S-2A, 511S-2B, 511S-3A and 511S-3B.

J. Pressure/Flow Control Valves

Assemblies shall be installed as indicated.

K. Connections to Existing System

Refer to Item No. 510, "Pipe" for connections to the existing system.

L. Shutoffs

Refer to Item No. 510, "Pipe" for shutoffs.

#### 511S.5 - Measurement

All types of valves will be measured per each. Fire hydrants and drain valve assemblies will be measured per each. Fire Hydrant barrel extensions will be measured per vertical foot. Pressure/Flow control valve assemblies and both manual and automatic air release assemblies will be measured per each.

Bury depths exceeding 5.5 feet are defined as Additional Bury Depths. Additional bury depths will only be measured if indicated on the Drawings and identified in the Standard Contract Bid Form 00300U; otherwise, the unit bid price for each completed unit includes all depths.

511S.6 - Payment

Payment shall include full compensation, in accordance with the pay item established in the bid, for excavation, furnishing, hauling and placing valves, drain valve assemblies, fire hydrants and barrel extensions including anchorage and all incidental materials and work; preparing, shaping, dewatering, bedding, placing and compacting backfill materials and for all other incidentals necessary to complete the installation, as indicated in the Drawings, complete in place.

Payment for iron fittings and for wet connections is covered in Section 510.6 of Standard Specification Item 510, "Pipe."

Payment for excavation safety systems is covered in Section 509S.10 of Standard Specification Item 509S, Excavation Safety Systems.

- A. Valves: Valves will be paid for at the unit bid price for the size and type valve installed, including valve stem casing and cover, excavation and backfill, setting, adjusting to grade, anchoring in place, and other appurtenances necessary for proper operation.
- B. Fire Hydrants: Fire Hydrants installation shall be paid for at the unit bid price, which includes all necessary labor and materials to set, adjust to grade and anchor the hydrant body, barrel extensions, concrete block, gravel drain and other appurtenances necessary for proper operation; but shall not include pipe and valve between the main line and fire hydrant base. The 6 inch connection pipe, 6 inch gate valve, test station, concrete collar, thrust block, drain pit, concrete pad, rods, bolts, paint, protective coatings and fittings for fire hydrants shall not be paid for separately. Fire hydrants shall be furnished with the proper length of barrel to comply with these Specifications. Reflectorized pavement markers shall be installed at the centerline of the street or roadway, perpendicular to the hydrant. Barrel extensions and reflectorized pavement markers will not be measure and paid for separately.
- C. Pressure or Flow Control Valve Assemblies: Pressure control and flow control valve assemblies will be paid for at the unit bid price, including box or vault, setting, adjusting to grade, anchoring in place, adjusting the control device to the required conditions, providing other appurtenances necessary for proper operation, and placing in operation.
- D. Drain Valve Assemblies: Drain valve installation shall be paid for at the unit bid price, which includes all necessary labor and materials to set, adjust to grade and anchor the bends, vertical piping, blind flange, joint restraint devices, concrete blocking, concrete pad the drain valve, setting, adjusting to grade, anchoring in place, and other appurtenances necessary for proper operation; but shall not include pipe and valve between the main line and drain valve buried bend.
- E. Air/Vacuum Release Valve Assembly: Automatic air-vacuum release assemblies will be paid for at the unit bid price and will include the main line tap or outlet, all pipe, valves, fittings, box or vault and cover, and other appurtenances necessary for proper operation.
- F. Reflectorized Pavement Markers: Pavement markers will be paid for at the unit bid price, which will include necessary surface preparation and adhesive, as per Standard Specification Item No. 863S.8.

Payment, when included as a contract pay item, will be made under one of the following:

<b>Pay Item No. 511S-A:</b>	Valves, _____ Type, _____ Diameter	Per Each.
<b>Pay Item No. 511S-B:</b>	Fire Hydrants (See Standard No. 511S-17)	Per Each.
<b>Pay Item No. 511S-C:</b>	Pressure or Flow Control Valve Assemblies	Per Each.
<b>Pay Item No. 511S-D:</b>	Drain Valve Assemblies (See Standard No. 511S-9A)	Per Each.
<b>Pay Item No. 511S-E:</b>	Automatic Combination Air/Vacuum Release Valve Assembly, _____ Diameter.	Per Each.

END

## ITEM NO. 551S - PIPE UNDERDRAINS

### 551.1 - Description

This item shall consist of pipe underdrains embedded in filter material, constructed at such places as indicated and in accordance with lines and grades established by Engineer. This item shall also consist of any pumping, bailing, drainage and Item No. 509, "Excavation Safety Systems" for trench walls, when indicated.

### 551.2 - Materials

#### (1) Pipe

The following materials will be permitted as alternates unless type is indicated. Size indicated shall be inside diameter. Pipe shall meet the following requirements:

##### **Type 1 Polyvinyl Chloride Pipe**

Pipe shall be Schedule 40 and conform to ASTM D 1785.

##### **Type 2 High Density Polyethylene Pipe**

Pipe shall conform to ASTM F2619 / F2619M.

##### **Type 3 Perforated Polyvinyl Chloride Pipe**

Pipe shall be Schedule 40 and conform to ASTM D 1785. Unless otherwise specified, the perforated pipe shall have two rows of holes 1/2 in. in diameter on 5 in. centers, with allowable tolerances of 1/16 in. on the diameter and +1/4, -0 in. on the spacing, and the rows shall be parallel to the axis of the pipe and  $120 \pm 5^\circ$  apart.

#### (2) Filter Material

##### (a) Aggregate

Filter material for use in backfilling trenches under, around and over underdrains shall consist of hard, durable, clean, washed gravel or crushed stone, ranging in size from 5/8 to 1 inch and shall be free from organic matter, clay balls or other deleterious matter.

##### (b) Geotextile

Geotextile shall conform to TxDOT DMS – 6200 "Filter Fabric".

### 551.3 - Construction Methods

Excavation of each trench shall begin at its outlet and proceed toward its upper end. Trench must not be excavated below proposed grade line and shall be located as indicated or as directed by Engineer and true to line and grade. Trench shall be dressed with a tile hoe or shovel in such manner that will facilitate placement of underdrain. Closed joints shall be coupled with bands, solvent weld couplings or integral joints. Perforated ABS pipe shall be jointed by couplers or solvent welding according to manufacturer's recommendation. No tar paper strips shall be used.

Approved plugs shall be placed in upper ends of pipes and exposed ends of underdrains shall be covered with 1/2 inch galvanized hardware cloth and filter fabric.

When indicated, concrete riprap or headwalls of dimensions indicated shall be constructed at outlet ends of pipe underdrains. Concrete materials and proportions shall conform to requirements specified for Class B Concrete conforming to Item No. 403, "Concrete for Structures".

When perforated metal pipe is used and trench is founded in pervious material, a thin layer of tamped impervious material shall be placed on bottom of trench as indicated or as directed by Engineer. Sections shall be jointed with band couplers.

When concrete pipe is used and trench is founded in pervious material, a bottom course of specified filter material shall be placed and tamped to a uniform depth of 2 inches. Pipe shall then be firmly embedded in filter material, hub upgrade and spigot firmly centered into adjacent hub end or in the case of butt end type drains with an open joint of approximately 3/8 inch. Open joints shall then be covered with approved 2 ply tar paper strips not less than 6 inches in width and of sufficient length to permit ends being turned outward and laid flat on bottom course of filter material of each side for a distance of 3 inches. When trench is founded in impervious material, the 2 inch bottom course of filter material shall be omitted, pipe laid directly in trench and filter material placed in trench to a depth of 2 inches on each side of pipe. Two ply tar paper strips shall then be placed as specified above.

#### 551.4 - Measurement

Work and accepted materials for "Pipe Underdrains" shall be measured by the linear foot of pipe measured along slope and shall include clearing, excavation, filter material, filter fabric, pipe, length of elbows, wyes, tees and other branches and backfill.

#### 551.5 - Payment

Work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit price bid per linear foot of "Pipe Underdrains" of type and size specified, which price shall be full compensation for furnishing and placing materials, for underdrain excavation and backfill, for filter materials, for plugs and screens and for labor, tools, equipment and incidentals necessary to complete the work.

Any riprap, headwalls or Trench Safety System indicated will be measured and paid for in accordance with provisions of Item No. 403, "Concrete for Structures", Item No. 410, "Concrete Structures", Item No. 509, "Excavation Safety Systems" and Item No. 591, "Riprap for Slope Protection".

Payment will be made under:

<b>Pay Item No. 551S-A:</b>	Pipe Underdrains, In.	Per Linear Foot.
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**END**



## ITEM NO. 558 - STRUCTURAL PLATE STRUCTURES

### 558.1 - Description

This item shall consist of furnishing and installing structural plate pipes, pipe arches, arches and special shapes conforming to these specifications, of the sizes, out dimensions and materials indicated at locations indicated or as directed by the Engineer, in conformity with established lines and grades. Structural plate pipes shall be furnished round or elongated, as indicated.

### 558.2 - Materials and Manufacture

#### (1) Plates

The plates and fasteners used for construction of structural plate pipes, pipe arches, arches, underpasses, box culverts and special shapes shall conform to AASHTO M 167 for galvanized corrugated steel structures and to AASHTO M 219 for aluminum alloy structures.

Steel fasteners may be mechanically galvanized or hot-dip galvanized.

Steel plates shall consist of structural units of corrugated galvanized metal. Single plates shall be furnished in standard sizes to permit structure length increments of 2 feet. Plates will have approximately a 2-inch lip beyond each end crest, which results in the actual length of a given structure being approximately 4 inches longer than the nominal length, except when skewed or beveled. Footings for arches shall be designed and constructed to accommodate this additional length.

Aluminum plate shall consist of structural units of corrugated aluminum alloy. For aluminum alloy structures, cut plates shall be furnished on structure ends to permit structure length increments of 1 foot.

Plates shall be formed to provide bolted lap joints. The bolt holes shall be so punched that all plates having like dimensions, curvature and the same number of bolts per foot of seam shall be interchangeable. Each plate shall be curved to the proper radius so that the cross-sectional dimensions of the finished structure will be as indicated. Joints shall be staggered so that not more than 3 plates are jointed at any one point. Unless otherwise indicated, bolt holes along those edges of the plates that will form longitudinal seams in the finished structure shall be (a) staggered in rows 2 inches apart, with 1 row in the valley and 1 in the crest of the corrugations and not less than 4 bolts per foot for galvanized steel structures or (b) in rows  $1\frac{3}{4}$  inches apart with 2 bolts in each valley and on each crest and not less than 16 bolts per 3 feet for aluminum alloy structures. Bolt holes along those edges of the plates that will form circumferential seams in the finished structure shall provide for a bolt spacing of not more than 12 inches. The minimum distance from center of hole to edge of the plate shall be not less than  $1\frac{3}{4}$  times the diameter of the bolt. The diameter of the bolt holes in the longitudinal seams shall not exceed the diameter of the bolt by more than  $\frac{1}{8}$  inch. Plates for forming skewed or sloped ends shall be cut so as to give the angle of skew or slope specified. Burned edges shall be free from oxide and burrs, shall present a workmanlike finish and legible identification numerals shall be placed on each plate to designate its proper position in the finished structure.

#### (2) Metal Headwalls

The material for metal headwalls shall comply with details indicated.

When required, aluminum alloy inverts, toe walls, footings and closure plates shall conform to the material requirements for the aluminum structural plate structure. Extruded aluminum transverse stiffeners shall conform to ASTM B 221, Alloy 6061-T6.

(3) Concrete

Concrete and reinforcing steel shall conform to Item No. 403S, "Concrete for Structures" and Item No. 406S, "Reinforcing Steel". Unless otherwise indicated, concrete for footings and headwalls shall be Class A. Riprap for slope protection and for invert paving, when required, shall be Class B concrete, with reinforcement as indicated and shall conform to Item No. 591S, "Riprap for Slope Protection".

Material for membrane curing shall conform to Item No. 409S, "Membrane Curing".

558.3 - Visual Inspection

The Contractor shall furnish an itemized statement of the number and size of plates in each shipment. From this list a visual inspection shall include an examination of the plates for deficiency in size, radius of curvature specified and any evidence of poor as outlined herein. The inspection may include the taking of samples for chemical analysis and determination of weight of spelter coating. The plates making up the shipment shall fully meet the requirements of these specifications. Any plates failing to do so will be rejected.

558.4 - Mill and Factory Inspection

If the Engineer so elects, he may have the material inspected and sampled in the rolling mill or in the shop where fabricated. He may require from the mill the chemical analysis of any plate. The inspection, either in the mill or in the shop, shall be under the direction of the Engineer. The Engineer or his representative shall have free access to the mill or shop for inspection and every facility shall be extended to him for this purpose. Any material which has been previously rejected at the mill or shop and included in a later lot will be cause for rejection unless it has been satisfactorily repaired.

558.5 - Quality of Work

Structural plates on which the spelter coating has been damaged or which show substandard work, shall be rejected, except that damaged areas of spelter coating deemed by the Engineer to be of a minor nature may be repaired by painting with a zinc dust-zinc oxide paint conforming to individual plates but to the shipment as a whole. The following defects indicate substandard work and their presence in any individual structure plate will be cause for rejection:

- (a) Uneven laps
- (b) Elliptical shaping (unless specified)
- (c) Variation from a straight center line
- (d) Ragged edges
- (e) Loose, uneven lined or spaced bolts
- (f) Illegible brand
- (g) Bruised, scaled or broken spelter coating

(h) Dents or bends in the metal itself

#### 558.6 - Design

(1) Gage or Minimum Thickness and Corrugations for Structural Plate

The gage or minimum thickness and permissible corrugations of metal plates to be furnished for each structure will be as indicated.

(2) Skewed Structures

The end skew shall not exceed 45 degrees. When the skew of arches is more than 15 degrees, the length of the structure shall be such that no portion of the live load will be carried by the cut portion of the arch end. Where right of way or other conditions do not permit the required length, the cut end shall be supported by a rigid headwall designed to meet the conditions. When the skew angle of pipes exceeds 20 degrees and the structure has the ends cut to fit a slope, the ends shall be reinforced with concrete riprap or other suitable end treatment as indicated on the plans or as directed by the Engineer. If headwalls are required, the plates shall be anchored to the headwall with not less than 3/4 inch diameter by 6-inch minilength bolts, at not over 19 inch centers. If structures are to have skewed ends, bevels, step-bevels or other special end treatment, this information will be indicated.

(3) Multiple Structures Installed in Parallel Lines

Where multiple lines of pipes, pipe arches or box culverts greater than 48 inches in diameter or span are used, they shall be spaced so that adjacent sides of the pipe shall be at least 1/2 diameter or 3 feet apart, whichever is less, to permit adequate compaction of backfill material. For diameters up to and including 48 inches, the minimum spacing shall be not less than 24 inches.

(4) Substructure for Arches

The substructure for structural plate arches shall be as indicated.

#### 558.7 - Designation of Type

The type(s) of structure will be indicated by one of the following descriptions:

Structural Plate Pipe (Galv. Steel)

Structural Plate Pipe (Alum.)

Structural Plate Pipe Arch (Galv. Steel)

Structural Plate Pipe Arch (Alum.)

Structural Plate Arch (Galv. Steel)

Structural Plate Underpass (Galv. Steel)

Structural Plate Underpass (Alum.)

Structural Plate Long Span Structures (Galv. Steel)

Structural Plate Long Span Structures (Alum.)

When designated as one of the above types without the material being shown, Contractor may furnish the structure in either galvanized steel or aluminum.

#### 558.8 - Construction Methods

##### (1) Excavation

All excavation shall conform to Item No. 401S, "Structural Excavation and Backfill". Trenches for pipes, pipe arches, underpasses or box culverts shall be of sufficient width to provide free working space for erection and thorough tamping of the backfill and bedding material under and around the structure. If the quality of the native soil is less than that of the proposed backfill material, the excavation shall extend, to each side of the barrel, a minimum horizontal distance of half the span or 2/3 of the total rise, whichever is greater. The Contractor shall make such temporary provisions as may be necessary to insure adequate drainage of the trench and bedding during the construction operation.

##### (2) Foundations, Structural Plate Structures with Metal Inverts

These structures shall be bedded in a foundation of sandy earth material carefully and accurately shaped to fit the lower part of the pipe for at least 10 percent of its overall height, except that the length of bedding arc need not exceed the width of the bottom plate. The sandy material shall be at least 3 inches in thickness so as to obtain uniform seating of the corrugations on the pipe bed. For culverts the bedding specified herein shall be the full width of the invert.

Where rock, in either ledge or boulder formation, is encountered, it shall be removed below grade and replaced with a compacted earth cushion having a thickness of not less than 1/2 inch per foot height of fill over the top of the pipe, with the minimum allowable thickness of 12 inches and a maximum of 24 inches under the pipe. Where the soil encountered at the established grade is a quicksand, muck or similar unstable material, it shall be removed and replaced in conformance with Item No. 401S, "Structural Excavation and Backfill". Special bedding, when required, shall be as indicated.

##### (3) Foundations, Structural Plate Structures with Reinforced Concrete Footings

Footings for these structures shall be formed and finished to true lines and grades as established by the Engineer. Anchors or slots (for box culverts) shall be set to true line and grade when placing concrete for each substructure unit. The work of placing substructure units shall conform to Item No. 403S, "Concrete for Structures", Item No. 406S, "Reinforcing Steel" and Item No. 410S, "Concrete Structures".

Footing shall be placed entirely on (a) rock, shale or similarly hard material or (b) firm soil or compacted soil cushion. When part of the founding area is rock, it shall be undercut and replaced with a minimum 12 inch thick compacted soil cushion. When a thin layer of soil is partially covering rock within the bearing area and when practical to do so, the soil may removed and the footings place directly on rock as indicated.

##### (4) Erection

Structural plate structures shall be installed as indicated and in accordance with this item.

Any steel in joints which is not protected by galvanizing shall be coated with suitable asphaltum paint.

Pipes and/or plates shall be handled carefully to avoid damage to any protective coating. Damaged coatings shall be repaired.

Anchor bolts used for anchoring plates to headwalls or other concrete end treatment shall be 3/4 inch diameter by 6 inch minimum length on not more than 19 inch centers.

No plates for arch structures shall be placed until the substructure has cured for a minimum of 3 days.

When all plates are in position, all bolts not already in place shall be inserted and all nuts tightened progressively and uniformly, beginning at one end of the structure. All nuts shall be tightened a second time to a torque of not less than 150 ft-lbs nor more than 300 ft-lbs for steel bolts and not less than 100 ft-lbs nor more than 150 ft-lbs if using aluminum bolts. It is essential that bolts be well if an impact wrench is used, a sufficient number of bolts should be checked with a long-handled, structural or socket wrench or a torque wrench to insure that they are properly tightened. All service bolts used in drawing the plates together shall be replaced with standard high strength bolts.

(5) Shape Control

The Contractor shall furnish acceptable shape control devices for monitoring the horizontal and vertical shape of the structure(s). The shape shall be kept within 2 percent of design measurements (span or rise, whichever is greater) or 5 inches whichever is less during erection and backfilling.

(6) Backfilling

Backfilling and/or construction of the embankment around and over the pipe is a critical phase of the construction and strict adherence to these construction methods is required. Backfilling and/or embankment construction around the pipe shall conform to Item No. 401S, "Structural Excavation and Backfill", except as modified herein.

Within vertical planes 2 feet beyond the horizontal limits of the structure and until a minimum of 2 feet of cover has been compacted over the structure, only hand operated, mechanical tamping equipment will be permitted.

Unless otherwise indicated or permitted in writing by the Engineer, no heavy earth moving equipment will be permitted to haul over the structure until a minimum of 4 feet of permanent or temporary, compacted fill has been placed thereon. Plates or structures damaged by the Contractor's equipment during backfilling operation shall be removed and replaced by the Contractor at his expense.

During the backfilling operations, extreme care shall be taken to avoid unequal pressures and to obtain uniformly compacted backfill material of uniform density throughout the length of the structure and to insure proper backfill under the structure.

Prior to adding each new layer of loose backfill material, until a minimum 2 feet of cover is obtained, an inspection will be made of the inside periphery of the structure to determine any local or unequal deformation caused by improper construction methods.

The structure shall be backfilled so that when backfill is complete the inside dimensions shall be within tolerances set forth in shape control above. In the case of arches (does not apply to pipe arches) when backfilling is completed before headwalls are placed, the first material shall be placed midway between the ends of the arch, forming as narrow a ramp as possible until the top of the arch is reached. The ramp shall be constructed evenly from both sides and the backfilling material shall

be thoroughly compacted as it is placed. After the 2 ramps have been constructed to the top of the arch, the remainder of the backfill shall be deposited from the top of the arch both ways from the center, to the ends and as evenly as possible on both sides of the arch. If the headwalls are built before the arch is backfilled, the fill material shall be placed first adjacent to one headwall until the top of the arch as been reached, after which the fill shall be dumped from the top of the arch toward the other headwall, with care being taken to deposit the material evenly on both sides of the arch.

For multiple structures the same backfill phases will be performed for all structures more or less simultaneously. Backfilling between the barrels will usually require that the material be placed with a crane and bucket or other suitable equipment. Backfill material shall not be dropped over the top arch so that damage to the flexible structure will result. Compaction of this backfill shall be with hand operated tampers or other acceptable equipment.

**558.9 - Measurement**

Structural plate pipes, pipe arches, arches or special shapes of the gage or minimum thickness and corrugation indicated will be measured by the linear foot of each structure along its flow line between the ends of the structure.

For multiple structures, the measured length will be the sum of the lengths of barrels as prescribed above.

Aluminum alloy inverts, toe walls, footings, closure plates and stiffeners, when required, will be considered a part of the requirements of the structure and will not be measured for payment.

**558.10 - Payment**

Payment for "Structural Plate Pipes, Pipe Arches, Arches or Special Shapes", measured as prescribed above, will be made at the unit price bid for the various sizes, gage or minimum thickness and of the required material, if specified, of the various items required by the plans, complete in place.

This payment shall be full compensation for furnishing, transporting and erecting; for handling and placing of select fill material; for all bolts, nuts, washers, anchor bolts and anchor channels or angles; for furnishing all aluminum alloy inverts, toe walls, footings, closure plates and stiffeners, when required; and for all other items of material, labor, equipment, tools and incidentals necessary to complete the various installations in accordance with these specifications.

Payment will be made under one of the following:

<b>Pay Item No. 558-A:</b>	Structural Plate Pipe, _____ , _____	Per Linear Foot.
<b>Pay Item No. 558-B:</b>	Structural Plate Pipe Arch, _____ , _____	Per Linear Foot.
<b>Pay Item No. 558-C:</b>	Structural Plate Arch, _____ , _____	Per Linear Foot.
<b>Pay Item No. 558-D:</b>	Structural Plate Underpass, _____ , _____	Per Linear Foot.
<b>Pay Item No. 558-E:</b>	Structural Plate Box Culvert, _____ , _____	Per Linear Foot.

**End**

## ITEM NO. 559S - PORTLAND CEMENT CONCRETE BOX CULVERTS

### 559S.1 - Description

This item governs the materials used and the constructing, furnishing and placing of concrete box culverts (boxes) on a prepared grade at the location shown on the Drawings and in accordance with Standard Detail 559S-1, "Fabrication Tolerances for Precast Box Culverts". Unless indicated otherwise on the Drawings, the Contractor shall have the option of furnishing cast-in-place, precast (formed) or precast (machine made) concrete box culverts.

When cast-in-place box culverts are used, they shall conform to the details indicated on the Drawings and Standard Detail 559S-1, "Fabrication Tolerances for Precast Box Culverts" along with the requirements for Standard Specification Item No. 403S, "Concrete for Structures" and Standard Specification Item No. 410, "Concrete Structures".

The manufacturing of precast box culverts shall conform to the requirements of the current version of ASTM C1577. When precast box culverts are used under traffic, the design loads shall consist of the impact load, dead load and live load [AASHTO LRFD Bridge Construction Design Specifications - greater of: Truck Axle load (32Kf {identical to HS-20load axial load of 32Kf}) or Tandem Axle load (2 at 25Kf each)].

### 559S.2 - Submittals

The submittal requirements of this specification item include for both cast-in-place and precast boxes:

- A. The foundation plan and drilling/excavation details;
- B. Class C and S Portland Cement (PC) concrete mix design for cast-in-place boxes;
- C. Anchor bolt plan and details;
- D. Reinforcing Steel details and placement drawings;
- E. Casting plan and details (if required);
- F. Certification of compliance with HL93 Liveload design standards;
- G. Bedding Material;
- H. Joint design;
- I. List of joint sizes showing the minimum size of sealant material to be used with each size joint, along with complete instructions on recommended installation procedures;
- J. Test results of the hydrostatic performance testing of the joints, if requested by the City;
- K. Box Culvert manufacturer's recommended final joint opening (gap) dimension on the inside of the installed box;
- L. Certification from the QCast Program, which provides a third party certification auditing firm to certify that the manufacturing plant is producing boxes based on the requirements of the National Precast Concrete Association;

- M. Inspection procedures to be used by the manufacturer for quality control and assurance for materials; and
- N. 5000 psi Concrete mix design for machine made boxes.

#### 559S.3 - Quality Control

Manufacturers of concrete boxes shall have a quality management system certified by the QCast Program following the requirements of the American Concrete Pipe Association (ACPA) Plant Certification Manual. Manufacturers of concrete boxes, inlets and storm water manholes shall have a quality control program consisting of one or more of the following: 1) a quality management system certified by the QCast Program following the requirements of the ACPA Plant Certification Manual, 2) a quality management system certified by the National Precast Concrete Association. 3) a quality control program approved by the OWNER prior to submittal of bids for the PROJECT, or 4) an independent, third party quality control testing and inspection firm for testing and inspecting box culverts produced for the PROJECT and approved by the OWNER prior to submittal of bids for the PROJECT.

All such quality control programs shall be paid for by the manufacturer. It is the intent of this requirement that the manufacturer will document all appropriate tests and inspections with sampling and inspection criteria, frequency of testing and inspection, date of testing and inspection and date on which every piece was manufactured. Required testing and inspection, including that by an independent, third party, shall be performed full-time during production of box culverts for the PROJECT. When requested by the OWNER, the manufacturer will provide copies of test data and results and inspection reports with the shipment of box culverts for the PROJECT. Test data and results and inspection reports shall be traceable to specific box culverts lots or pieces. Owner approval of the manufacturer's quality control program will expire after three years, at which time the manufacturer must present a current quality control program for approval.

The quality of materials and, the process of manufacturing and furnishing box culverts shall be subject to inspection and approval by the E/A at the box culvert manufacturing plant and at the project site prior to and during installation. Plant inspections shall be conducted at the discretion of the City Representative. Only manufacturers having a quality control program of the type described above will be considered as approved providers of concrete box culverts and storm water manholes.

#### 559S.4 - Materials

##### A. Concrete

Class C Concrete shall be used for cast-in-place and precast (formed) box culverts conforming to the requirements of Standard Specification Item No. 403S, "Concrete Structures" and Standard Specification Item No. 410S, "Concrete for Structures", except that Class S PC Concrete will be required for the top slab of direct traffic boxes.

PC concrete for precast (machine made) boxes shall conform to the current version of ASTM C 1577 and shall have a minimum 28-day compressive strength of 5,000 psi.

##### B. Reinforcement

Reinforcing steel for cast-in place and precast (formed) box culverts shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

Reinforcing steel for machine made boxes shall in accordance with ASTM C1577.



### C. Jointing Material

Unless otherwise shown on the drawings, when installing box culverts, the Contractor shall have the option of making joints with preformed flexible joint sealants or with rubber gaskets. Preformed flexible joint sealants for box culvert joints shall comply with ASTM C990, and rubber gaskets for box culvert joints shall comply with ASTM C1677. Mortar shall not be used to seal pre-fabricated joints. Box culvert joint shall be designed to prevent the flow of solids through the joint.

### D. Membrane Curing

Materials for membrane curing for cast-in-place and precast (formed) box culverts shall conform to Standard Specification Item No. 409S, "Membrane Curing". Materials for membrane curing for machine made boxes shall be in accordance with ASTM C1577.

### E. Admixtures

Admixtures for all box culverts shall conform to Standard Specification Item No. 405S, "Concrete Admixtures". Air entraining admixtures shall be added to the mixture to produce concrete with not less than 4, nor more than 7 percent, air content by volume.

### F. Granular Backfill

Materials for Granular Backfill shall conform to Standard Specification Item No. 210S, "Flexible Base".

### G. Foundation Rock

Bedding material shall be 1-inch to 3-inch diameter clean gravel or crushed gravel or crushed rock in conformance with Standard Specification Item No. 510 "Pipe."

### H. Geotextile Filter Fabric for Bedding Material

Geotextile filter fabric for bedding material shall be Webtec, Terra Tex NO 4 (AOS US Standard Sieve 70) geotextile fabric or approved equal.

### 559S.5 - Fabrication

The fabrication of machine-made precast boxes shall comply with ASTM C1577.

Forms for precast (machine made) boxes shall be made of steel. Forms for precast (formed) boxes may be either wood or steel. Forms shall be mortar-tight and of sufficient strength to prevent bulging or misalignment of adjacent boxes. They shall be constructed to permit their removal without damage to the concrete. Offsets at form joints shall not exceed 1/8 inch. Forms shall be clean and free of extraneous matter when PC concrete is placed.

Positive means of supporting steel cages in place throughout forming and PC concrete placement will be required and subject to the approval of the Engineer or designated representative. Welding of reinforcing steel will be permitted only where shown on the Drawings. Welding shall be done by a qualified welder.

Precast (machine made) boxes shall be cast by a process, which will provide for uniform placement of the PC concrete in the forms and compaction by mechanical devices, that will assure dense concrete. PC concrete shall be mixed in a central batch plant or other approved batching facility from which the quality

and uniformity of the PC concrete can be assured. Transit-mixed concrete will not be acceptable for use in precast (machine made) boxes.

Curing of precast boxes made in a commercial plant shall be by any one or by a combination of the following methods, which are compatible with the joint materials selected or as directed by the Engineer or designated representative.

A. Steam Curing

Boxes will be placed in a curing chamber, free from outside drafts and cured in a moist atmosphere maintained by the injection of steam for such time and temperature as necessary for proper curing. The curing chamber shall be constructed to allow full circulation of steam around the entire box. Steam outlets shall be positioned so that live steam is not applied directly to the PC concrete.

B. Water Curing

Boxes may be water cured by covering with water saturated cotton mats, polyethylene sheeting or polyethylene burlap blankets, by a system of perforated pipe or mechanical sprinklers, by porous hose or by other methods that will keep the boxes moist during the curing period. Water for curing shall conform to Standard Specification Item No. 403S, "Concrete for Structures".

C. Membrane Curing

Type 1 membrane curing compound may be used for interim curing or for complete curing. All surfaces shall be kept moist prior to the application of the curing compound and shall be damp when the compound is applied.

When used for interim curing, the curing compound shall be applied to the outside surface of the box upon removal of forms. It shall also be applied to the inside surface or a suitable covering may be placed over the box opening to protect the inside of the box against rapid drying.

When used for complete curing, curing compound shall be applied to the inside surface of the box when interim curing is applied or when handling strength has been attained, but not later than 24 hours after casting.

Curing shall not be delayed longer than 1 hour after the PC concrete has been placed in the forms or more than 1/2 hour after removal of forms, unless interim curing is applied.

Precast boxes made in a commercial plant shall be continuously cured for a period of 3 days after reaching handling strength or until the design strength has been attained. Curing may be interrupted for no more than 30 minutes for form removal and no more than 4 hours for removal to a storage area and resumption of curing. All precast boxes shall be protected from freezing during the curing period.

A curing day is a calendar day when the air temperature, taken in the shade away from artificial heat, is above 50°F for at least 19 hours or for colder days if satisfactory provisions are made to maintain the temperature at all surfaces of the concrete above 50°F for the entire 24 hours.

Test cylinders shall be cured at the same time and in the same manner as the boxes.

Not more than 4 lifting holes may be provided in each box to facilitate handling. They may be cast-in, cut into the fresh PC concrete after form removal or drilled and shall not be more than 2 inches in

diameter or 2 inches square. Cutting or displacement of reinforcement will not be permitted. Spalled areas around the holes shall be repaired. Concrete boxes shall be given an ordinary finish conforming to Standard Specification Item No. 410S, "Concrete Structures".

Precast boxes of either type, made in a plant, shall bear the following marking:

The name or trademark of the manufacturer;

The date of manufacture;

The box size and height of fill.

When fitting holes are not provided, one end of each box section shall be clearly marked on the inside and outside walls to indicate the top and/or bottom as it will be installed.

Marking shall be indented into the box or may be painted thereon with waterproof paint.

#### D. Grout and Bentonite Slurry Injection Holes

Box culvert sections installed by trenchless tunneling and jacking method shall have drilled or fabricated grout injection holes and bentonite slurry injection holes as required by Standard Specification Item No. 501S "Tunneling or Boring Pipe" and its special provision. Injection holes shall be 1½ inch minimum diameter with plugs cast into the box culvert at the time of manufacture.

#### 559S.6 - Testing

Precast box culverts made in a commercial plant shall be tested and accepted in accordance with ASTM C1577.

Testing of cast-in-place and precast (formed) box culverts shall conform to Standard Specification Item No. 403S, "Concrete for Structures".

#### 559S.7 - Fabricating Tolerances

Tolerances for precast boxes of either type shall conform to the following:

- A. The inside vertical and horizontal dimensions shall not vary from plan requirements more than + 1/2 inch.
- B. The horizontal or vertical plane at each end shall not vary from being perpendicular to the top and bottom by more than 1/2 inch when measured diagonally between opposite interior corners of the end section.
- C. The sides of a section at each end shall not vary from being perpendicular to the top and bottom by more than 1/2 inch when measured diagonally between opposite interior corners of the end section.
- D. The thickness of walls and slabs shall not be less than that required by the Drawings, except that an occasional deficiency not greater than 1/4 inch, will be acceptable. If proper jointing is not affected, thicknesses in excess of Drawing requirements are acceptable.
- E. The straightness of the tongue and groove at the mating surface shall not vary by more than 1/4 inch.

Deviations from the above tolerances will be acceptable if the box sections can be fitted at the plant or job site and it is determined that an acceptable joint can be made. For this condition, an acceptable joint is:

When 2 box sections are fitted together on a flat surface in proper alignment and in the position they will be installed, the longitudinal opening at any point shall not exceed 1 inch. Box sections accepted in this manner shall be match-marked for installation.

#### 559S.8 - Defects and Repair

Fine cracks or checks on the surface of the member which do not extend to the plane of the nearest reinforcement will not be cause for rejection unless they are numerous and extensive. Cracks, which extend into the plane of the reinforcing steel, but are acceptable otherwise, shall be repaired in an approved manner.

Small damaged or honeycombed areas, which are purely surface in nature, may be repaired. Excessive damage, honeycomb or cracking will be subject to structural review. Repairs shall be sound, properly finished and cured in conformance with the pertinent specifications.

When fine cracks or hairchecks on the surface indicate poor curing practices, further production of precast boxes shall be discontinued until corrections are made and proper curing provided.

#### 559S.9 - Storage and Shipment

Precast boxes shall be stored on level blocking in a manner acceptable to the Engineer or designated representative. No load shall be placed upon them until design strength is reached and curing completed. Shipment of boxes may be made when the design strength and curing requirements have been met.

#### 559S.10 - Construction Methods

Excavation and backfill shall conform to Standard Specification Item No. 401S, "Structural Excavation and Backfill" and Standard Specification Item No. 510, "Pipe", except where tunneling or jacking methods are required or indicated on the Drawings.

Precast concrete boxes shall be bedded on a foundation of firm stable material accurately shaped to conform to their base. When indicated on the Drawings, special bedding materials shall be provided.

The envelope shall extend the full trench width from a depth of 6" and shall rise to at least 12" above the box. Geotextile filter fabric shall be placed within the bedding envelope approximately 8" above the top of the box and covered with a minimum of 4" of bedding material to protect fabric during placement of compaction and backfill. Damaged fabric should be removed and replaced or overlapped at least 12".

Joints sealed with preformed flexible joint sealants shall comply with ASTM C990. Joints sealed with rubber gaskets shall comply with ASTM C1677. Install joint sealants in accordance with the box culvert and joint sealant manufacturers' recommendations. Place the joint sealer so that no dirt or other deleterious materials come in contact with the joint sealing material. Pull or push home the box culvert with enough force to properly seal the joint. Remove any joint material pushed out into the interior of the box culvert to be flush and smooth with the inside surface of the box culvert. Protrusion of joint material greater than 1/8 " into the interior of the box culvert shall be grounds for rejection of the box as installed. Observe joint sealant manufacturer's recommendations for installation temperature of the joint sealant. Apply joint sealant to box culvert joint immediately before placing box culvert section in trench, and then connect box culvert section to previously laid box culvert section.

Contractor shall provide video recording of installed box culverts, in accordance with the video recording work requirements of Standard Specification Item No. 510 "Pipe".

If video inspections reveals joints where soil infiltration is evident, or where joints or conduits are otherwise defective, then the contractor shall remove and replace all affected conduit or repair joints using joint repair techniques recommended by the manufacturer to achieve a completed system that meets all Contract requirements.

When precast boxes are used to form multiple barrel structures, they shall be placed in conformance with the details indicated on the Drawings. Materials to be used between barrels shall be as indicated on the Drawings.

Connections of precast boxes to cast-in-place boxes or to any required headwalls, wingwalls, riprap or other structures shall conform to the details indicated on the Drawings.

Lifting holes shall be filled with mortar or concrete and cured to the satisfaction of the Engineer or designated representative.

#### 559S.11 - Measurement

##### A. Cast in Place Box Culverts

The quantities of PC concrete of the various classifications, which will constitute the completed and accepted "Box Culverts" in place will be measured by the cubic yard based on the dimensions indicated on the Drawings.

##### B. Precast

Concrete box culverts of each size and type shall be measured by the lineal foot. The measurement will be made between the ends of the box along the central axis. For concrete boxes used in multiple barrel structures, the measured length will be the sum of the lengths of all barrels measured as described above.

#### 559S.12 - Payment

"Concrete Box Culverts" shall be full compensation for constructing, furnishing and transporting boxes; excavation; disposal of surplus or unusable excavated material; providing, hauling, placing, preparing and shaping bedding material and leveling courses; concrete, reinforcing steel; jointing of boxes; connections to existing systems or structures; connections to new systems or structures; preparing, shaping, pumping for dewatering up to 360 gpm; particle migration measures including geotextile filter fabric; hauling, moving, placing and compacting backfill materials; installation and maintenance of temporary pavement repairs; temporary removal and replacement of pavement, curb, drainage structures, driveways, sidewalks, and any other improvements damaged or removed during construction;; and all other items of material, labor, equipment, tools and incidentals necessary to complete this work in accordance with the Drawings and specifications.

Video recording shall be paid for under Standard Specification No. 510 "Pipe":

Payment will be made under one of the following:

<b>Item No. 559S-A:</b>	Precast Concrete Box Culverts, _____ Ft. x _____ Ft.	Per Lineal Foot.
<b>Item No. 559S-B:</b>	Cast in Place Concrete Box Culverts	Per Cubic Yard.

END

DRAFT

## ITEM NO. 591S - RIPRAP FOR SLOPE PROTECTION

### 591S.1 - Description

This item shall govern the excavation of all materials encountered for placing riprap, disposal of excess material and backfilling around the completed riprap to the grade indicated on the Drawings. The work shall include all pumping and bailing, furnishing and placing riprap of rock or concrete in accordance with the details and to the dimensions indicated on the Drawings.

The work conducted under this item pertains to riprap for protection of slopes, cuts, fills, drainage facilities and other features susceptible to erosion.

### 591S.2 - Submittals

The submittal requirements for this specification item shall include:

- A. The type, size, gradation, physical properties and source of rock riprap material; test data for specific gravity, absorption, soundness; and field verification of the rock riprap gradation including a size distribution plot and a list of the measured D15, D50, D85, and D100 (refer to Item No. 591S.3.A).
- B. The type, size, and source of broken concrete riprap material.
- C. Aggregate types, gradations and physical characteristics for the Portland Cement (PC) concrete mix.
- D. Proposed proportioning of materials for the mortar mix.
- E. Type, details and installation requirements for reinforcement, joint material, tie backs and anchors.
- F. Description of filter fabric including characteristics, test data and manufacturer's recommendations for installation.
- G. The type, size, gradation and source of granular filter material.

Where vegetated soil-riprap is used, and proposed materials differ from the materials already approved for use elsewhere on the project, the submittal requirements also include:

- H. Identification of the seed species, source, mixture, pure live seed (PLS) as listed on the analysis tags, certification tags from all seed bags, and seed calculation worksheet per Item No. 604S "Seeding For Erosion Control", Table 3.
- I. Soil retention blanket material type, evidence that the material is listed on the TxDOT Approved Products List, one (1) full set of manufacturer's literature and installation recommendations, and any special details necessary for the proposed application.
- J. Identification of fill soil class, source, and characteristics of proposed borrow material as described in Item No. 130S Borrow.
- K. Identification of topsoil source and characteristics including textural (clay/silt/sand) percentage.

591S.3 - Materials

A. Rock

The rock shall be suitable in all respects for the purpose intended. Rock sources shall be selected well in advance of the time the rock will be required and shall be pre-approved by the Engineer. Rock used for riprap shall be hard, durable, and angular in shape and consist of clean field rock or rough unhewn quarry rock as nearly uniform in section as practicable. Neither the width nor the thickness of a single rock shall be less than one-third of its length. The rocks shall be dense, resistant to weathering and water action, and free of overburden, spoils, shale, and organic material. Shale, chalk, and limestone with shale or chalk seams shall not be acceptable. Rounded rock (river rock) shall not be acceptable.

The rock durability shall be evaluated by laboratory tests for specific gravity, absorption, and soundness. The minimum specific gravity shall be 2.4 (150 pounds per cubic foot) and the maximum absorption 4.2% using ASTM D 6473 or Tex-403-A. Soundness shall be tested in accordance with ASTM D 5240 or Tex-411-A and weight loss shall not exceed 18% after 5 cycles of magnesium sulfate solution, nor 14% after 5 cycles of sodium sulfate solution.

The rock riprap material shall be provided as a gradation of larger and smaller rock sizes associated with a rock class or median diameter (D50) as specified in the drawings. Rock diameter for angular material represents the length of the intermediate axis of an individual rock. The material gradation shall conform to table below for the class sizes corresponding to the D50. The D15, D50, D85, and D100 are the rock sizes for which 15%, 50%, 85%, and 100% of the total sample are of equal size or smaller, respectively.

<b>Rock Riprap Gradation Table</b>									
<b>Rock Riprap Class by Median Particle Diameter (D50)</b>		<b>D15 (in)</b>		<b>D50 (in)</b>		<b>D85 (in)</b>		<b>D100 (in)</b>	
<b>Class</b>	<b>Diameter (in)</b>	<b>Min</b>	<b>Max</b>	<b>Min</b>	<b>Max</b>	<b>Min</b>	<b>Max</b>	<b>Max</b>	
I	6	3.7	5.2	5.7	6.9	7.8	9.2	12.0	
II	9	5.5	7.8	8.5	10.5	11.5	14.0	18.0	
III	12	7.3	10.5	11.5	14.0	15.5	18.5	24.0	
IV	15	9.2	13.0	14.5	17.5	19.5	23.0	30.0	
V	18	11.0	15.5	17.0	20.5	23.5	27.5	36.0	
VI	21	13.0	18.5	20.0	24.0	27.5	32.5	42.0	
VII	24	14.5	21.0	23.0	27.5	31.0	37.0	48.0	
VIII	30	18.5	26.0	28.5	34.5	39.0	46.0	60.0	
IX	36	22.0	31.5	34.0	41.5	47.0	55.5	72.0	
X	42	25.5	36.5	40.0	48.5	54.5	64.5	84.0	

1. Reference: NCHRP Report 568.



2. Conversion to weight-based gradation:  $W = 0.0275D^3S_g$  where  $W$  is rock size in lbs,  $D$  is diameter in inches and  $S_g$  is the specific gravity of the rock.

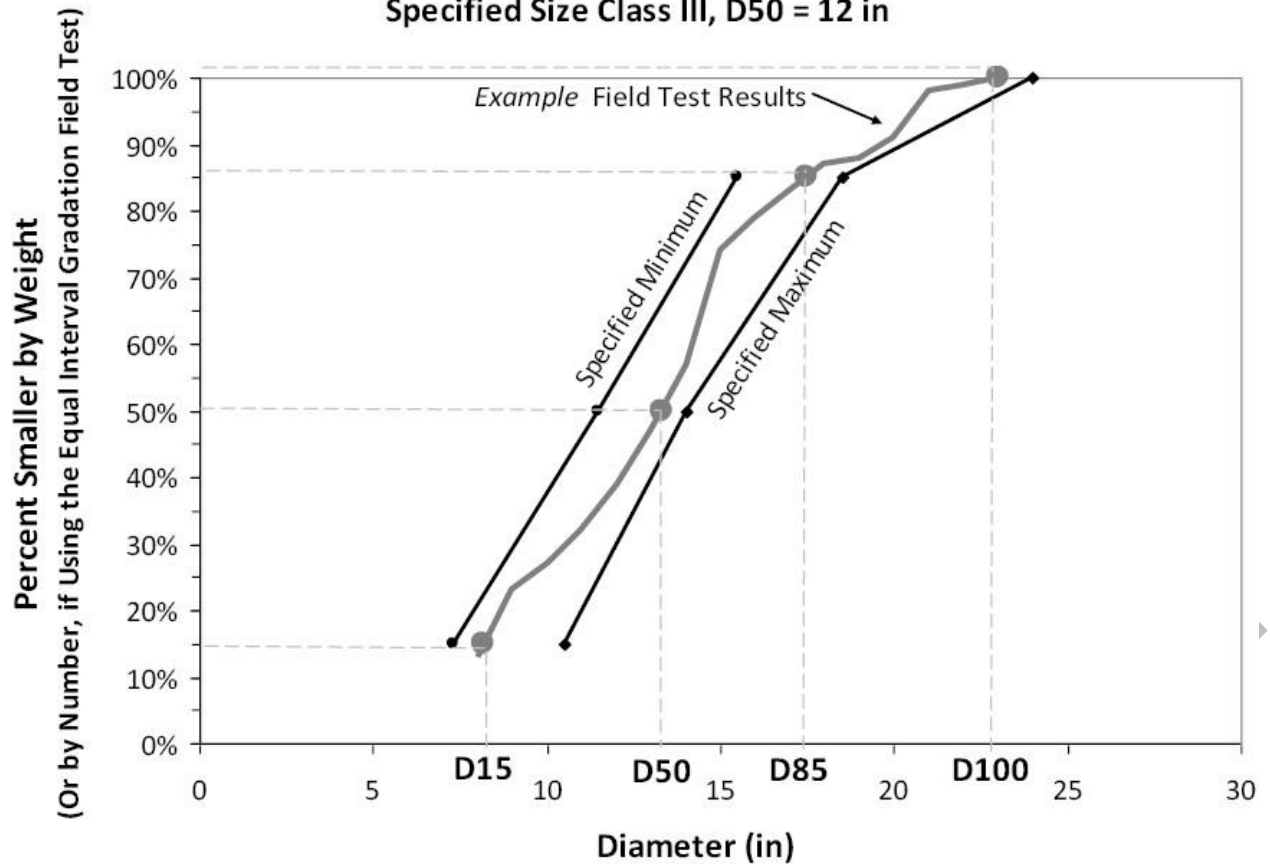
Conformance of rock riprap to the gradation requirements shall be accomplished by field tests for rock sizes that cannot be analyzed via sieve or mechanical sorting machines. In order to perform a field test, the contractor shall provide a sample of the proposed rock riprap material meeting the gradation for the specified size class. Gradation field tests shall follow the equal interval test procedure in NCHRP Report 568, Section 3.2.3, ASTM D 5519, or the modified equal interval method. The general steps of the modified equal interval method are:

1. Spread a representative, well-mixed sample of riprap to form a flat, rectangular pile. The thickness of the pile should be approximately equal to the D100. The length and width of the footprint should be determined based on the rock size and the minimum sample size that is requested by the Engineer.
2. With a tape measure, create a linear transect across the sample pile. Mark each rock that falls directly under the tape measure at an equal interval. The interval should be two feet or greater, depending on the D50, such that no rock is marked more than once.
3. Lay additional transects parallel to the first transect, at a spacing equal to the interval between marked rocks. Repeat Step B for each transect such that the marked rocks form an equally spaced grid across the pile.
4. Measure the diameter of each marked rock across the intermediate (middle or B) axis. The number of rocks measured shall be equal or greater than the minimum sample size.
5. Analyze the data by sorting and plotting a curve of percent smaller by number vs diameter. Identify the diameters.

Gradation tests shall result in: (1) a size distribution plot comparing the measured sample data with the specified diameter ranges for the rock size class (example below), and (2) the calculated D100, D85, D50, and D15 of the rock sample. The sample gradation is acceptable if the calculated diameters fall within the specified ranges of the applicable gradation. The acceptability of rock that falls outside the specified gradation ranges shall be at the discretion of the Engineer.



**Example Plot: Riprap Gradation Field Test**  
**Specified Size Class III, D50 = 12 in**



Approved rock riprap samples shall be stored onsite as a reference for ongoing visual inspection of additional materials supplied. Supplementary tests may be required for supply materials where visual inspection determines there may be a deviation from the required gradation. Labor, equipment and site location needed to assist in checking gradation shall be provided by the contractor at no additional cost to the owner.

B. Broken Concrete

With approval of the engineer, the rock used for mortar riprap may consist of broken concrete removed under the contract or obtained from other approved sources. Broken concrete shall be as nearly uniform in section as practicable and of the sizes indicated in Section 591S.4.A, "Dry Rock Riprap". All reinforcing steel shall be removed.

C. Concrete

Cast in place concrete shall be Class A Concrete and shall conform to Standard Specification Item No. 403S, "Concrete for Structures".

D. Grout and Mortar

Grout and mortar shall consist of 1 part Portland Cement (PC) and 3 parts sand, thoroughly mixed with water. Mortar shall have a consistency such that it can be easily handled and spread by trowel. Grout shall have a consistency such that it will flow into and completely fill all joints.

E. Reinforcement

Reinforcement shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

F. Joints

Premolded expansion joint material shall conform to Standard Specification Item No. 408S, "Concrete Joint Materials".

G. Tie Backs and Anchors

Galvanized tie backs and anchors shall be as indicated on the Drawings.

H. Filter Fabric

Filter Fabric shall conform to TxDOT DMS - 6200 "Filter Fabric".

I. Granular Filter

Aggregate used for granular filters shall conform to Standard Specification Item No. 403S "Concrete for Structures".

J. Soils

For vegetated soil-rock riprap, soil shall be integrated with the rock riprap at 30% soil to 70% rock by volume with minimal voids. Unless specified otherwise in the Drawings, soil that is placed below six inches (6") below the riprap top surface shall be Class A Select Borrow material, as described in Item No. 130S Borrow, and referred to herein as "fill soil." Soil that is placed within the top six inches (6") of the riprap top surface shall be topsoil material as described in Item No. 601S "Salvaging and Placing Topsoil", Section 3.

#### K. Seed

For vegetated soil-rock riprap, the type of seed mix and application rates shall be as specified on the Drawings and within the referenced Standard Specification. If no seed mix is specified, apply according to Item No. 604S "Seeding for Erosion Control", Section 5.

#### 591S.4 - Construction Methods

Prior to commencement of this work, all required erosion control and tree protection measures shall be in place and utilities located and protected as set forth in the "General Conditions". Construction equipment shall not be operated within the drip line of trees unless indicated on the Drawings. Construction materials shall not be placed under the canopies of trees. No excavation or embankment shall be placed within the drip line of trees until tree wells (Standard Detail Number 610S-6, "Slope Protection and Tree Wells") are constructed. Spalls and small stones used to fill open joints and voids in rock riprap shall be rocked and wedged to provide a tight fit.

Unsuitable excavated materials or excavation in excess of that needed for construction shall be known as "Waste" and shall become the property of the Contractor and it shall become his sole responsibility to dispose of this material in an environmentally sound manner off the limits of the right of way at a permitted disposal site.

Areas to be protected by rock riprap shall be free of brush, trees, stumps and other objectionable materials and be graded to a smooth compacted surface. All soft or spongy material shall be removed and replaced with appropriate material to the depths shown on the plans or as directed by the engineer. Fill Areas, unless otherwise specified will be compacted in accordance with Item No. 132S "Embankment". Unacceptable subgrade conditions shall be reworked according to the Engineer's recommendations. Excavation areas shall be maintained until the riprap is placed.

#### A. Dry Rock Riprap

The mass of rock riprap shall be placed as to be in conformance with the required gradation mixtures, to the lines, grades and layers thickness that is shown on the drawings.

When the riprap will be placed on an erodible soil, as determined by the Engineer or designated representative, a layer of geotextile filter fabric or a granular filter layer shall be placed, prior to placement of the riprap material. In some cases multiple layers of granular filter material of varying gradations may be required. The median rock riprap size (D50), rock riprap layer thickness, filter type, when applicable the number of granular filter layers, granular filter aggregate gradations (grade/size classification), granular layer thicknesses shall be specified on the plans. The minimum granular filter layer thickness shall be 4 inches. Geotextile filter fabric shall be installed with sufficient anchoring and overlap between seams according to the manufacturer's recommendations to ensure full filter barrier protection of the subgrade after riprap installation. When specified on the plans a four (4) inch minimum thickness granular cushion layer of gravel or sand may be placed over the filter fabric to prevent damage the fabric during placement of rock riprap.

Rock riprap shall be machine placed and distributed such that there will be no large accumulations of either larger or smaller sizes. Placing rock riprap by dumping into chutes or similar methods shall not be permitted. The rocks shall be placed in a single layer with close joints. The rock riprap layer thickness shall be no less than the specified maximum stone size (D100) or 1.5 times the D50, whichever produces the greater thickness. In areas exposed to flowing water the rock riprap layer thickness should be no less than 2.0 times the D50. The upright axis of the rocks shall make an

angle of approximately 90 degrees with the embankment slope. The courses shall be placed from the bottom of the embankment upward, with the larger rocks being placed on the lower courses. Open joints shall be filled with spalls. Rocks shall be arranged to present a uniform finished top surface such that the variation between tops of adjacent rocks shall not exceed 3 inches. Rocks that project more than the allowable amount in the finished work shall be replaced, embedded deeper or chipped.

#### B. Mortared Rock Riprap

Rock for this purpose, as far as practicable, shall be selected as to size and shape in order to secure fairly large, flat-surfaced rock which may be laid with a true and even surface and a minimum of voids. Fifty percent of the mass rock shall be broad flat rocks, weighing between 100 and 150 pounds each, placed with the flat surface uppermost and parallel to the slope. The largest rock shall be placed near the base of the slope. The spaces between the larger rocks shall be filled with rocks of suitable size, leaving the surface smooth, reasonably tight and conforming to the contour required on the Drawings. In general, the rocks shall be placed with a degree of care that will insure plane surfaces with variation from the true plane of no more than 3 inches in 4 feet. Warped and curved surfaces shall have the same general degree of accuracy as indicated for plane surfaces.

Before placing mortar, the rocks shall be wetted thoroughly and as each of the larger rocks is placed, it shall be surrounded by fresh mortar and adjacent rocks shall be shoved into contact. After the larger rocks are in place, all of the spaces or opening(s) between them shall be filled with mortar and the smaller rocks then placed by shoving them into position, forcing excess mortar to the surface and ensuring that each rock is carefully and firmly embedded laterally. After the work described above has been completed, all excess mortar forced up shall be spread uniformly to completely fill all surface voids. All surface joints then shall be pointed up roughly, either with flush joints or with shallow, smooth raked joints.

#### C. Vegetated Soil-Rock Riprap

Adjacent stockpiles of rock riprap, fill soil, and topsoil shall be created and there shall be no premixing of fill soil, topsoil and rock prior to placement. Sufficient soil volume shall be provided to result in a final, complete-in-place ratio of 30% soil to 70% rock riprap by volume.

Place underlying filter material and first layer of rock riprap in accordance with 591S.4.A to a thickness equivalent to the D50 rock size or half the design rock layer thickness, whichever is greater. Place a layer of soil over and within the rock voids such that the top of the soil layer is approximately 75% of the rock layer thickness. Work the soil into the rock layer voids by wetting, prodding with a rock bar, and/or vibratory compaction until the soil height is approximately 50% of the rock height. If the soil height becomes less than 50% of the rock height then repeat the previous steps.

Place the second layer of rock riprap per 591S.4.A up to the final design grade. Place soil over and within the rock riprap, working it into the voids as in the previous step and repeating application as needed until the top of the soil layer approximately matches the top surface of the rock riprap. Excess soil shall not be placed in the voids to the extent that the rock riprap is displaced. The resulting soil-riprap surface shall be smooth, with no lumps or depressions greater than two inches ( $\pm 2$ " ) from the final design grade.

Once the soil-rock matrix is placed, the surface of the soil-rock riprap shall be seeded per the Drawings and covered with biodegradable erosion control fabric.

#### D. Concrete Riprap

Concrete for riprap shall be placed as indicated on the Drawings or as directed by the Engineer or designated representative. Unless otherwise indicated on the Drawings, concrete riprap shall be reinforced using wire or bar reinforcement.

Concrete shall be Class A or as indicated otherwise on the Drawings and shall conform to Standard Specification Item No. 403S, "Concrete for Structures".

When welded wire reinforcement is indicated, it shall be a minimum of 6 × 6 W1.4 × W1.4 (150 × 150 MW9 × MW9) with a minimum lap of 6 inches at all splices. At the edge of the riprap, the wire fabric shall not be less than 1 inch nor more than 3 inches from the edge of the concrete and shall have no wires projecting beyond the last member parallel to the edge of the concrete.

When bar reinforcement is used, the sectional area of steel in each direction shall not be less than the sectional area of the wire fabric described above. The spacing of bar reinforcement shall not exceed 18 inches in each direction and the distance from the edge of concrete to the first parallel bar shall not exceed 6 inches.

Reinforcement shall be supported properly throughout the placement to maintain its position approximately equidistant from the top and bottom surface of the slab.

Unless otherwise noted, expansion joints of the size and type indicated on the Drawings shall be provided at intervals not to exceed 40 feet and shall extend the full width and depth of the concrete. Marked joints shall be made 3/8 inch deep at 10 foot intervals. All joints shall be perpendicular and at right angles to the forms unless otherwise indicated on the Drawings.

Slopes and bottom of the trench for toe walls shall be compacted and the entire area sprinkled before the concrete is placed.

After the concrete has been placed, consolidated and shaped to conform to the dimensions indicated on the Drawings and has set sufficiently to avoid slumping, the surface shall be finished with a wooden float to secure a reasonably smooth surface.

Immediately following the finishing operation, the riprap shall be cured conforming to Standard Specification Item No. 410S, "Concrete Structures".

#### E. Pneumatically Placed Concrete Riprap, Type I and Type II

Pneumatically placed concrete for riprap shall be placed as indicated on the Drawings or as established by the Engineer or designated representative. Pneumatically placed concrete shall conform to Standard Specification Item No. 404S, "Pneumatically Placed Concrete". Reinforcement shall conform to the details indicated on the Drawings and Standard Specification Item No. 406S, "Reinforcing Steel". Reinforcement shall be supported properly throughout placement of concrete. All subgrade surfaces shall be moist when concrete is placed.

The surface shall be given a wood float finish or a gun finish as indicated on the Drawings.

The strength and design of Pneumatically Placed Concrete Riprap shall be either Type I or if indicated, Type II conforming to Standard Specification Item No. 404S, "Pneumatically Placed Concrete".

Immediately following the finishing operation, the riprap shall be cured conforming to Standard Specification Item No. 410S, "Concrete Structures".

591S.5 - Measurement

Measurement of acceptable riprap will be made on the basis of the (a) area in square yards indicated on the Drawings, complete in place or (b) the volume of concrete placed in cubic yards, complete in place as indicated on the Drawings for the thickness specified.

Concrete toe walls will not be measured separately but shall be included in the unit price bid for riprap of the type with which it is placed.

591S.6 - Payment

The riprap quantities, measured as provided above, will be paid for at the unit bid prices per square foot or per cubic yard as indicated for riprap of the various classifications. The Unit Bid Price shall include full compensation for furnishing, hauling and placing all materials, including toe walls, geotextile filter fabric, granular filter material, fill soil and top soil, seed, erosion control fabric, granular cushion, reinforcement and premolded expansion joint material and for all labor, tools, equipment and incidentals necessary to complete the work.

Payment for excavation of toe wall trenches and for all necessary excavation below natural ground or the bottom of excavated drainage channels will be included in the unit bid price for riprap. Excavation, grading and fill materials required to shape drainage channels shall not be included in the unit bid price for riprap.

Payment for excavation required for shaping of slopes for riprap shall be included in the unit bid price for riprap, except for the situation when the header banks upon which the riprap is to be placed are built by prior contract. In this specific case the excavation for shaping of slopes, will be paid for conforming to Standard Specification Item No. 401S, "Structural Excavation and Backfill".

Payment will be made under one of the following:

<b>Pay Item No. 591S-A:</b>	Dry Rock Riprap	Per Square Yard.
<b>Pay Item No. 591S-B:</b>	Dry Rock Riprap	Per Cubic Yard.
<b>Pay Item No. 591S-D:</b>	Mortared Rock Riprap	Per Square Yard.
<b>Pay Item No. 591S-F:</b>	Concrete Riprap, _____ In.	Per Square Yard.
<b>Pay Item No. 591S-G:</b>	Concrete Riprap	Per Cubic Yard.
<b>Pay Item No. 591S-I:</b>	Vegetated Soil-Rock Riprap	Per Square Yard.
<b>Pay Item No. 591S-J:</b>	Vegetated Soil-Rock Riprap	Per Cubic Yard.

<b>Pay Item No. 591S-P:</b>	Pneumatically Placed Concrete Riprap, _____ In.	Per Square Yard.
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**END**





## ITEM NO. 593S - PC CONCRETE RETARDS

### 593S.1 - Description

This item governs Portland Cement (PC) concrete retards used to anchor underground pipe. Retards shall be constructed as indicated on the Drawings, presented in City of Pflugerville Standard Detail 593S-1 "Concrete Retard" or as directed by the Engineer or designated representative in accordance with these specifications.

### 593S.2 - Submittals

The submittal requirements of this specification item include:

- A. Class D PC concrete mix design,
- B. Construction details (i.e. reinforcing steel, curing membrane).

### 593S.3 - Materials

#### A. PC Concrete

The concrete materials used in construction under this item shall conform to Class D, Standard Specification Item No. 403, "Concrete for Structures".

#### B. Reinforcement

Reinforcement shall conform to Standard Specification Item No. 406, "Reinforcing Steel".

### 593S.4 - Construction Methods

Prior to placement of PC concrete, excavation for retards shall be made to proper section and depth. If considered necessary by Engineer or designated representative, the bottom of the excavation shall be hand tamped and sprinkled. The excavated area for concrete retards shall be moist when the PC concrete is placed.

After the PC concrete has been placed, consolidated and shaped to conform to the dimensions indicated on the Drawings and after sufficiently set, it shall be given a moderately rough finish by floating with a wood float (Standard Specification Item No. 411S, "Surface Finishes for Concrete").

No mortar or concrete work shall be undertaken, when the ambient temperature is below 35°F and Work shall be protected from freezing. After completion of the concrete retard, exposed surfaces shall be covered with burlap, cotton mats or other approved covering and kept moist for a minimum period of 3 days. White pigmented curing compound conforming to Item No. 409S, "Membrane Curing", Type 2, will be permitted when applied to exposed surfaces.

Unless directed otherwise by the Engineer or designated representative, the material excavated during trenching shall be disposed of at a permitted site.

### 593S.5 - Measurement

Concrete Retards will be measured either by the cubic yard per Drawing dimensions or on a unit basis complete in place.

593S.6 - Payment

Work performed and materials furnished as prescribed by this Standard Specification item, measured as provided under the "Measurement" section will be paid for by the cubic yard or the unit price bid for "Concrete Retards", as indicated in the Contract Documents. The bid pay item price shall include full compensation for excavation, reinforcing, furnishing, hauling and placing all materials required in the construction, the disposal of excavated material and any manipulation, labor, tools, equipment and incidentals necessary to complete the work.

This item shall also govern any pumping, bailing and dewatering or drainage necessary to complete the work when Concrete Retards are indicated on the Drawings or required by the Engineer or designated representative.

Payment will be made under one of the following:

<b>Pay Item No. 593S-B:</b>	PC Concrete Retards	Per Each.
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**END**

## ITEM NO. 594S - GABIONS AND REVET MATTRESSES

### 594S.1 – Description & Submittals

#### A. Description

The work to be performed under this specification shall include furnishing, assembling, filling, and tying rock-filled wire mesh compartmented gabions and revet mattresses in accordance with the lines, grades, and dimensions shown on the Drawings or otherwise established in the field by the Engineer or designated representative. The type of construction (i.e. twisted woven mesh, welded mesh or both) and wire sizes (i.e. 13.5 gage, 12 gage or 10 gage) shall be as defined in the Drawings or otherwise established by the Engineer or designated representative.

#### B. Submittals

The submittal requirements of this specification item may include:

- a. Wire sizes
- b. Rock Gradation

### 594S.2 - Materials

Gabions and revet mattresses shall be constructed of galvanized steel wire with polyvinylchloride (PVC) flexible coating. The gabions and revet mattresses shall be of the construction and sizes specified in the Drawings and shall meet the specifications presented herein. Unless otherwise specified in the Drawings or approved by the Engineer or designated representative, the gabions and revet mattresses may be constructed of either double twist woven mesh or welded wire mesh.

Gabions shall be furnished in the specified dimensions within a tolerance of  $\pm 5$  percent. Revet mattresses shall be furnished in the specified dimensions within a tolerance of  $\pm 5$  percent for the length and width and  $\pm 10$  percent for the height. For each individual gabion or revet mattress, the same mesh style shall be used for the base, front, ends, back, diaphragms and lid panels. Each gabion or revet mattress shall be manufactured and divided into cells of equal length, no greater than 3 feet, by diaphragm panels.

#### (1) Gabion and Revet Mattress Wire

Gabion wire shall be galvanized steel, Class 3 or A coating, soft temper conforming to ASTM A 641, and shall specifically meet the requirements given below for gabions (12 gage wire) and/or revet mattresses (13.5 wire gage) as called for in the Drawings. PVC coating of the wire may be fusebonded or extruded onto the wire. Galvanization of welded wire shall be performed either before or after welding.

**Table 1: Requirements - Mesh Wire for Gabions and Revet Mattress Units**

Characteristic	Gabions	Revet Mattresses
Wire Gage	12 gage	13.5 gage
Maximum Tensile Strength (ASTM 641)	70,000 psi	75,000 psi

Characteristic	Gabions	Revet Mattresses
Nominal Wire Diameter (ASTM A 641)	0.106 inch	0.0866 inch
Minimum Diameter (ASTM A 641, Table 3)	0.102 inch	0.0826 inch
Galvanizing, Zinc (ASTM A 641, Table 1)	0.80 oz/ft <sup>2</sup>	0.70 oz/ft <sup>2</sup>

(2) Gabion Mesh

(A) Woven Mesh

Woven mesh shall be of a uniform nonraveling, double twist hexagonal pattern nominally of dimensions 3.25 inches by 4.5 inches. Selvedge wire shall be 10 gage.

(B) Welded Mesh

Mesh opening shall be nominally 3 inches by 3 inches. Strength of welds shall meet the following requirements when tested in accordance with section 13.4 of ASTM A-974:

**Table 2: Minimum Weld Strength Requirements**

Type of Structure	Wire Size (Diameter)	Minimum Average Weld Shear Strength
	Gage	English Units
Gabions	12	472 lbf
Revet Mattress	13.5	292 lbf

(C) Manufacturing

Twisted wire mesh gabions shall be manufactured in conformance with ASTM A-975, while welded wire mesh gabions shall be manufactured in conformance with ASTM A-974.

(3) Revet Mattresses

(A) Woven Mesh

Woven mesh shall be of a uniform nonraveling, double twist hexagonal pattern, nominally of dimensions 2.5" × 3.25". Selvedge wire shall be 12 gage.

(B) Welded Mesh

Mesh opening shall be nominally 1.5" × 3.0". Strength of welds shall meet the requirements listed in Table 2 for 13.5 gage wire, when tested in accordance with section 13.4 of ASTM A-974:

(C) Manufacturing

Twisted wire mesh revet mattresses shall be manufactured in conformance with ASTM A-975, while welded wire mesh revet mattresses shall be manufactured in conformance with ASTM A-974.

(4) PVC Coating

All wire used in fabrication of the gabions, revet mattresses and wiring operations during construction shall, after zinc coating, have a fusebonded or extruded coating of PVC. The coating shall be gray in color. The thickness shall be nominally 0.020 inch and shall not be less than 0.015 inch in thickness. It shall be capable of resisting deleterious effects of natural weather exposure, and immersion in saltwater.

For PVC-coated welded wire fabric panel, cutting of the panels shall not be allowed closer than 1/4 inch  $\pm$  1/8 inch after fabrication in order to prevent exposure near the welds.

(A) Initial Properties:

1) Woven Mesh:

The initial properties of the PVC coating material shall have a demonstrated ability to conform to the following requirements specified in ASTM A-975:

a) Specific Gravity:

The specific gravity as determined in accordance with ASTM D-792 shall be between 1.3 to 1.35.

b) Durometer Hardness:

The hardness as determined in accordance with ASTM D-2240 shall be between 50 to 60, Shore D.

c) Tensile Strength:

The tensile strength when tested in accordance with ASTM D-412 shall not be less than 2985 psi.

d) Modulus of Elasticity at 100% Elongation:

The Modulus of Elasticity when determined in accordance with ASTM D-412 shall not be less than 2700 psi.

e) Resistance to Abrasion:

The percentage loss in weight during abrasion testing in accordance with ASTM D-1242 shall be less than 12%.

f) Brittleness Temperature:

The brittleness temperature shall not be higher than 15°F or a lower temperature specified by the Engineer, when tested in accordance with ASTM D-746. The

maximum brittleness temperature should be at least 15°F below the minimum temperature at which the gabion will be handled or filled.

2) Welded Mesh:

The initial properties of the PVC coating material shall have a demonstrated ability to conform to the following requirements specified in ASTM A-974:

a) Specific Gravity:

The specific gravity as determined in accordance with ASTM D-792 shall be between 1.20 and 1.40.

b) Durometer Hardness:

The hardness as determined in accordance with ASTM D-2240 shall not be less than 75, Shore A.

c) Tensile Strength:

The tensile strength when tested in accordance with ASTM D-638 shall not be less than 2275 psi.

d) Modulus of Elasticity:

The Modulus of Elasticity when determined in accordance with ASTM D-638 shall not be less than 1980 psi.

e) Resistance to Abrasion:

The percentage loss in weight shall be less than 12% during abrasion testing in accordance with ASTM D-1242, Method B, at 200 cycles, CSI-A abrader tape, 80 grit.

f) Brittleness Temperature:

The brittleness temperature shall not be higher than 15°F or a lower temperature specified by the Engineer, when tested in accordance with ASTM D-746. The maximum brittleness temperature should be at least 15°F below the minimum temperature at which the gabion will be handled or filled.

g) Adhesion:

The PVC coating on the wire shall adhere to the wire such that the coating breaks rather than separates from the wire, when tested in accordance with the PVC Adhesion Test described in Section 13.3 of ASTM A-974.

h) Mandrel Bend:

The PVC-coated wire, when subjected to a single 360° bend at 0°F around a mandrel ten times the diameter of the wire, shall not exhibit breaks or cracks in the PVC coating.

(B) Performance Tests:

The PVC coating shall have the demonstrated ability to withstand the specified exposure testing.

- 1) Exposure to Salt Spray: The PVC shall show no effect after 3000 hours of salt spray exposure in accordance with ASTM Test Method B-117.
- 2) Exposure to Ultraviolet Rays:

The PVC shall show no effect of exposure to ultraviolet light with test exposure of 3000 hours, using apparatus Type E and 145°F, when tested in accordance with ASTM Practice D-1499 and G-23.

(C) Properties After Exposure Tests:

After conclusion of the salt spray and exposure to ultraviolet light tests, the PVC shall not show cracks, blisters or splits, nor any noticeable change in color. In addition the PVC coating shall not show cracks or breaks after the wires are twisted in the fabrication of the mesh, nor shall there be any moisture intrusion under the PVC coating as a result of the test.

After completion of the exposure tests the following criteria shall also be met:

- 1) Woven Mesh:
  - a) The Specific Gravity shall not change more than 6% of its initial value.
  - b) The Durometer Hardness shall not change more than 10% of its initial value.
  - c) The Tensile Strength shall not change more than 25% of its initial value.
  - d) The Resistance to Abrasion shall not change more than 10% of its initial value.
- 2) Welded Mesh:
  - a) The Specific Gravity shall not change more than 6% of its initial value.
  - b) The Modulus of Elasticity shall not change more than 25% of its initial value.
  - c) The Tensile Strength shall not change more than 25% of its initial value.
  - d) The Resistance to Abrasion shall not change more than 10% of its initial value.

(D) Salt Spray Resistance for Fastener:

The fasteners for twisted mesh wire gabions and revet mattresses shall be subjected to Salt Spray Test of Test Method B-117 for a period of not less than 48 ±1 hour cycle length. After testing the fasteners, the selvedge, or mesh wire confined by the fasteners shall show no rusty spots on any part of the surface excluding the cut ends.

(5) Stone

(A) Gabion Basket Stones

Stone fill shall be durable and of suitable quality to ensure permanence in the structure. The stone used to fill the gabion baskets shall be a clean, sound, and durable rock meeting the following requirements. It shall have a wearing loss less than 35 percent when the stone is tested with the Los Angeles Abrasion Machine in accordance with ASTM Test Method C535 (TxDOT Test Method Tex-410-A). The loss of material experienced during five cycles of magnesium sulfate exposure conducted in accordance with TxDOT Test Method Tex-411-A for Rock RipRap shall not exceed 18 percent. The stone shall be well graded to produce a dense fill, angular in texture, while meeting the following gradation requirements:

**Table 3: Gabion Stone Gradation Requirements**

<b>Sieve Size</b>	<b>Percent by Weight % Passing Each Individual Sieve</b>
8 Inch	100
4 Inch	0—5
3 Inch	0

The minimum unit weight of a rock filled gabion shall be 120 pcf. Verification of unit weight shall be performed when ordered by the Engineer, by constructing a test gabion with materials supplied for construction with the same effort and method intended for production gabions.

(B) Revet Mattress Stone:

The stone used to fill the revet mattresses shall be as specified for gabions except that it shall have a maximum dimension of 5 inches and a minimum dimension of 3 inches. The majority of the stone shall be in the 3 to 4 inch range; cubical or rounded in shape. A tolerance of 5% shall be allowed on the upper and lower dimensions of the rock.

(6) Connections

(A) Wire

Lacing wire and connecting wire shall be 13.5 gage PVC coated galvanized steel, Class 3, soft temper, conforming to ASTM A-641. During testing, any separation of 2 inches or more between connecting wires shall be considered as a failure.



(B) Spiral Binder for Welded Wire Mesh

Spiral binders shall consist of 0.106 inch PVC coated wire for the gabion and 0.087 inch PVC coated wire for the revet mattresses. Spiral binders shall have a 3.0 inch maximum separation between continuous successive loops.

The binder shall be made of galvanized steel, Class 3, soft temper, conforming to ASTM A-641.

(C) Alternate Fasteners for Twisted Woven Mesh

Alternate fasteners, acceptable for use by the intended gabion basket manufacturer, may be submitted to the Engineer for consideration and approval prior to construction. The fasteners may consist of split ring or interlocking fasteners. Alternate fasteners systems shall produce a joint that meets the requirements of ASTM A-975, Section 7, Table 2.

(7) Fastener System

The Contractor shall provide a complete description of the fastener system, including the number of fasteners required for all vertical and horizontal connections for single- and multiple-basket joinings, as well as the number and size wires the fastener is capable of properly joining. The Contractor shall provide a description of a properly installed fastener, including test reports, drawings and/or photographs. Properly formed fasteners shall meet the requirements of ASTM A-974 for welded wire mesh or ASTM A-975 for twisted woven mesh.

(A) Each interlocking fastener shall be locked and closed.

(B) Each overlapping ring fastener shall be closed and the free ends shall overlap an average of 1 inch.

(C) Spiral binders shall be screwed into position such that they pass through each mesh opening along the joint. In order to prevent unraveling, both ends of the spiral shall be crimped back around itself.

(D) Wire fasteners shall not be used to join more wires, or larger wires, than tested and approved for the application.

(8) Panel to Panel Joint Strength

The minimum strength of the joined panels shall be as specified in Section 7.3 of ASTM A-974 for Welded wire panels or Section 7.3 of ASTM A-975 for twisted woven mesh.

(9) Miscellaneous

Aggregate bedding, geotextiles or other materials shall conform to the requirements established on the Drawings.

(10) Certificate of Compliance

The Contractor shall submit Certificates of Compliance for all materials proposed for use to the Engineer for review and approval one week prior to construction.

### 594S.3 - Construction

Twisted wire mesh Gabion's and revote mattresses shall be supplied in the forms allowed in ASTM A-975, while welded wire mesh Gabion's and revote mattresses shall be supplied in a form allowed in ASTM A-974.

The Gabion/revote mattress manufacturer/supplier will be required to have a qualified representative on site at the start of gabion/revet mattress construction. The Contractor shall submit work experience documentation of the representative for review/approval by the Engineer or designated representative. The representative shall be available for consultation as needed throughout the gabion construction.

Gabions and revet mattresses shall be constructed to the lines and grades shown on the Drawings. Individual or groups of gabions or revet mattresses, which deviate from line and grade, shall, at the direction of the Engineer or designated representative, be removed and replaced at no cost to the owner. Gabions or revet mattresses, which are constructed with bulges, and/or underfilled, loosely filled, or otherwise lacking a neat and compact appearance shall, at the direction of the Engineer or designated representative, be repaired/replaced at no cost to the owner. Underfilling of gabion/revet mattress corners to facilitate insertion of spirals shall not be permitted.

#### (1) Foundation Preparation

The foundation shall be excavated to the extent shown on the Drawings or as directed by the Engineer or designated representative. All loose or otherwise unsuitable materials shall be removed. All depressions shall be carefully backfilled to grade. The depressions shall be backfilled with suitable materials from adjacent required excavation, or other approved source, and compacted to a density at least equal to that of the adjacent foundation. If pervious materials are encountered in the foundation depressions, the areas shall be backfilled with free draining materials.

Any buried debris protruding from the foundation that will impede the proper installation and detrimentally impact the final appearance of the gabion, shall also be removed, and the voids carefully backfilled and compacted as specified above. Immediately prior to gabion or revet mattress placement, the prepared foundation surface shall be inspected and approved by the Engineer and no material shall be placed thereon until that area has been approved.

Placement of filter material and/or filter fabric shall be as shown on the Drawings or directed by the Engineer.

#### (2) Gabion/Revet Mattress Basket Assembly

No work shall take place using PVC coated materials unless both the ambient air temperature and the temperature of the PVC materials are at least 15°F above the brittleness temperature of the PVC materials.

Assembly of gabions and revet mattresses shall consist of shaping and tying each individual basket. Baskets shall be assembled by connecting all untied edges including diaphragms with lacing wire, spirals or approved fasteners. The connections for the completed assemblies shall conform to the requirements of Section 7 of ASTM specifications A-974 (welded wire) and Section 7.3 and Table 2 of A-975 (double twisted).

Assembly of baskets, connection of baskets together and lid closures shall be accomplished in accordance with one of the following approved procedures:

(A) Lacing Wire:

Using lacing wire of appropriate length, secure one end of the wire onto the basket corner by looping and twisting the lacing wire together. Proceed along the joint by tying with double loops every other mesh opening at intervals not more than 6 inches apart, while pulling the basket elements tightly together. Secure the other end of the lacing wire again by looping and twisting the wire around itself.

(B) Spiral Binders for Welded Wire Mesh:

Spiral binders, meeting the minimum acceptance criteria of article 594S.2(6)(C) shall be screwed into position such that they pass through each mesh opening along the joint. To prevent unraveling, each end of the spiral binder shall be crimped back against itself.

(C) Alternate Fasteners for Twisted Woven Mesh:

Interlocking fasteners meeting the minimum acceptance criteria of article 594S.2(6)(C), shall be installed with, as a minimum, one interlocking fastener in every other opening.

Ring fasteners meeting the minimum acceptance criteria of 594S.2(6)(C), shall be installed with, as a minimum, one split ring fastener in every opening, having a minimum 1 inch total overlap and securing only the number and diameter of wires for which tested.

Placing of gabions and revet mattresses shall consist of installing baskets to the lines and grades shown on the Drawings. Gabions and revet mattresses shall be securely fastened to each adjoining unit along the vertical and top reinforced edges of all contact surfaces. Overlying rows of baskets shall be staggered appropriately. Empty sections stacked on a filled line of gabions and revet mattresses shall be securely fastened to the bottom unit along the front, back and ends.

Prior to the placement of rock, the baskets used in the front vertical exposed faces of retaining walls shall be aligned. To facilitate alignment, tension may be applied to empty units at the direction of the Engineer or designated representative.

(3) Filling of Gabions and Revet Mattresses

The gabions and revet mattresses may be filled by machine, in maximum lifts of 12 inches. The machine work shall be supplemented with handwork to avoid bulges and provide a compact mass with a minimum of voids. Care will be exercised so as not to damage the gabion/revet mattress elements or wire coating by limiting height of drop during filling to 3.0 feet for Gabions and 1.5 feet for revet mattresses. Undue deformation or bulging of the mesh shall be corrected prior to further stone filling. Where specified on the Drawings, select large stone shall be hand placed on vertical outside faces to achieve a desired neat appearance.

During placement, the depth of stone in any cell shall not exceed the depth in an adjoining cell by more than one foot. Stone smaller than the mesh opening found against vertical faces shall be removed.

Two connecting wires in each direction for end units and two parallel connecting wires perpendicular to the exposed face for exposed face units shall be installed at every 12-inch lift. The connecting wires shall loop around two mesh openings, and the ends of wires shall be securely twisted with a

minimum of three twists after looping. Prefabricated connecting wire may be used in lieu of connecting wire.

Connecting wires associated with 18-inch gabions shall be installed when and as specified on the Drawings or as recommended by the gabion/revet mattress manufacturer.

The gabion or revet mattress unit shall be overfilled by 1½ to 2 inches and the lid shall be bent and stretched until it meets the perimeter edges of the front and end panels. The stretching shall be accomplished using an approved lid closing tool in order to prevent damage to the PVC coating. Crow bars or similar single point leverage devices will not be allowed. The lid shall then be securely tied with lacing wire, spirals or approved fasteners to the fronts, ends and diaphragms. Excessive deformation of the lid panel to facilitate closing of a bulging gabion or revet mattress will not be permitted.

All backfill shall be placed and compacted in sequence with the filling of the baskets; however, care shall be exercised in compacting the fill behind a single row of baskets since excessive compaction effort can displace the gabions/revet mattresses from the desired alignment.

Gabion or revet mattress units may be cut or shaped to fit odd length or odd shaped areas. They shall be cut at least 6" to 8" larger than the opening to allow sufficient material for overlap and lacing. All edges or faces formed in this manner shall be adjusted to present a finished and pleasing appearance.

At all times, care shall be taken to turn all loose and projecting ends of wire into the gabion units to prevent injury.

#### 594S.4 - Quality of Work

Wire of proper grade and quality, when fabricated and installed in the manner herein required, shall result in a strong, serviceable mesh-type product having substantially uniform openings. It shall be fabricated and finished properly, as determined by visual inspection, and shall conform to this specification.

#### 594S.5 - Measurement

Measurement of acceptable "Gabions and Revet Mattresses", complete in place, will be made on the basis of volume determined by the actual length, width and height.

#### 594S.6 - Payment

The Gabion and revet mattress quantities, measured as described above, will be paid for at the unit bid prices per cubic yard of the various types indicated. The price shall include full compensation for furnishing, hauling and placing all materials, including filter fabric, wire containers, connectors, reinforcement stones and backfill; for all labor, tools, equipment and incidentals needed to complete the work.

Excavation and all subgrade preparation required for shaping the foundation for the wire containers shall be included in the unit bid price for "Gabions and Revet Mattresses".

Payment will be made under one of the following:

<b>Pay Item No. 594S-A:</b>	Gabions, Twisted Woven Wire	Per Cubic Yard.
<b>Pay Item No. 594S-B:</b>	Gabions, Welded Wire	Per Cubic Yard.
<b>Pay Item No. 594S-C:</b>	Revet Mattresses, Twisted Woven Wire	Per Cubic Yard.
<b>Pay Item No. 594S-D:</b>	Revet Mattresses, Welded Wire	Per Cubic Yard.

END

## ITEM NO. 601S - SALVAGING AND PLACING TOPSOIL

### 601S.1 - Description

This item shall govern the removal, storage and placement of approved on-site naturally occurring topsoil and topsoil mix (see 601S.3.A) to the depths and area shown on the Drawings or as directed by the City Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

### 601S.2 - Submittals

- A. The Contractor shall submit the following submittal items electronically a minimum of 14 days prior to the commencement of related work:
1. Soil test results and soil classification necessary for approval of material as suitable topsoil. Soil test results should include, at minimum, texture; percentage organic matter (OM); salinity (soil salt) level; pH; and amounts of phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), nitrate-nitrogen ( $\text{NO}_3\text{-N}$ ), and sulfate-sulfur ( $\text{SO}_4\text{-S}$ ).
  2. For topsoil mixes containing compost, the soil test for shall also include moisture content, C:N ratio and Solvita compost maturity index.
  3. At least 10 days prior to anticipated start of top soiling operations, a one (1) pint sample of topsoil material shall be delivered by the Contractor to a laboratory for testing and approval. All testing shall be at the sole expense of the Contractor. Based on tests performed by the laboratory, the topsoil shall be identified as acceptable, acceptable with certain fertilizer and limestone applications or unacceptable. If the topsoil is found acceptable the fertilizer and lime requirements will be as specified or as recommended by the laboratory. If the topsoil is found unacceptable, the Contractor shall be responsible for identifying another source of topsoil and shall incur all expenses associated with testing additional samples. All topsoil incorporated into the site work shall match the sample provided to the laboratory for testing. Topsoil stockpiled under other Sections of these Specifications may be used subject to the testing and approval outlined above. Contractor will be responsible for screening stockpiled topsoil and providing additional topsoil as required at his/her own expense.
- B. Submittals/Inspection required during construction:
1. Delivery tickets indicating type/product name, source and quantities of imported topsoil mix or compost (for mixing with salvaged soil).
  2. Deliveries of soil to a job site shall be inspected by the City Engineer or designated representative before placement to verify product compliance with specification.

### 601S.3 - Materials

#### Topsoil

- A. Topsoil shall be fertile, friable, natural topsoil typical of topsoil of the locality and shall be obtained from a well-drained site that is free of flooding. It shall be without admixture of subsoil or slag and

free of stones, lumps, plants or their roots, sticks, clay, peat and other extraneous matter and shall not be delivered to the site or used while in a frozen or muddy condition. Topsoil as delivered to the site or stockpiled shall have pH between 6.0 and 7.0 and shall contain not less than three (3) percent organic matter as determined by loss of ignition of moisture-free samples dried at 100 degrees Celsius.

The topsoil shall meet the following mechanical analysis:

Sieve Size	Percent Passing
1-inch Screen Opening	100
No. 10 Mesh	95 – 100
No. 270 Mesh	35 – 75
0.002 mm*	5 - 25

\*Clay size fraction determined by pipette or hydrometer analysis.

- B. At least 10 days prior to anticipated start of topsoiling operations, a one (1) pint sample of topsoil material shall be delivered by the Contractor to a laboratory for testing and approval. All testing shall be at the sole expense of the Contractor. Based on tests performed by the laboratory, the topsoil shall be identified as acceptable, acceptable with certain fertilizer and limestone applications or unacceptable. If the topsoil is found acceptable the fertilizer and lime requirements will be as specified or as recommended by the laboratory. If the topsoil is found unacceptable, the Contractor shall be responsible for identifying another source of topsoil and shall incur all expenses associated with testing additional samples. All topsoil incorporated into the site work shall match the sample provided to the laboratory for testing. Topsoil stockpiled under other Sections of these Specifications may be used subject to the testing and approval outlined above. Contractor will be responsible for screening stockpiled topsoil and providing additional topsoil as required at his/her own expense.
- C. Lime shall be ground limestone containing not less than 85-percent calcium and magnesium carbonates and be ground to such fineness that at least 50-percent shall pass a 100-mesh sieve and at least 90-percent shall pass a 20-mesh sieve.
- D. Grass seed shall be applied in accordance with the following table:

Time of Year	Seed Type	Amount of Seed per 1,000 SF
October – February (Requires both seed types)	Unhulled Bermuda	1 lb.
	Winter Rye	3 lbs.
March – September	Hulled Bermuda	1 lb.

- E. The seed shall be furnished and delivered premixed in the proportions specified within. A Manufacturer's Certificate of Compliance to the specified mixes shall be submitted by the Manufacturers for each seed type. These certificates shall include the guaranteed percentages of purity, weed content and germination of the seed and also the net weight and date of shipment. No seed may be sown until the Contractor has submitted the certificates.
- F. Seed shall be delivered in sealed containers bearing the dealer's guaranteed analysis.
- G. Mulch shall be a specially processed cellulose fiber containing no growth or germination-inhibiting factors. It shall be manufactured in such a manner that after addition and agitation in slurry tanks

with water, the fibers in the material become uniformly suspended to form a homogeneous slurry. When sprayed on the ground, the material shall allow absorption and percolation of moisture. Each package of the cellulose fiber shall be marked by the manufacturer to show the air-dry weight content and not contain in excess of 10-percent moisture.

- H. Soil retention blanket installed in all drainage swales and ditches shall be in accordance with Specification Item No. 642S "Temporary Erosion and Sediment Control".

#### 601S.4 - Sources

The salvaged topsoil may be obtained from the right-of-way at sites of proposed excavation or embankment when shown on the Drawings or identified by the City Engineer or designated representative. The approximate quantity of acceptable topsoil to be salvaged from the project will be shown on the Drawings. The topsoil or topsoil mix may also be obtained from approved sources, which are located outside the right-of-way and have been secured by the Contractor.

#### 601S.5 - Construction Methods

Tree protection fencing will be maintained at all times to protect all trees in the limits of construction in accordance with the of Pflugerville Standard Detail 610S-4 "Tree Protection Fence Modified Type A-Chain Link" Where removal of trees is indicated on the Drawings, they shall be marked as directed by the City Engineer, designated representative, certified arborist, or City Planning Department.

The Contractor shall cut, grub, remove and dispose of all trees (non-protected), stumps, brush, shrubs, roots and any other objectionable material within the limits defined in the Drawings. Trees and brush shall be removed to a depth at least 3 feet below finished grade. Heavy growth of weeds and other plants shall be stripped from the surface in order to provide clear access to the work site and to prevent their inclusion in stockpiles soil to be reused. Trees, stumps, surface plants and all debris shall be removed from the site and disposed of off-site at Contractor's expense. No stumps, trees, limbs or brush shall be buried in any fills or embankments.

Construction equipment shall not be operated, nor construction materials stockpiled within the critical root zone of trees. Tree protection fencing shall remain in place per tree protection plan. Topsoil materials shall not be placed within the critical root zones of trees until tree wells are constructed that conform to 610S-6 "Slope Protection and Tree Wells". The source and stockpile areas shall be kept drained, insofar as practicable, during the period of topsoil removal. Avoid mixing topsoil with subsoil, and stockpile topsoil in areas on the Site approved by the City Engineer or designated representative. All excess topsoil shall remain property of the City as its option, and the Contractor shall place extra materials at a site designated by the City Engineer or designated representative.

Unless otherwise shown on the plans, topsoil shall be placed to a minimum compacted depth of four (4) inches on all parts of the site not covered with structures, pavement, or existing woodland.

Seeding shall be in conformance with the City of Pflugerville Standard Specification Item No. 604S "Seeding for Erosion Control" and the following:

1. Fertilizer (10-20-10) shall be applied at the rate of 30-lbs. per 1,000-sq. ft. or as determined by the soil test.
2. Seed shall be applied at the rate of five (5) lbs. per 1,000-sq. ft.
3. Fiber mulch shall be applied at the rate of 40-lbs. per 1,000-sq. ft.



After the topsoil is placed and before it is raked to true lines and rolled, limestone shall be spread evenly over the loam surface and thoroughly incorporated by heavy raking to at least one half the depth of topsoil.

The application of fertilizer may be performed hydraulically in one (1) operation with hydroseeding and fiber mulching. The Contractor is responsible for cleaning all structures and paved areas of unwanted deposits of the hydroseeded mixture.

Previously established grades, as shown on plans shall be maintained in a true and even condition.

Subgrade shall be prepared by tilling prior to placement of topsoil to obtain a more satisfactory bond between the two layers. Tillage operations shall be across the slope. Tillage shall not take place on slopes steeper than two (2) horizontal to one (1) vertical or where tillage equipment cannot be operated. Tillage shall be accomplished by disking or harrowing to a depth of nine (9) inches parallel to contours. Tillage shall not be performed when the subgrade is frozen, excessively wet, extremely dry or in other conditions which would not permit tillage. The subgrade shall be raked and all rubbish, sticks, roots and stones larger than two (2) inches shall be removed. Subgrade surfaces shall be raked or otherwise loosened immediately prior to being covered with loam.

Topsoil shall be placed over approved areas to a depth sufficiently greater than required so that after natural settlement and light rolling, the complete work will conform to the lines, grades and elevations indicated. No loam shall be spread in water or while frozen or muddy.

After topsoil has been spread, it shall be carefully prepared by scarifying or harrowing and hand raking. All stiff clods, lumps, roots, litter and other foreign material shall be removed from the loamed area and disposed of by the Contractor. The areas shall also be free of smaller stones, in excessive quantities, as determined by the City Engineer or designated representative. The whole surface shall then be rolled with a hand roller weighing not more than 100-lbs per foot of width. During the rolling, all depressions caused by settlement of rolling shall be filled with additional loam and the surface shall be regraded and rolled until a smooth and even finished grade is created.

Seeding shall be done within 10 days following soil preparation. Seed shall be applied hydraulically at the rates and percentages indicated. The spraying equipment and mixture shall be so designed that when the mixture is sprayed over an area, the grass seed and mulch shall be equal in quantity to the specified rates. Prior to the start of work, the Contractor shall furnish the City Engineer or designated representative with a certified statement as to the number of pounds of materials to be used per 100-gallons of water. This statement shall also specify the number of square feet of seeding that can be covered with the quantity of solution in the Contractor's hydroseeder. Upon completion of seeding operations, the Contractor shall furnish the City Engineer or designated representative with a certified statement on the actual quantity of solution applied.

In order to prevent unnecessary erosion of newly topsoiled and graded slopes and unnecessary siltation of drainageways, the Contractor shall carry out seeding and mulching as soon as he/she has satisfactorily completed a unit or portion of the project. A unit or portion of the project shall be determined by the City Engineer or designated representative. When protection of newly loamed and graded areas is necessary at a time which is outside of the normal seeding season, the Contractor shall protect those areas by whatever means necessary as approved by the City Engineer or designated representative and the City and shall be responsible for prevention of siltation in the areas beyond the limit of work.

When newly graded subgrade areas cannot be topsoiled and seeded because of season or weather conditions and will remain exposed for more than 14 days, the Contractor shall protect those areas

against erosion and washouts in accordance with Specification Item No. 642S, "Temporary Erosion and Sediment Control", or by other measures as approved by the City Engineer or designated representative. Prior to application of topsoil, any such materials applied for erosion control shall be removed or thoroughly incorporated into the subgrade by disking. Fertilizer shall be applied prior to spreading of topsoil.

#### 601S.6 – Acceptance of Work

Work under this section shall be considered acceptable when the grass has grown at least 1-1/2 inches high with a minimum of 90% coverage, provided no bare spots larger than 10 square feet exist.

Acceptance of work normally coincides with final acceptance of the entire project. However, seasonal factors may be cause for delay in grass planting, development, and acceptance.

The City will accept responsibility for normal maintenance when grass is accepted. However, the Contractor shall remain responsible for any subsequent grass damage that he causes and for warranty of materials and workmanship for a period of not less than 1 year from the time of acceptance.

The Contractor shall furnish full and complete written instruction for maintenance of the seeded areas to the City Engineer or designated representative at the time of acceptance.

#### 601S.7 - Measurement and Payment

Salvaging, removal and/or placing topsoil or grass materials and fertilizing will not be measured for payment, but shall be included in the unit price bid for the item of construction in which these activities are used.

**END**

## ITEM NO. 602S - SODDING FOR EROSION CONTROL

### 602S.1 - Description

This item shall govern planting of Bermuda grass or other acceptable grass sod at locations indicated on the Drawings or as directed by the City Engineer or designated representative in accordance with this Standard Specification Item.

### 602S.2 - Submittals

Within 14 days prior to the commencement of related work, the Contractor shall submit electronically the following submittal requirements including the identification of the type and source of sodding, the type of mulch, type of tacking agent and type and rate of application of fertilizer.

### 602S.3 - Materials

#### A. Block and Mulch Sod

The sod shall consist of live, growing Bermuda Grass when shown on the Drawings, or other acceptable grass sod indicated on the Drawings secured from sources that are approved by the City Engineer or designated representative. Bermuda Grass sod or other grass sod as shown on the Drawings shall have a healthy, virile root system of dense, thickly matted roots throughout the soil of the sod for a minimum thickness of 1-inch. The thickness measure does not include grass. The sod shall be cut in rectangular pieces with its shortest side not less than 12-inches. The Contractor shall not use sod from areas where the grass is thinned out nor where the grass roots have been dried out by exposure to the air and sun to such an extent as to damage its ability to grow when transplanted.

The sod shall be substantially free from noxious weeds, Johnson grass or other grasses and shall not contain any matter deleterious to its growth or which might affect its subsistence or hardiness when transplanted. Unless the area has been closely pastured, it shall be closely mowed and raked to remove all weeds and long-standing stems. Sources from which sod is to be secured shall be approved by the City Engineer or designated representative.

Care shall be taken at all times to retain the native soil of the roots of the sod during the process of excavating, hauling and planting. Sod material shall be kept moist from the time it is dug until it is planted. The sod existing at the source shall be watered to the extent required by the City Engineer or designated representative prior to excavating.

#### B. Fertilizer

Fertilizer and the rate of application shall conform to the requirements of Standard Specification Item No. 606S, "Fertilizer".

#### C. Mulch

Straw mulch shall be oat, wheat or rice straw and shall be in accordance with the City of Pflugerville Standard Detail 645S-1 "Mulching." Hay mulch may be substituted for straw mulch and shall be Prairie Grass, Bermuda grass or other hay approved by the City Engineer or designated representative. The hay or straw mulch shall be free of Johnson grass or other noxious weeds and foreign materials. It shall be kept in a dry condition and shall not be molded or rotted.

D. Water

Water shall be furnished by the Contractor and shall be clean and free of industrial wastes and other substances harmful to the growth of sod or to the area irrigated.

E. Tacking Agents

Tacking agents for straw or hay mulch shall be as shown on the Drawings.

602S.4 - Planting Season

All planting shall be done in accordance with the following table:

<u>Time of Year</u>	<u>Seed Type</u>	<u>Amount of Seed per 1,000 SF</u>
October – February (Requires both seed types)	Unhulled Bermuda	1 lb.
	Winter Rye	3 lbs.
March – September	Hulled Bermuda	1 lb.

602S.5 - Construction Methods

A. General

After the designated areas have been completed to the lines, grade and cross sections indicated on the Drawings, the surface shall be worked to a depth of not less than 4 inches with a disc-tiller or other equipment approved by the City Engineer or designated representative. Fertilizer nutrients shall be applied and tilled. Areas that become crusted shall be reworked to an acceptable condition before sodding. Sodding of the type specified shall conform to the requirements of this Specification Item. The Contractor shall give continuous care to the sodded area until the sod is accepted.

B. Placement

The sod shall be placed on the prepared surface with the edges in close contact and alternate courses staggered. In ditches the sod shall be placed with the longer dimension perpendicular to the flow of water in the ditch. On slopes, starting at the bottom of the slope, the sod shall be placed with the longer dimension parallel to the contours of the ground. The exposed edges of sod shall be buried flush with the adjacent soil. On slopes exceeding 3:1 or where the sod may be displaced, the sod shall be pegged with not less than 4 stakes or ground staples per square yard with at least 1 stake or ground staple for each piece of sod.

Pegs shall be of wood lath or similar material, pointed and driven with the flat side against the slope, 6 inches into the ground, leaving approximately 1/2-inch of the top above the ground. Ground staples shall not be less than 13 inches in length and shall be constructed of No. 11 gage wire that is bent to form a "U" approximately 1-inch in width.

### C. Watering

Immediately after the area is sodded, it shall be watered with a minimum of 5 gallons of water per square yard and at 10-day intervals as needed and as directed by the City Engineer or designated representative. Subsequent to the initial application water shall be applied at a minimum rate of 3 gallons per square yard, as required on the Drawings or as directed by the City Engineer or designated representative until final acceptance by the City Engineer or designated representative. Work under this Section will be considered acceptable when grass has grown at least 1-1/2 inches high with a minimum of 90% coverage, provided no bare spots larger than 10 square feet exist.

### D. Finishing

Where applicable, the shoulders, slopes and ditches shall be smoothed after planting has been completed and shaped to conform to the desired cross sections shown on the Drawings. Any excess soil from planting operations shall be spread uniformly over adjacent areas or disposed of as directed by the City Engineer or designated representative so that the completed surfaces will present a neat appearance. All sodded areas shall be rolled after the initial watering application, when sufficiently dry.

### 602S.6 - Block Sodding

At locations indicated on the Drawings or where directed by the City Engineer or designated representative, sod blocks shall be carefully placed on the prepared areas. The fertilizer shall then be applied in accordance with the applicable provisions of Item No. 606S, "Fertilizer" and thoroughly watered. When sufficiently dry, the sodded area shall be rolled or tamped to form a thoroughly compacted, solid mat. Any voids left in the block sodding shall be filled with additional sod and tamped. Surfaces of block sod which, in the opinion of the City Engineer or designated representative may slide due to the height and slope of the surface or nature of the soil, shall be pegged with wooden pegs driven through the sod blocks into firm earth sufficiently close to hold the block sod firmly in place. Edges along curbs and drives, walkways, etc., shall be carefully trimmed and maintained until the sodding is accepted.

### 602S.7 - Mulch Sodding

The sod source shall be disked in 2 directions cutting the sod thoroughly to a depth of not less than 4 inches. Sod material shall be excavated to a depth of not more than 2 inches below the existing root system, being careful to avoid having soil containing no grass roots. The disked sod may be windrowed or otherwise handled in a manner satisfactory to the City Engineer or designated representative. The material shall be rejected if not kept in a moist condition.

Prior to placement of mulch sod, the cut slopes shall be scarified by plowing furrows 4 inches to 6 inches deep along horizontal slope lines at 2-foot vertical intervals. Excavated material from the furrows shall not protrude more than 3 inches above the original surface of the cut. Fertilizer shall be distributed uniformly over the area in accordance with the applicable provisions of Item No. 606S, "Fertilizer". The sod shall then be deposited upon the prepared area and spread uniformly to the thickness indicated on the Drawings.

Any section that is not true to lines and cross sections shall be remedied by the addition of sod material or by reshaping the material to meet the requirements of "Finishing" [Section 602S.5 (D)]. After the sod material has been spread and shaped, it shall be thoroughly wetted and compacted with a corrugated roller of the "Cultipacker" type. All rolling of slope areas shall be on the contour.

602S.8 - Measurement

Work and acceptable material for "Sodding for Erosion Control" will be measured by the square yard complete in place with a minimum of 90 percent growth with a 1-½ inch stand of grass.

602S.9 - Payment

The work performed and materials furnished and measured as provided under "Measurement" will be paid for at the unit bid price for Bermuda Block Sodding", "Bermuda Mulch Sodding" or "Other Approved Grass Sodding". The prices shall each represent full compensation for completion of the work including all water applications, rolling, pegging and fertilizer as indicated on the Drawings.

Payment will be made under one of the following:

<b>Pay Item No. 602S-A:</b>	Bermuda Block Sodding	Per Square Yard.
<b>Pay Item No. 602S-C:</b>	Bermuda Mulch Sodding	Per Square Yard.
<b>Pay Item No. 602S-D:</b>	Grass Sodding	Per Square Yard.

END

ITEM NO. 604S - SEEDING FOR EROSION CONTROL

604S.1 - Description

This item shall govern the preparation of a seed bed for temporary or permanent erosion control; sowing of seeds; fertilizing; mulching with straw, cellulose fiber wood chips, and recycled paper mulch; and other management practices along and across such areas as indicated in the Drawings or as directed by the City Engineer or designated representative.

604S.2 - Submittals

The following submittal items are required to be submitted to the City Engineer or designated representative electronically within 14 days prior to the construction of related work:

- A. Identification of the seed species, source, mixture, and pure live seed (PLS) of the seed as listed on the analysis tags and certification tags from all seed bags.
- B. Identification of the fertilizer proposed for use.
- C. Type of hydraulic seeding equipment and nozzles proposed for use.
- D. If pesticide use is proposed, an Integrated Pest Management (IPM) plan for pest removal including pesticide label, proposed application rate and timing, and MSDS sheets. Pesticides should be used only when determined to be absolutely necessary. If determined to be necessary, an IPM plan shall be utilized. Suggested IPM information is in TCEQ RG-348 Section 2.3.2.
- E. One-gallon sample of proposed vegetative mulch.

The following submittal items are required before Substantial Completion:

- A. For hydromulch applications, the complete hydromulch application log, including date, time and quantity of product units placed in the slurry tank. An example of an application log is provided in Table 1. This log may be requested at any time during construction by the City Engineer, designated representative, or authorized inspector.
- B. Pesticide application tracking log to demonstrate compliance with the EPA/TCEQ mandated Municipal Stormwater Permit, the TPDES General Pesticide Permit, City Code, and the IPM program.

**Table 1: Example of Hydromulch Application Log**

Date	Start Time	Finish Time	ac/Tank	Water (gal)	Seed Mix	Hydro Slurry Unit (per acre rates)				
						Seed (Bags/ac)	Tackifier (Buckets/ac)	Mulch (Bales/ac)	Fertilizer (Bags/ac)	Addl. Amendments (Bags/ac)
4/13	10:30	11:15	1.0	3300	A	1	100	1000	50	5
4/17	2:00	2:30	0.5	3300	A	2	200	1500	50	5
5/20	8:30	10:00	1.2	3300	B	3	300	3000	50	5
					Totals	6	600	5500	127	15

604S.3. - Materials

A. Seed

All seed must meet the requirements of the Texas Seed Law including the labeling requirements for showing pure live seed (PLS), name and type of seed, and all other required elements of the Analysis and Certification Tags.

Grass seed shall be common Bermuda grass, hulled, and minimum 82% PLS. All grass seed shall be free from noxious weed, grade "A" recent crop, recleaned and treated with appropriate fungicide at the time of mixing. Seed shall be furnished in sealed, standard containers with dealer's guaranteed analysis.

The amount of seed planted per square yard or acre shall be of the type specified in Section 604S.5.

B. Water

Water shall be clean and free of industrial wastes and other substances harmful to the growth of plant material or the area irrigated.

C. Topsoil

Topsoil shall conform to Item No. 601S.3(A). Topsoil shall be generally free from clay, lumps, coarse sand, stones, roots and other foreign matter. For hydromulch applications, topsoil shall be high quality imported topsoil of loamy character high in humus and organic content from a local agriculture source and shall be applied to the limits shown on the Drawings. There shall be no toxic amounts of acid or alkaline elements.

D. Fertilizer

The fertilizer shall conform to Specification Item No. 606S, Fertilizer.

<b>Application</b>	<b>N-P-K</b>	<b>Rate</b>
Broadcast Seeding	10-20-10	30 lbs per 1,000 SF
Hydroseeding	10-20-10	30 lbs per 1,000 SF
Hydromulching	18-18-5	25 lbs per 1,000 SF

Fertilizer should be applied only when plants can take them up for growth, during: 1) seed germination and plant establishment and 2) after plant establishment. Fertilizer shall not be applied within 48 hours of a potential rain event.

E. Straw Mulch or Hay Mulch

Straw Mulch shall be oat, wheat or rice straw. Hay mulch shall be prairie grass, or other hay approved by the City Engineer or designated representative. The straw or hay shall be free of Johnson grass or other noxious weeds and foreign materials. It shall be kept in a dry condition and shall not be moldy or rotted.



F. Tackifier

The tackifier shall be a biodegradable tacking agent, approved by the City Engineer or designated representative.

G. Cellulose Fiber Mulch (Natural Wood)

Cellulose Fiber Mulch shall be in accordance with TxDOT's Approved Product List Item 164 "Seeding for Erosion Control". The mulch shall be designed for use in conventional mechanical planting, hydraulic planting of seed or hydraulic mulching of grass seed, either alone or with fertilizers and other additives. The mulch shall be such, that when applied, the material shall form a strong, moisture-retaining mat without the need of an asphalt binder.

H. Recycled Paper Mulch

Recycled paper mulch shall be specifically manufactured from post-consumer paper and shall contain a minimum of 85% recycled paper content by weight, shall contain no more than 15% moisture and 1.6% ash, and shall contain no growth inhibiting material or weed seeds. The recycled paper mulch shall be mixed with grass seed and fertilizer (see "fertilizer" above) for hydro-seeding/mulching, erosion control, and a binder over straw mulch. The mulch, when applied, shall form a strong, moisture-retaining mat of a green color without the need of an asphalt binder.

I. Mulch

Mulches, acting as seed coverings, can enhance seed germination and seedling establishment. Characteristics of ideal mulches for seeding are those that protect seeds from wind (drying), excessive solar radiation, high evapotranspiration rates, and erosion, while allowing germination and growth. Relatively coarsely shredded, weed-free vegetative mulch should be used on seed installations, especially in open, sunny areas. These materials shall be clean, free of foreign matter, and dry enough to spread evenly.

J. Pesticide

A least toxic, integrated pest management (IPM) approach shall be used to control weeds. A written request for approval of weed control products and materials shall be submitted to the City of Pflugerville for approval. Pesticides should be used only when determined to be absolutely necessary. If determined to be necessary, an IPM plan shall be utilized. Suggested IPM information is in TCEQ RG-348 Section 2.3.2.

604S.4 - Construction Methods

A. Product Delivery, Storage and Handling

Deliver fertilizer to site in original unopened container bearing Manufacturer's guaranteed chemical analysis, name, trademark and conformance to State Law.

Store fertilizer in a dry location and protect from weather.

B. General

The Contractor shall limit preparation of the seedbed to areas that will be seeded immediately. When seeding for permanent erosion control, weed species listed in Table 2 shall be managed by application of an appropriate herbicide and/or by physical removal by the roots before the seeding operation. The goal of weed management is to facilitate establishment of the permanent vegetative cover. Additionally, the Owner may require removal of any plant species that appears to be out-competing seeded or planted species during the construction period. For final acceptance of permanent stabilization by the City Engineer or designated representative, no more than 5% of vegetative cover may be weed species.

**Table 2: Weed List**

<b>Weed Type</b>	<b>Botanical Name</b>	<b>Common Name</b>
Annual Grass	<i>Cenchrus spp.</i>	Sandbur
Herb	<i>Cnidocolus texanus</i>	Bull Nettle
Herb	<i>Urtica spp.</i>	Stinging Nettle
Vine	<i>Toxicodendron radicans</i>	Poison Ivy
Perennial Grass	<i>Sorghum halapense</i>	Johnson Grass
Perennial Grass	<i>Arundo donax</i>	Giant Cane
Perennial Grass	<i>Phyllostachys aurea</i>	Golden Bamboo
Summer Annual Herb	<i>Ambrosia trifida</i>	Ragweed
Winter Annual Herb	<i>Rapistrum rugosum</i>	Bastard Cabbage
Winter Annual Herb	<i>Bromus arvensis</i>	Japanese Brome
Winter Annual Herb	<i>Lolium multiflorum</i>	Annual Ryegrass

C. Preparing Seed Bed

After the designated areas have been fine graded to the final elevations indicated in the Drawings a suitable seedbed shall be prepared removing any debris and ensuring the seedbed is smooth. The seedbed shall consist of a minimum of either 4 inches of approved topsoil or 4 inches of approved salvaged topsoil.

The topsoil or growing medium must be prepared so that compaction is appropriate for plant growth, and to achieve acceptable bulk density or hydrologic function. Rippers and subsoilers may be used to loosen compacted soil and roughen the surface. Disks, plows and excavator attachments are good for compaction reduction, roughening and incorporating amendments. If tracked machinery is used in seedbed preparation, cleat marks should run with the contour to prevent rills. The optimum depth for seeding shall be 1/8- to 1/4-inch.

Water shall be gently applied as required to prepare the seedbed prior to the planting operation either by broadcast seeding or hydraulic planting. Seeding shall be performed in accordance with the requirements described below.

#### D. Watering

All seeded areas regardless of method of seeding (e.g., broadcast, hydroseed) shall be watered immediately after installation. For seed germination and establishment, it is important to keep the seedbed in a moist condition favorable for the growth of plant materials.

Watering applications shall constantly maintain the seedbed in a moist condition favorable for the growth of plant materials. Watering shall continue until the plant material is accepted by the City Engineer or designated representative. Acceptance requires at least 1-1/2 inches high with a minimum of 90% coverage, provided no bare spots larger than 10 square feet exist. Supplemental watering can be postponed immediately after a half-inch or greater rainfall on the site but shall be resumed before the soil dries out.

#### E. Guarantee and Replacement

The Contractor shall provide guaranty for a period of 1 year after final completion and acceptance of project, that the installed grass areas be at least the quality and condition as during acceptance.

The Contractor shall re-hydrmulch unacceptable areas during the guarantee period. Guarantee shall not include damage or loss of lawn due to acts of God, acts of vandalism or negligence on the part of the City.

### 604S.5 - Native Seeding

Seed shall be applied by broadcast, hydromulch, blown compost, or drill method and shall be distributed evenly over the topsoil areas. Mulching shall immediately follow seed application for broadcast and hydromulch applications.

#### A. Method A - Broadcast Seeding

The seed or seed mixture in the quantity specified shall be uniformly distributed over the prepared seed bed areas indicated on the Drawings or where directed by the City Engineer or designated representative. If the sowing of seed is by hand, rather than by mechanical methods, the seed shall be sown in two directions at right angles to each other. If mechanical equipment is used, all varieties of seed, as well as fertilizer (if required), may be distributed at the same time, provided that each component is uniformly applied at the specified rate. After planting, the planted area shall be rolled with a corrugated roller of the "Cultipacker" type. All rolling of the slope areas shall be on the contour.

Seed Mixture and Rate of Application for Broadcast Seeding shall be in conformance with the City of Pflugerville Standard Specification Item No. 604S "Seeding for Erosion Control" and the following:

1. Fertilizer shall conform to the following table:

<b>Application</b>	<b>N-P-K</b>	<b>Rate</b>
Broadcast Seeding	10-20-10	30 lbs per 1,000 SF
Hydroseeding	10-20-10	30 lbs per 1,000 SF
Hydromulching	18-18-5	25 lbs per 1,000 SF

2. Seed shall be applied at the rate of five (5) lbs. per 1,000-sq. ft.
3. Fiber mulch shall be applied at the rate of 50-lbs. per 1,000-sq. ft.

Water shall be applied after completing the installation as necessary to insure germination of grass. The area shall be maintained by the Contractor until complete germination and establishment of all areas.

**B. Method B - Hydraulic Planting**

The seedbed shall be prepared as specified above and a hydromulcher (sprayer), which is capable of placing all materials in a single operation, shall be used. Hydroseeding equipment shall be clean and free of all previous seeds, fertilizer, mulch, or any hydroseeding products used on prior jobs.

The hydromulcher shall apply the seed mixture (made in accordance with Manufacturer's recommendations) at the following rates:

1. Mulch: 60 lbs. per 1,000 SF.
2. Fertilizer:

<b>Application</b>	<b>N-P-K</b>	<b>Rate</b>
Broadcast Seeding	10-20-10	30 lbs per 1,000 SF
Hydroseeding	10-20-10	30 lbs per 1,000 SF
Hydromulching	18-18-5	25 lbs per 1,000 SF

Water shall be applied after completing the installation as necessary to insure germination of grass. The area shall be maintained by the Contractor until complete germination and establishment of all areas.

C. Seed Rate Calculations

The amount of seed needed to be planted on a project shall be calculated before installation to ensure adequate seed is placed, and provided electronically as a submittal within 14 days prior to the commencement of related work. Table 3 is an example worksheet, followed by an example calculation. Information for calculation can be obtained from seed tags or the supplier.

**Table 3. Seed Calculation Worksheet**

<b>Plant Group</b>	<b>Desired Seeding Rate (lbs/ac)</b>	<b>PLS (pure live seed)</b>	<b>Bulk Rate (lbs/ac)</b>	<b>Seeding Area (ac)</b>	<b>Amt. of Seed to be Installed (lbs)</b>
Grasses					

Formulas:

PLS (pure live seed) = (Purity × Germination) × 100. Can also use average PLS from seed tags.

Bulk Rate (lbs/ac) = Desired Seed Rate (lbs/ac) / PLS

Amt. of Seed to be Installed (lbs) = Bulk Rate (lbs/ac) × Seeding Area (ac)

**Example:**

<b>Plant Group</b>	<b>Desired Seeding Rate (lbs/ac)</b>	<b>PLS [pure live seed] (% decimal)</b>	<b>Bulk Rate (lbs/ac)</b>	<b>Seeding Area (ac)</b>	<b>Amt. of Seed to be Installed (lbs)</b>
Grasses	131.00	0.81	161.73	1.50*	242.60

\*applied over the same 1.5-acre area

604S.7 - Mulch

Mulches may be used to help prevent soil erosion until final stabilization is achieved. Mulch shall be used to cover broadcasted seeds, especially in sunny, open areas, to protect them from drying out during germination.

A. Straw Mulch

Straw mulch shall be spread uniformly over the area indicated or as designated by the City Engineer or designated representative at the rate of 2 to 2½ tons of straw per acre. The actual rate of application will be designated by the Landscape Architect, City Engineer or designated representative. Straw may be hand or machine placed and adequately secured.

B. Hydromulch

Hydromulch mix shall be Conwed regular wood fiber mulch or approved equivalent. The hydromulcher shall apply the seed mixture (made in accordance with Manufacturer's recommendations) at the following rates:

1. Mulch: 40 lbs per 1,000 SF.
2. Fertilizer:

Application	N-P-K	Rate
Broadcast Seeding	10-20-10	30 lbs per 1,000 SF
Hydroseeding	10-20-10	30 lbs per 1,000 SF
Hydromulching	18-18-5	25 lbs per 1,000 SF

C. Shredded Brush Mulch

Small brush or tree limbs, which have been shredded, may be used for mulching Native Grass seeding.

604S.8 – Management & Maintenance Practices

Management Practices include (1) weed management (pesticide application or mechanical removal) such that 90 percent of the revegetation area is free of weeds listed in Table 2, and (2) maintenance and reseeded of poor germination to achieve coverage and height per 604S.9, with no bare areas greater than 10 SF.

A. Weed Management

Ninety (90) percent of a permanent revegetation area must be free of weeds listed in Table 3. Weeds shall be controlled in the most efficient manner possible. Management of weed species should begin early in the project, before seeding for permanent control, and extend into plant establishment, especially for perennial weeds. Manual removal or application of an appropriate herbicide may be required after the initial seeding if emergence of an annual weed species threatens establishment of sufficient preferred plant cover. Disturbance due to weed management after the initial seeding may necessitate re-seeding of the area to establish sufficient preferred plant coverage. Care should be taken to temporarily stabilize areas where physical removal of weeds has been performed to prevent erosion and sediment runoff. The entire root system of perennial weeds shall be removed to prevent re-sprouting.

Weeds may be controlled with an approved contact, systemic herbicide, provided the product is used with appropriate care and is applied in accordance with label instructions and the following guidelines:

1. Herbicide shall not be applied when the wind is greater than 8 mph,
2. Herbicide shall not be applied when rainfall is expected within 24 hours,

3. Herbicide shall not contact surface water, i.e. creeks, rivers, and lakes. Application of herbicide shall be at a minimum setback of 50 ft from any source of surface water. Targeted use of herbicide to individual plants by direct application to woody vegetation is allowable.
4. Herbicide shall not contact desirable vegetation (a wicking method shall be used, if necessary, to accurately contact target weed only during application).
5. Only herbicides known to have low toxicity to terrestrial and aquatic organisms and do not leach into ground and surface waters are recommended.
6. The use of herbicides must comply with state and Federal regulations.
7. The contractor shall possess a permit to apply herbicide as required by the Texas Herbicide Law of the Texas Department of Agriculture.
8. The Federal Insecticide, Fungicide, and Rodenticide Act requires that herbicides comply with the Endangered Species Act.
9. Special precautions must be taken to ensure that adverse impacts to rare, threatened, and endangered species are avoided.

The City Engineer or designated representative shall be consulted to determine appropriate weed control management when weeds are located in an environmentally sensitive location (e.g. near water or adjacent to a critical environmental feature).

#### B. Maintenance and Reseeding

At locations that fail to show an acceptable stand of planting for any reason during the initial seeding, repair and/or reseed locations as determined by the City Engineer or designated representative. A successful stand of grasses for erosion control should exhibit the following:

1. Seedlings with vigorous green foliage;
2. Green leaves remaining throughout the summer, at least at the plant bases;
3. Uniform density;
4. No bare spots larger than 10 SF;
5. Grass is at least 1-1/2 inches high.
6. There is a minimum of 90% grass coverage;

The Contractor shall water and maintain all grassed areas until final acceptance. He shall also re-fertilize at the rates listed here in and in the City of Pflugerville Standard Specification Item No. 606S "Fertilizer."

The City will accept responsibility for normal maintenance when grass is accepted. However, the contractor shall remain responsible for any subsequent grass damage that he causes and for warranty of materials and workmanship for a period of not less than 1 year from the time of acceptance. The Contractor shall furnish full and complete written instruction for maintenance of the seeded areas to the City Engineer at the time of acceptance.

604S.9 - Measurement

Work and acceptable material for Seeding for Erosion Control will be measured by the square yard or by the acre, complete in place.

604S.10 - Payment

The work performed and materials furnished and measured will be paid for at the unit bid price for Seeding for Erosion Control of the method specified on the Drawings and type of mulch. The unit bid price shall include full compensation for furnishing all materials, including all topsoil, water, seed, tackifier, fertilizer or mulch and for performing all operations necessary to complete the work.

All fertilizer will be measured and paid for conforming to Item No. 606S, Fertilizer.

Payment will be made under one of the following:

<b>Pay Item No. 604S-A:</b>	Native Seeding for Erosion Control Method, Hydraulic Planting	Per Square Yard
<b>Pay Item No. 604S-B:</b>	Native Seeding for Erosion Control, Broadcast Seeding	Per Square Yard
<b>Pay Item No. 604S-C:</b>	Native Seeding for Erosion Control Method, Hydraulic Planting	Per Acre
<b>Pay Item No. 604S-D:</b>	Mulch	Per Square Yard
<b>Pay Item No. 604S-E:</b>	Mulch	Per Acre
<b>Pay Item No. 604S-F:</b>	Watering	Per 1000 gal
<b>Pay Item No. 604S-G:</b>	Management Practices	Per Square Yard
<b>Pay Item No. 604S-H:</b>	Management Practices	Per Acre

END



ITEM NO. 606S – FERTILIZER

606S.1 - Description

This item shall govern the provision and incorporation of fertilizer into the soil on areas of proposed seeding, sodding, or other planting areas indicated on the Drawings and in accordance with these specifications.

606S.2 - Submittals

Within 14 days prior to the commencement of related work, the Contractor shall submit electronically the following submittal requirements:

- A. Analysis of native soil or introduced soil, including nutrient (N-P-K) content, textural class and soil organic matter percentage.
- B. Type(s) of re-vegetation (seeding, sodding, etc.) proposed.
- C. Fertilizer labels, for all type(s) of fertilizer proposed, including chemical analysis.
- D. Proposed rate(s) of application of fertilizer.
- E. Schedule of proposed fertilizer applications.

606S.3 - Materials

All fertilizer used on site shall be delivered in bags or containers that are clearly labeled according to the Association of American Plant Food Control Officials (AAPFCO) protocol. Five required components must appear on a fertilizer's label, including the brand, the grade, guaranteed analysis, net weight, and name and address of the registrant or licensee. The fertilizer may be subject to testing by the Texas State Chemist in accordance with the Texas Commercial Fertilizer Rules or Texas Fertilizer Control Act.

The fertilizer type and rate of application should be based on chemical tests of representative soil samples taken after completion of construction and ground work, but before installation of plant materials. The required types and rates of fertilizer can be found in the following table:

<b>Application</b>	<b>N-P-K</b>	<b>Rate</b>
Broadcast Seeding	10-20-10	30 lbs per 1,000 SF
Hydroseeding	10-20-10	30 lbs per 1,000 SF
Hydromulching	18-18-5	25 lbs per 1,000 SF

A pelleted or granulated fertilizer shall be used. Fifty percent or greater of the Nitrogen required shall be in the form of Nitrate Nitrogen ( $\text{NO}_3$ ). The remaining Nitrogen required may be in the form of Urea Nitrogen [ $\text{CO}(\text{NH}_2)_2$ ].

The total amount of nutrients furnished and applied per acre shall equal or exceed that specified for each nutrient.

Chemical fertilizer shall not be applied within the FEMA designated floodplain or within 100-feet of the creek centerline (unmapped creeks).

#### 606S.4 - Construction Methods

Pelleted or granulated fertilizer shall be applied uniformly into the soil at time of seedbed preparation to a depth of 4 inches over the area to be fertilized and in the manner directed for the particular item of work. The fertilizer shall be applied at the rate recommended by soil tests. The fertilizer shall be dry and in good physical condition. Fertilizer that is powdered or caked will be rejected. Distribution of the fertilizer for the particular item of work shall meet the approval of the City Engineer or designated representative.

Fertilizer should be applied (1) during seed germination and plant establishment and (2) after plant establishment. To minimize potential nutrient leaching to groundwater, fertilizer shall not be applied during plant dormancy or within 48 hours of a potential rain event. If needed, maintenance fertilizing shall be applied every 6 months after the new sod, grass or seeding is placed or until the work is accepted by the City Engineer.

The fertilizer may also be applied with the hydromulch.

#### 606S.5 - Measurement

Work and acceptable material for "Fertilizer" will be measured by the normal ton of 2,000 pounds or by the 100 pounds as determined by approved scales or guaranteed weight of sacks shown by the manufacturer.

#### 606S.6 - Payment

The work performed and materials furnished and measured as provided under "Measurement" shall be included in the unit price bid for the item of construction in which fertilizer is used, unless specified in the Drawings as a Pay Item.

When fertilizer is specified on the Drawings as a pay item or included in the contract bid form, the work performed and materials furnished and measured as provided under "Measurement" will be paid for at the unit bid price for "Fertilizer" of the analysis specified on the Drawings. The unit bid price shall include full compensation for furnishing all materials and performing all operations necessary to complete the work.

Payment, when specified, will be made under one of the following:

<b>Pay Item No. 606S-A:</b>	Fertilizer	Per Ton.
<b>Pay Item No. 606S-B:</b>	Fertilizer	Per 100 Pounds.

**END**

ITEM NO. 639S - ROCK BERM

639S.1 - Description

This item shall govern the construction of a temporary berm of open graded rock that is installed at the toe of a slope on the perimeter of a developing area. Rock berms are appropriate for use as flow diverters, energy dissipators, grade control, and level spreaders to release the water in sheet flow. This item shall also govern the removal of the "Rock Berm" and re-vegetation of the area.

639S.2 - Submittals

Within 14 days prior to the commencement of related work, the Contractor shall submit electronically the following submittal requirements:

- A. Function (flow diversion, grade control, energy dissipator, level spreader, or other) and dimensions of the rock berm
- B. Source, type and gradation of rock
- C. Re-vegetation program, including:
  - 1. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.
  - 2. Type of mulch.
  - 3. Type of tacking agent.
  - 4. Type and rate of application of fertilizer.

639S.3 - Design Criteria

A detailed design is not required for the installation of a rock berm; however, the following criteria shall be observed:

<b>Drainage Area</b>	-	less than 5 acres (2 hectares).
<b>Height</b>	-	18 inches minimum height, measured vertically from the top of the existing ground at the upslope toe to the top of the berm.
<b>Top Width</b>	-	2 feet minimum.
<b>Side Slopes</b>	-	2:1 or flatter.
<b>Grade</b>	-	Berms will be built along a contour as near possible to a 0 percent grade.

639S.4 - Materials

Rock shall be 3 inches to 5 inches, open graded as indicated on Standard Detail No. 639S-1 "Rock Berm". Seeding for re-vegetation shall conform to Item No. 604S, "Seeding for Erosion Control".

Woven wire sheathing shall be 20-gauge with 1-inch openings.

639S.5 - Construction Methods

All trees, brush, stumps and objectionable material shall be removed and disposed in a manner that will not interfere with the construction of the berm.

A trench shall be excavated to a minimum depth of 4 inches below existing grade for placement of the rock as indicated on Standard Detail No. 639S-1 "Rock Berm" and the Drawings. Woven wire fabric shall be placed on the ground along the proposed installation with enough overlap to completely encircle the finished size of berm. Rock shall be placed along the center of the wire to the designated height indicated on the Drawings, and the structure wrapped in the previously placed wire mesh secure enough so that when it is walked across its shape is maintained. The wire mesh shall be secured with tie wire. The ends of the berm shall be tied into existing upslope grade.

The area upstream from the rock berm shall be maintained in a condition, which will allow sediment to be removed following the runoff from a rainfall event. After each rainfall event with an accumulation of 1 inch or more, an inspection of the rock berm will be made by the Contractor and the stone shall be replaced, when the structure ceases to function as intended because of sediment accumulation among the rocks, washout, construction traffic damage, etc.

If the sediment reaches a depth equal to 1/3 the height of the berm or 6 inches, whichever is less, the Contractor will remove the accumulated sediment and dispose of it at an approved disposal site in a manner that will not contribute to additional sedimentation. The berm will be reshaped as needed during construction.

When the site is completely stabilized, the berm will be removed and disposed of in a manner approved by the City Engineer or designated representative.

The area will be re-vegetated as required by Item No. 604S, "Seeding for Erosion Control".

639S.6 - Measurement

Acceptable work performed and prescribed in this item will be measured by the linear foot along the centerline of top of berm

639S.7 - Payment

The work performed and material furnished and measured as provided under "Measurement" to construct this item will be paid for at the unit bid price per linear foot of rock berm barrier as indicated on the Drawings. The Unit Bid Price shall include full compensation for: (a) furnishing, hauling and placing all materials including all labor, tools, equipment and incidentals needed to complete the work, (b) maintaining the berm, (c) removing sediment accumulations, (d) rock replacement, (e) removing and disposing of all materials when the berm is no longer required and (f) re-vegetating the site upon removal of the berm.

Payment will be made under:

<b>Pay Item No. 639S-A:</b>	Rock Berm	Per Lineal Foot.
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**END**

## ITEM NO. 641S - STABILIZED CONSTRUCTION ENTRANCE

### 641S.1 - Description

This item governs the construction of a stabilized pad of crushed stone located at any point where traffic will be entering or leaving a construction site to or from a public right of way, street, alley, sidewalk or parking area. The removal of the stabilized pad of crushed stone shall also be included in the item. The purpose of a stabilized construction entrance is to reduce or eliminate the tracking or deposition of sediment onto public right of way.

### 641S.2 - Submittals

Within 14 days prior to the commencement of related work, the Contractor shall submit electronically the following submittal requirements:

- A. Source, type and gradation of rock

### 641S.3 - Materials

Rock shall be 4-inch to 8-inch coarse aggregate.

### 641S.4 - Construction Methods

All trees, brush, stumps, obstructions and other objectionable material shall be removed and disposed of in a manner that will not interfere with the excavation and construction of the entrance as indicated on the Drawings or as presented in Standard Details No. 641S-1 "Stabilized Construction Entrance".

The stabilized construction entrance shall have a minimum width not less than the full width of the ingress/egress and a minimum length of 50 feet. An 8-inch high diversion ridge shall be constructed 15 feet from the edge of the existing roadway. Rock used shall be 4-inch to 8-inch coarse aggregate and shall be placed to a depth of at least 8 inches. Geotextile fabric shall be used as required in accordance with the Drawings.

The entrance shall not drain onto the public right of way or shall not allow surface water runoff to exit the construction site. Runoff from the stabilized construction entrance onto a public street will not be allowed except for the first 15 feet connecting to the public street.

When necessary, vehicle wheels shall be cleaned to remove sediment prior to entrance onto public right of way. When vehicle washing is required, it shall be done on an area stabilized with crushed stone, which drains into an approved sediment trap or sediment basin. All sediment shall be prevented from entering any storm drain, ditch or watercourse through use of sandbags, gravel, boards, silt fence (Standard Specification Item No 642S "Temporary Erosion and Sediment Control") or other methods approved by the City Engineer or designated representative.

The entrance shall be maintained in a condition that will prevent tracking or disposition of sediment onto public right of way. This restriction may require periodic top dressing with additional stone as conditions demand, as well as the repair and/or cleanout of any measures used to trap sediment. All sediment that is spilled, dropped, washed or tracked onto public right of way must be removed immediately.

641S.5 - Measurement

Acceptable work performed as prescribed in this item will be measured by unit of each stabilized construction entrance installed.

641S.6 - Payment

The work performed and materials furnished and measured as provided under "Measurement" will be paid for at the unit bid price per lineal foot of "Stabilized Construction Entrance". The price shall include full compensation for furnishing, hauling and placing all materials, labor, tools, equipment and incidentals necessary to complete the work including inspecting, repairing, replacing and relocating existing fencing, removal of silt and removal and disposal of all materials at the completion of construction.

Payment, when included as a contract pay item, will be made under:

<b>Pay Item No. 641S-A:</b>	Stabilized Construction Entrance	Per Each.
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**END**

## ITEM NO. 642S - TEMPORARY EROSION AND SEDIMENT CONTROL

### 642S.1 - Description

This item shall govern the provision and placement of a silt fence fabric fence, triangular filter dike, curb inlet protection and soil retention blankets, including maintenance, removal of accumulated silt, removal of the temporary erosion control devices and re-vegetation of disturbed areas upon completion of the project.

### 642S.2 - Submittals

Within 14 days prior to the commencement of related work, the Contractor shall submit electronically the following submittal requirements:

- A. Source, manufacturer, characteristics and test data for the silt fence fabric
- B. Manufacturer, characteristics and test data for the posts and wire fence for silt fence
- C. Source, manufacturer, characteristics and test data for wire mesh for silt fence
- D. Source, manufacturer, characteristics and test data for the geotextile fabric for triangular filter dikes
- E. Source, type and gradation of rock for triangular filter dikes
- F. Source, manufacturer, characteristics and test data for welded wire mesh for triangular filter dikes
- G. Source, manufacturer, characteristics and test data for the geotextile fabric for curb inlet protection
- H. Re-vegetation program, including:
  1. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.
  2. Type of mulch.
  3. Type of tacking agent.
  4. Type and rate of application of fertilizer.

### 642S.3 - Materials

#### A. Fabric

##### 1. Silt Fence

The silt fence fabric shall be 4.5 oz. per SY minimum and supplied in rolls a minimum of 36 inches wide. Silt fence shall conform to the City of Pflugerville Standard Detail 642S-1 "Silt Fence".

##### 2. Triangular Filter Dike

Geotextile fabric shall be nonwoven, 4.5 oz. minimum and 30 inches wide.

### 3. Curb Inlet Protection

Geotextile fabric shall be nonwoven, 4.5 oz. minimum.

#### B. Posts

Posts for silt fence shall be heavy-weight steel Tee posts, not less than 4 feet in length.

#### C. Wire Fence

##### 1. Silt Fence

Welded wire fabric for silt fence shall be 2-inch by 4-inch mesh of 12-gauge by 12-gauge galvanized wire.

##### 2. Triangular Filter Dike

Welded wire mesh fabric for triangular filter dikes shall be 6-inch by 6-inch mesh of 6-gauge by 6-gauge wire.

#### D. Tie Wires

Tie wires for securing silt fence fabric to wire mesh shall be light gauge metal clips (hog rings) or 1/32-inch diameter soft aluminum wire.

#### E. Rock

Rock for triangular filter dikes shall be 3-inch to 5-inch open graded.

#### F. Soil Retention Blanket

Only soil retention blankets included on TxDOT's Approved Product List will be considered acceptable.

#### G. Prefabricated Commercial Silt Fence

Prefabricated commercial silt fence may be substituted for built-in-field fence. Prefabricated silt fence shall be "Envirofence" as manufactured by Mirafi Inc., Charlotte, NC or approved equivalent.

### 642S.4 - Construction Methods

#### A. Silt Fence

The silt fence shall be laid out as closely as possible to the contour. The ground shall be cleared of debris, rocks, and plants (including grasses taller than 2 inches) to provide a smooth flow approach surface. A trench 4 inches deep by 4 inches wide shall be excavated on the upstream side of the fence per the Drawings.

Heavy Tee posts shall be driven at least 12 inches to the ground and at a slight angle towards the flow. Wire mesh shall be attached to the Tee posts with 1 ½-inch galvanized Tee post clips. The top of the wire is to be 24 inches above ground level. The welded wire mesh shall be overlapped 6 inches and tied at least 6 times with hog rings.



The site fence shall be installed with a skirt (11 inches wide, minimum) placed on the uphill side of the fence inside the excavated trench. The fabric shall overlap the top of the wire by 1 inch.

The silt fence shall be anchored by backfilling the trench with excavated dirt and rocks.

The silt fence shall be repaired, replaced, and/or relocated when necessary or as directed by the City Engineer or designated representative. Accumulated silt shall be removed when it reaches a depth of 6 inches.

Per OSHA §1926.701, "all protruding reinforcing steel, onto and into which employees could fall, shall be guarded to eliminate the hazard of impalement". Caps must be large enough to dissipate the forces of impact to prevent impalement from a reasonably foreseeable fall distance. It should be noted that the use of impalement protection caps is but one method of protection; covers or wooden troughs can be another means of meeting the guarding requirement. For City of Pflugerville purposes, this also applies to Tee posts.

#### B. Triangular Filter Dike

The triangular filter dike shall be laid out as closely as possible to the contour. The area for the filter dike shall be cleared of debris, rocks and plants that will interfere with installation. The dike shall be placed 1 section at a time, with the skirt on the uphill side on the uphill side towards the direction of flow, anchoring each section to the ground before the next section is placed. Anchors should be placed 2 feet on center alternating from front to back so that there is actually 1 foot in between anchors. Securely fasten the skirt from 1 section of filter dike to the next. Filter dikes must maintain continuous contact with the ground.

Triangular filter dike sections shall be either 10 feet or 20 feet in length, and 18 inches wide on all 3 faces. Geotextile fabric shall extend to 12-inches upstream of the triangular filter dike structure. 3-inch to 5-inch open graded rock shall be placed over the skirt to anchor it on the upstream side.

The triangular filter dike shall be repaired, replaced and/or relocated when necessary or as directed by the City Engineer or designated representative. After the site is completely stabilized, the dikes and any remaining silt should be removed. Silt should be disposed of in a manner that will not contribute to additional siltation.

#### C. Curb Inlet Protection

Pavement shall be cleared of debris, rock and other objectionable materials to provide a smooth surface for installation.

The Contractor shall place the nonwoven 4.5 oz. (minimum) filter fabric over the inlet and extend to 5 feet beyond the opening, upstream of the inlet. Fabric shall be terminated in the street gutter with sandbags placed in the gutter flow line. Sandbags shall be placed on top of filter fabric around the perimeter of the protected area to secure the fabric. The fabric must be secured to wire backing with clips or hog rings. A section of filter fabric shall be removed to allow for a clear gap near the top of the inlet opening. The bottom of the gap must be a minimum of 4" from the bottom of the inlet opening.

Care shall be taken to ensure that the inlet protection will remain in place during periods of heavy runoff and that sever ponding will not occur in the street.

#### D. Soil Retention Blankets

Soil retention blankets shall be installed in all seeded drainage swales and ditches as shown on the Drawings or as directed by the City Engineer or designated representative. Only soil retention blankets included on TxDOT's Approved Product List will be considered acceptable for use.

The area to be covered shall be properly prepared, fertilized and seeded with permanent vegetation before the blanket is applied.

When the blanket is unrolled, the netting shall be on top and the fibers in contact with the soil over the entire area.

The blankets shall be applied in the direction of water flow, and stapled. Blankets shall be placed a minimum of three (3) rows, of four (4) foot wide (total approx. 12-foot width) within the drainage swale/ditch and stapled together in accordance with Manufacturer's instructions.

Side overlaps shall be four (4) inch minimum. The staples shall be made of wire, 0.091-inch in diameter or greater, "U" shaped with legs 10-inches in length and a 1 1/2-inch crown. The staples shall be driven vertically into the ground, spaced approximately two (2) linear feet apart, on each side, and one (1) row in the center alternately spaced between each size.

Upper and lower ends of the matting shall be buried to a depth of four (4) inches in a trench.

Erosion stops shall be created every 25-feet by making a fold in the fabric and carrying the fold into a silt trench across the full width of the blanket. The bottom of the fold shall be four (4) inches below the ground surface. Staple on both sides of fold.

Where the matting must be cut or more than one (1) roll length is required in the swale, turn down upper end of downstream roll into a slit trench to a depth of four (4) inches. Overlap lower end of upstream roll four (4) inches past edge of downstream roll and staple.

To ensure full contact with soil surface, roll matting with a roller weighing 100-pounds per foot of width perpendicular to flow direction after seeding, placing matting and stapling.

Thoroughly inspect channel after completion. Correct any areas where matting does not present a smooth surface in full contact with the soil below.

#### E. Tree Protection – Chain Link Fence

Chain link fence shall be five (5) feet in height.

Fence shall be installed around the driplines of the trees to be protected.

Tree protection fences shall be installed prior to the commencement of any site preparation work (clearing, grubbing, or grading).

Fences shall completely surround the tree, or clusters of trees; will be located at the outermost limit of the tree branches (dripline), and will be maintained throughout the construction of the project in order to prevent the following:

1. Soil compaction in the root zone area resulting from vehicular traffic, or storage of equipment or materials.

2. Root zone disturbances due to grade changes greater than six (6) inches cut or fill or trenching not reviewed and authorized by the City.
3. Wounds to exposed roots, trunks or limbs by mechanical equipment.

Other activities detrimental to trees, such as chemical storage, cement truck cleaning and fire.

Exceptions to installing fences at tree driplines may be permitted in the following cases:

Where permeable paving is to be installed, erect the fence at the outer limits of the permeable paving area.

Where trees are close to a proposed building, erect the fence no closer than six (6) feet to building.

#### F. Tree Protection – Wood Slats

Where any exceptions result in a fence being closer than four (4) feet to a tree trunk, protect the trunk with strapped-on-planking two inches by four inches (2"x4") wood slats to a height of eight (8) feet, or to the limits of lower branching in addition to the reduced fencing provided.

Trees most heavily impacted by construction activities should be watered deeply once a week during periods of hot, dry weather. Tree crowns should be sprayed with water periodically to reduce dust accumulation on the leaves.

Any trenching required for the installation of landscape irrigation shall be placed as far from existing tree trunks as possible.

No landscape topsoil dressing greater than four (4) inches shall be permitted within the dripline of the tree. No soil is permitted on the root flare of any tree.

Any roots exposed by construction activity shall be pruned flush with the soil. Backfill root areas with good quality topsoil as soon as possible. If exposed root areas are not backfilled within two (2) days, cover them with organic material in a manner which reduces soil temperature, and minimizes water loss due to evaporation.

Prior to excavation or grade cutting within tree dripline, make a clean cut between the disturbed and undisturbed root zones with a rock saw or similar equipment, to minimize damage to remaining roots.

Pruning to provide clearance for structures, vehicular traffic and equipment shall take place before construction starts.

#### 642S.5 - Measurement

The work performed and the materials furnished under this item will be measured by the lineal foot of "Silt Fence", complete in place.

#### 642S.6 - Payment

The work performed and materials furnished and measured as provided under "Measurement" will be paid for at the unit bid price per lineal foot of "Silt Fence". The price shall include full compensation for furnishing, hauling and placing all materials, labor, tools, equipment and incidentals necessary to

complete the work including inspecting, repairing, replacing and relocating the fence, removal of silt and removal and disposal of all materials at the completion of construction in and re-vegetation of disturbed areas.

Payment will be made under:

<b>Pay Item No. 642S-A:</b>	Silt Fence for Erosion Control	Per Lineal Foot.
<b>Pay Item No. 642S-B:</b>	Rock Berm	Per Lineal Foot.
<b>Pay Item No. 642S-C:</b>	Tree Protection	Per Each.

END

## SERIES 700 - INCIDENTAL CONSTRUCTION

### ITEM NO. 700S - MOBILIZATION

#### 700S.1 - Description

This item shall govern the mobilization of personnel, equipment and materials at the work site for other contract items that will be performed by the Contractor. Mobilization shall include, but not be limited to the movement of equipment, personnel, material, supplies, etc. to the Work site; the installation of temporary facilities (when not paid for separately) and the establishment of office and other necessary facilities prior to the initiation of the Work. The cost of the Payment Bond and Performance Bond on the Work that is delayed due to circumstances beyond Contractor's control, a closed construction season or for the convenience of the City of Pflugerville will be considered part of the mobilization item under this Contract.

#### 700S.2 - Measurement.

Measurement of the Specification Item, "Mobilization", as specified herein as "Total Mobilization Payment", will be by the "Lump Sum", as the Work progresses.

#### 700S.3 - Payment.

The adjusted contract amount as used below is defined as the original contract amount less the lump sum bid for Mobilization and any payments for materials or equipment not yet incorporated in the Work. The Contractor shall submit a lump sum amount for Payment Item No. 700S-TM, "Total Mobilization Payment".

"Initial Mobilization Payout" as used below is defined as:

1. 8% of the original contract amount for projects with an original contract amount of \$ 0.5 million or less; or
2. 4% of the original contract amount for projects with an original contract amount greater than \$ 0.5 million.

In those instances where the "Initial Mobilization Payout", as defined above, exceeds the "Total Mobilization Payment" lump sum bid item (i.e. Payment Item No. 700S-TM), the "Total Mobilization Payment" shall be used as the "Initial Mobilization Payout". In no instance shall the "Initial Mobilization Payout" exceed the "Total Mobilization Payment" bid item.

Partial payments of the "Initial Mobilization Payout" shall be as follows:

- A. Upon presentation of a paid invoice for the Payment Bond, Performance Bond and/or required insurance, the Contractor will be paid that cost from the amount bid for "Total Mobilization Payment".
- B. The Mobilization of tunnel boring machines, batch plants or other similar facilities, along with supporting materials and equipment, to the work site or to the vicinity of the Work site will be considered as partial Mobilization under this contract. The Contractor shall provide a certified statement of the Contractor's expenditure for the Mobilization and setup of the facility and supporting equipment. Upon approval by the Engineer or designated representative, the certified expenditure will be paid from the amount bid for the Specification Item, "Total Mobilization Payment". In no case shall the combined amount for all of these facilities be more than 10 percent of the Mobilization "Total Mobilization Payment" lump sum bid or one (1) percent of the total contract amount, whichever is less.

- C. When one (1) percent of the adjusted contract amount is earned, 50 percent of the "Initial Mobilization Payout will be paid. Previous payments under this item will be deducted from this amount.
- D. When five (5) percent of the adjusted contract amount is earned, seventy-five (75) of the "Initial Mobilization Payout will be paid. Previous payments under this item will be deducted from this amount.
- E. When ten (10) percent of the adjusted contract amount is earned, one hundred (100) percent of the "Initial Mobilization Payout will be paid. Previous payments under this item will be deducted from this amount.
- F. Payment for the remainder of Pay Item No. 700S-TM, "Total Mobilization Payment" will be made upon receipt of the final pay estimate.

Payment will be made under:

<b>Pay Item No. 700S-TM:</b>	"Total Mobilization Payment"	Lump Sum
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**END**

## ITEM NO. 701S - FENCING

### 701S.1 - Description

This item shall govern furnishing and installing fencing and gates at locations shown on the Drawings or directed by the Engineer or designated representative, including all posts, bracing and accessories as specified in this Item and as indicated on the Drawings.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text inch-pound units are given preference followed by SI units shown within parentheses.

### 701S.2 - Submittals

Prior to installation of the fencing the Contractor shall furnish the Engineer or designated representative with certification from the manufacturer that all fencing materials comply with the requirements specified in this Item.

### 701S.3 - Materials

#### A. Chain Link Fabric

1. Wire fabric for fencing shall be 9-gauge steel with a minimum breaking strength of 1,290 pounds per foot. The overall height of the fence when erected shall be the height above grade as indicated on the Drawings. The fabric shall be woven into an approximately 2-inch  $\pm$  1/8 -inch mesh such that in a vertical dimension of 23 inches along the diagonals of the openings there shall be at least 7 meshes. Unless indicated otherwise on the Drawings the fabric shall have a knuckled (K) and twisted (T) finish for the top and bottom selvages respectively. The wire in the fabric shall withstand a minimum tensile strength test of 75,000 psi after galvanizing. Except as provided herein, the chain link fence fabric shall conform to ASTM A392, Class I or ASTM A491.
2. The fabric shall be hot dip galvanized after weaving and shall have a minimum coating of 1.2 ounces per square foot of uncoated surface conforming to ASTM A392, Class I.
3. Between posts the fabric shall be fastened at 12-inch intervals to a top and bottom tension wire. When a top rail is shown on the Drawings, the fabric shall also be fashioned in the same manner. On gate frames, the fabric shall be fastened to top and bottom of the gate frame at all 12-inch intervals. Steel or aluminum wire fabric ties with a minimum 9-gauge diameter shall be used.

#### B. Woven Wire Fencing

Woven wire fencing shall be either galvanized steel wire fencing or aluminum-coated steel wire fencing conforming to the following requirements:

1. Galvanized steel wire fencing shall conform to ASTM A116, Class 1.
2. Aluminum-coated steel wire fencing shall consist of aluminum-coated steel wire conforming to the requirement for galvanized steel wire fencing, except the wire shall be aluminum coated. The wire shall not have less than 0.40-ounce coating of aluminum alloy per square foot of uncoated surface in accordance with ASTM A491

C. Wire Fencing

Wire shall be either galvanized or aluminum alloy coated 9 gage steel wire conforming to the specifications for galvanized steel or aluminum alloy coated woven wire fencing above.

D. Wood Fencing

Wood for wood fencing shall be Wolmanized pine, cedar or as indicated on the Drawings. The timber shall be sound and free from all decay, shakes, splits or any other defects, which would make it structurally unsuitable for the intended purpose.

E. Metal Posts, Top Rails, Braces and Gates

Steel pipe used for posts, top rails, braces and gate frames shall conform to the specifications of ASTM A 53. Steel sections used for posts, top rails, frames and braces shall be a good commercial quality weldable steel. All material shall be new and no used, re-rolled or open seam material will be acceptable. All posts shall meet the weight and length requirements indicated. The fabric bands and steel wire ties shall conform to the gauge and spacing indicated and shall be of suitable design to fasten fabric to the posts. Wire ties of the gauge shown may be used in lieu of fabric bands. All fittings required for posts shall be pressed or rolled steel, forge steel, malleable iron or wrought iron of good commercial quality and spaced as indicated on the Drawings.

1. Line Posts

Line posts may be either C-section or tubular. Tubular line posts shall be fitted with watertight malleable iron caps. Line posts shall be furnished in sufficient quantity to provide a maximum spacing of 10 feet.

2. Terminal Posts

All end, corner and pull posts shall be known as terminal posts and shall be of either round or square sections. All terminal posts shall be furnished with watertight malleable iron caps. Fabric shall be fastened to terminal posts by steel stretcher bars and stretcher bar bands fitted with carriage bolts and nuts of the size and spacing indicated on the Drawings.

3. Gate Posts

Gateposts shall be either round or square. All gateposts shall be furnished with watertight malleable iron caps. The fabric shall be attached to the gateposts by means of steel stretcher bars and stretcher bar bands fitted with carriage bolts and nuts of the size and spacing indicated on the Drawings.

4. Post Caps

Post caps for pipe sections shall be designed to exclude all moisture. Where a top rail is shown on the Drawings, post caps shall have an opening for the top rail. All post caps shall have a 2-inch skirt for rigidity. When barbed wire is allowed for topping a six-foot or higher fence (LDC Section 10-1-9) the barbed wire support arms shall be integral with post caps.



## 5. Gates

### a. Single Swing Gate

The gate frames shall be fabricated from sections either round or square of the size and weight indicated on the Drawings and shall be filled out with the same type fabric specified for the chain link fence. All gates shall be equipped with approved malleable iron or steel latches, stops and center rest. A satisfactory locking device suitable for padlocking shall be provided. The gates shall be hung by at least 2 steel or malleable iron hinges securely fastened to the posts. Hinges shall not twist or turn under the action of the gate, shall be capable of allowing a full 180 degree opening turn, shall be so arranged that a closed gate cannot be lifted off the hinges to obtain entry and shall be easily operated by one person.

### b. Double Swing Gate

Double swing gates shall be furnished and installed as indicated on the drawings. Gates shall be of the same height as the fence and shall have a single vertical mat of barbed wire. The gates shall be hinged to swing 180 degrees from closed to open. The gates shall be complete with frames, latches, stops, keepers, hinges, fabric, braces, padlocks and three strands of barbed wire. Gates shall have intermediate members and diagonal truss rods as required for rigid construction and shall be free from sag and twist. Gates shall be fitted with vertical extension arms or shall have frame end members intended to carry barbed wire.

Hinges shall be pinned type, heavy pattern with large bearing surface and shall not twist or turn under the action of gate. Latches for double swing gates shall be plunger bar type, full gate height, and arranged to engage the gate stop. Stops shall consist of a roadway plate with anchor set in Portland Cement (PC) concrete and arranged to engage the plunger. Keepers shall consist of mechanical devices for securing and supporting the free end when in the full open position. Latches shall be arranged for padlocking with padlock accessible from sides of the gate. Gates shall be installed so that they cannot be removed without disassembly of the hardware. Hardware attachment bolt shall be pinned to prevent easy removal.

## 6. Top Rail

The top rail shall be of size and weight indicated on the Drawings and shall be furnished in random lengths, not less than 18 feet per section with outside sleeve type couplings at least 6 inches long and having a wall thickness of not less than 0.70-inch. One coupling in five shall have a heavy spring to take up expansion and contraction of the rail. The top rail shall be installed before installing chain link fabric and shall pass through post tops.

## 7. Braces

All braces shall be of the size, weight and length indicated on the Drawings. All braces shall be trussed with rods and turnbuckles of the dimensions indicated on the Drawings. Braces shall be installed on all terminal posts and shall extend to the adjacent line posts. All corner and pull posts shall have braces on each side of terminal.

## 8. Fittings, Bolts and Other Miscellaneous Hardware

All fittings, bolts and miscellaneous hardware shall be hot dip galvanized in conformance with TxDOT Standard Specification Item No. 445, "Galvanizing".

## 9. Tension Wire

Between posts, the fabric shall be fastened to a top and bottom tension wire or to the top rail and bottom tension wire by steel wire ties of the gauge and spacing indicated on the Drawings. The tension wire shall be at least 7-gauge galvanized coil spring steel of good commercial quality.

Tension wire shall have a minimum coating of 0.8 ounce per square foot of uncoated surface when tested in conformance with ASTM A116.

## 10. Security Fence

The security fence shall be 8 feet high with brackets and 3 strands barbed wire.

Barbed wire, when specified on the Drawings, shall be 12-½ gauge wire, twisted with two-point 14 gauge barbs spaced approximately 5 inches apart and shall conform to ASTM A121 or ASTM A585. Three strands of barbed wire will be required when a barbed wire top is specified on the Drawings.

Barbed wire support arms shall be at an angle of 45° from vertical and shall have clips for attaching three (3) strands of barbed wire to each support arm. Each support arm shall be of sufficient strength to support a 200-pound weight applied at the outer strand of barbed wire.

## 11. Barbed Wire Fencing

Furnish barbed wire in accordance with ASTM A121, Class 1. Use barbed wire consisting of 2 strands of 12 ½ gauge wire, twisted with 2-point 14 gauge barbs spaced no more than 5 in. apart, or other barbed wire as directed.

## 12. Galvanizing

Thin-wall, high-strength pipe posts shall be externally hot-dip galvanized with a minimum weight of coating of 0.9 ounce per square foot. After galvanizing, thin-wall, high-strength pipe posts shall be externally chromated by total immersion followed by application of clear polyurethane finish.

Interior surfaces shall have a hot-dip galvanized coating, a zinc base coating with thickness 0.5 mil ± 0.2 mil. The coating shall be 94 percent zinc powder by weight.

All tubular posts, rails and braces shall comply with the following salt spray performance requirements when tested in accordance with ASTM B117.

Exterior - 1250 hours to maximum 5 % red rust

Interior - 650 hours to maximum 5 % red rust

The uniformity of the zinc coating shall be determined by visual inspection. If, in the opinion of the Engineer or designated representative, visual examination is not conclusive, he may use the

Preece Test as described in ASTM A239. When so tested, all items shall withstand a minimum of 6 one-minute dips except for those items designated in ASTM A153 as Class B-2, B-3, C and D, which shall withstand a minimum of 4 one-minute dips.

Careful visual inspection shall be made to determine the quality of the zinc coating. Excessive roughness, blisters, salammoniac spots, bruises and flaking if present to any considerable extent, shall provide a basis for rejection. Where practicable, all inspection and tests shall be made at the place of manufacturer prior to shipment and shall be so conducted as not to interfere unnecessarily with the progress of the work.

Damaged spelter coating shall be repaired by thoroughly wire brushing the damaged area and removing all loose, cracked or weld-burner spelter coating. The cleaned area shall be painted with 2 coats of zinc oxide-zinc dust paint conforming to the requirements of Federal Specification TT-P-641B. The paint shall be furnished at the Contractor's expense.

#### F. Concrete Post Anchorages

Concrete for post footings, catch blocks, anchors and other such items related to the fence construction, shall be Class B Concrete conforming to Item No. 403S, "Concrete for Structures" or as indicated on the Drawings. Maximum size of aggregate shall be 3/4 inch. Hand mixing of concrete will be permitted on batches under 1/2 cubic yard. All batches exceeding this volume will be machine mixed.

Concrete shall be placed promptly and without segregation after mixing. The Contractor shall consolidate the concrete satisfactorily by tamping or vibrating. Excess excavation from footings shall be satisfactorily disposed of.

The tops of post footings shall extend slightly above ground and shall be steel troweled to a smooth finish sloped to drain away from posts. Posts, braces and other units shall be centered in footings.

#### G. Mowing Strip

When called out in the drawings, a mowing strip shall be Class A concrete. It shall be 24 inches wide and a minimum of 4 inches thick. Three (3) number 3 (#3) bars shall be evenly spaced and supported along the full length of the mow strip, and a number 3 (#3) bar shall be cross-tied every 4 feet. Fence posts shall be installed in center of mow strip.

#### 701S.4 - Inspection and Sampling

The Contractor shall furnish, upon request of the Engineer or designated representative, samples of each component part of the fence including fittings. These samples shall be subjected to the galvanizing, weight and where required, strength tests. A sample may be taken for each project or for each shipment to a project, when requested by the Engineer or designated representative. All samples shall be furnished to the City free of charge.

If any specimen tested fails to meet the requirements of this specification, two (2) additional specimens shall be cut from the remainder of the sample and tested, both of which shall meet the requirements in every respect or the lot represented by the sample may be rejected.

## 701S.5 - Construction Methods

The Chain Link Fence shall be erected to lines and grades established by the Engineer or designated representative in accordance with the details indicated on the Drawings. The fence shall be true to line, taut and shall comply with the best practice for fence construction of this type.

### A. Clearing and Grading

The Contractor shall perform all clearing of brush, rocks and debris necessary for the installation of this fencing.

### B. Erection of Posts

Posts shall be set plumb and permanently positioned and anchorages firmly set before fabric is placed. Posts shall be set in concrete, unless otherwise indicated on the Drawings.

Concrete footings shall be carried to the depth and dimensions indicated on the Drawings. Where rock is encountered within the required depth to which the post is to be erected, a hole of a diameter slightly larger than the largest dimension of the post may be drilled into the rock and the post grouted in. The regular dimensioned concrete footing as indicated on the Drawings shall then be placed between the top of the rock and required grade indicated on the Drawings. Posts shall be approximately centered in their footings. All concrete shall be placed promptly and compacted by tamping or other approved methods. Concrete shall be finished in a dome and shall be cured a minimum of 48 hours before further work is done on the posts.

Pull posts shall be placed not over 500 feet apart in straight runs and at each vertical angle point, all as directed by the Engineer or designated representative. Corner posts shall be placed at each horizontal angle point greater than 15 degrees. Corner and pull posts shall have horizontal braces and tie rods as specified above and as indicated or designated representative.

### C. Erection of Top Rail and Tension Wire

The top rail and bottom tension wire and/or top and bottom tension wires shall be installed before installing the chain link fabric. The top rail shall be firmly attached in final position. Tension wires shall be within 4 inches of the top and bottom of the fabric and shall be pulled taut.

### D. Erection of Fabric

After all posts have been permanently positioned and anchorages firmly set with the cables drawn taut with the turnbuckles, the fabric shall be placed by securing one end and applying sufficient tension to the other end to remove all slack before making attachments. Unless otherwise indicated on the Drawings, the fabric shall be cut and each span shall be attached independently at all corner posts and pull posts.

Fabric shall be fastened as indicated on the Drawings and the bottom of the fabric shall be placed a normal distance of 2 inches above the ground line; however, over irregular ground this distance may vary between 1 inch and 6 inches for a distance not to exceed 8 feet. Any necessary backfilling required, in order to comply with these provisions, will be considered as incidental work.

E. Fence Grounding

This fence shall be grounded where a power line passes over the fence. In any case, a ground shall be provided at locations not to exceed 1,000 feet apart in straight runs of fence. Each individual section of fence shall have at least 1 ground. The ground shall consist of a copper-weld rod 8 feet long and a minimum of 5/8 inch in diameter driven or drilled in vertically until the top of the rod is approximately 6 inches below the top of the ground. A No. 6 solid copper conductor shall be brazed to the rod and to the fence in such a manner that each element of the fence is grounded.

F. Erection of Wood Fencing Material

After all posts have been permanently positioned and anchorages firmly set, stringers shall be placed and boards secured to the stringers. Other techniques utilizing modular precut panels may be used, when indicated on the Drawings.

701S.6 - Measurement

Chain Link Fence, of each height specified, will be measured by the lineal foot of fence measured at the bottom of the fabric along the centerline of fence from center to center of terminal posts, excluding gates. Gates will be measured as each gate, complete in place.

701S.7 - Payment

The work performed and material furnished as prescribed by this item, measured as provided under "Measurement" will be paid for at the unit bid price for "Chain Link Fence" of the height specified. The unit bid price shall include full compensation for furnishing and installing all fencing materials (except gates) including all miscellaneous fittings, braces, post caps, line wires, connection clips or wires; digging post holes and grouting in rock where required; furnishing and placing concrete for setting posts; furnishing and installing all electrical grounds; all hauling and handling charges; and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work, including excavation, backfilling and disposal of surplus material.

Gates measured as provided under "Measurement" will be paid for at the unit bid price for "Pedestrian Gate" or "Vehicular Gate", of the type, height and opening specified. The unit bid price shall include full compensation for furnishing all materials; fabricating, preparation, hauling, handling charges and erecting, including all miscellaneous fittings, braces, latches, gate hinges, stops and center anchorage; and for all manipulations, labor, tools, equipment and incidentals necessary for complete installation.

Payment will be made under one of the following:

<b>Pay Item No. 701S-A:</b>	Chain Link Fence,	Per Lineal Foot.
<b>Pay Item No. 701S-BS:</b>	Chain Link Pedestrian Single Swing Gate, __ Foot. x __ Foot.	Per Each.
<b>Pay Item No. 701S-BD:</b>	Chain Link Pedestrian Double Swing Gate, __ Foot. x __ Foot.	Per Each
<b>Pay Item No. 701S-CS:</b>	Chain Link Vehicular Single Swing Gate, __ Foot. x __ Foot.	Per Each.

<b>Pay Item No. 701S-CD:</b>	Chain Link Vehicular Double Swing Gate, __ Foot. x __ Foot.	Per Each
<b>Pay Item No. 701S-D:</b>	Wire Fence	Per Lineal Foot.
<b>Pay Item No. 701S-E:</b>	Wood Fence	Per Lineal Foot.
<b>Pay Item No. 701S-F:</b>	Wood Fence Pedestrian Gate, __ Foot. x __ Foot.	Per Each.
<b>Pay Item No. 701S-G:</b>	Wood Fence Vehicular Gate, __ Foot. x __ Foot.	Per Each.
<b>Pay Item No. 701S-H:</b>	Security Fence, __ Foot High, Type __	Per Lineal Foot.
<b>Pay Item No. 701S-T:</b>	Temporary Fence, __ Foot High, _____ Type	Per Lineal Foot.
<b>Pay Item No. 701S-MS:</b>	Mowing Strip	Per Lineal Foot
<b>Pay Item No. 701S-BW:</b>	Barbed Wire Fence	Per Lineal Foot

END

## ITEM NO. 702S - REMOVAL AND RELOCATION OF EXISTING FENCES

### 702S.1 - Description

This item shall govern the removal and relocation of existing fence, gates and hardware to a new alignment at the location in conformance to the typical details indicated on the Drawings or as directed by the Engineer or designated representative.

### 702S.2 - Removal of Existing Materials

The existing boards, fabric, posts, wire, rails, braces, hardware, gates and miscellaneous items shall be carefully removed, bundled, rolled and stockpiled as indicated on the Drawings for installation at the new fence assignment. The removal and handling shall be such that the fence materials may be reused in the relocated fence.

#### A. Removal of Fabric and Wire

Fabric and wire of all types shall be carefully untied or disassembled from the posts and other appurtenances and shall be rolled in bundles of a size that will allow handling with ordinary equipment.

#### B. Removal of Posts

Posts shall be carefully removed from the ground and the concrete footing removed. The concrete shall be disposed of offsite. Post holes shall be filled with suitable embankment material and thoroughly compacted.

#### C. Removal of Boards

Boards of all types shall be carefully disassembled from the rails and other appurtenances to facilitate removal in panels. Excess material removed shall be disposed of as indicated below.

#### D. Storage of Materials

Storage of all salvageable materials, that will be reinstalled at a new location, shall be stored on-site or at such other locations as the Contractor may elect, subject to approval by the Engineer or designated representative. Security and maintenance of the salvageable materials shall be the responsibility of the Contractor.

#### E. Excess Materials

Materials, that are damaged, unsuitable for reinstallation or unnecessary for completion of the scope of the fence work in the new alignment shall be considered as excess but shall be offered to the Owner before removal from the site by the Contractor.

### 702S.3 - New Materials

New materials that are required to complete the fence at the location indicated on the Drawings shall be of equal quality to the existing materials. Used materials from other projects or from the Contractor's own used material stocks will not be allowed. The new materials to be furnished will be those necessary to replace items from the existing fence which were damaged during removal operations or which for other reasons cannot be reused.

702S.4 - Construction Methods

The removed fence shall be installed at the new assignment in accordance with the typical details indicated on the Drawings and shall comply with Standard Specification Item No. 701S, "Fencing" and the best practice for fence construction of the specified type.

702S.5 - Measurement

Fences of the height and type to be relocated will be measured by the lineal foot of fence in its new location measured at the bottom of the fence along the centerline of the fence from center to center of terminal posts, excluding gates.

702S.6 - Payment

The work performed and material furnished as prescribed by this item measured under "Measurement" will be paid for at the unit bid price for "Removing and Relocating Fences" of the size and type specified to be relocated. The unit bid price shall include full compensation for removing, salvaging, storing and handling all existing fence materials; furnishing new posts, boards, rails, braces, tie wires, connection clips, fabric, rails, brace rods and any other fence component items that were damaged during removal and necessitating new material being furnished to complete the project; digging post holes and grouting in rock where required; furnishing concrete for post footings; and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work including excavation, backfilling and disposal of surplus materials.

Gates as provided under "Measurement" will be paid for at the unit bid price for Removal and Relocation of Existing Pedestrian or Vehicular Gates of the type and size specified to be relocated. The unit bid price shall include full compensation for removing the gate from the existing locations, handling, storing and hauling all gate materials, furnishing any new materials necessary for installing at new locations; providing new center anchorage blocks, latches and catch blocks and for manipulations, labor, tools, equipment and incidentals necessary to complete the gate relocation.

Payment will be made under one of the following:

<b>Pay Item No. 702S-A:</b>	Removing and Relocating Existing _____ Ft. Chain Link Fence	Per Lineal Foot.
<b>Pay Item No. 702S-B:</b>	Removing and Relocating Existing _____ Ft. x _____ Ft. Chain Link Pedestrian Gate	Per Each.
<b>Pay Item No. 702S-C:</b>	Removing and Relocating Existing _____ Ft. x _____ Ft. Chain Link Vehicular Gate	Per Each.
<b>Pay Item No. 702S-D:</b>	Removing and Relocating Existing _____ Ft. Wooden Fence	Per Lineal Foot.
<b>Pay Item No. 702S-E:</b>	Removing and Relocating Existing _____ Ft. x _____ Ft. Wooden Pedestrian Gate	Per Each.



<b>Pay Item No. 702S-F:</b>	Removing and Relocating Existing _____ Ft. x _____ Ft. Wooden Vehicular Gate	Per Each.
<b>Pay Item No. 702S-G:</b>	Removing and Relocating Existing _____ Ft. Wire Fence	Per Lineal Foot.
<b>Pay Item No. 702S-H:</b>	Removing & Relocating Existing _____ Ft. x _____ Ft. Metal Gate	Per Each.
<b>Pay Item No. 702S-I:</b>	Removing and Relocating Existing _____ Ft. Barbed Wire Fence	Per Lineal Foot.

END

ITEM NO. 703 - FENCING FOR EXCAVATIONS

703.1 - Description

This item to consist of temporary safety fencing supported on posts and constructed of materials as indicated and removed when excavation is backfilled.

703.2 - Materials

1) Fabric

Fabric to be 4 feet in width, made of high-density polyethylene resin, extruded and stretched to provide a highly visible international orange, non-fading fence which will remain flexible from -60 F to 200 F, and be inert to most chemicals and acid. Pattern may vary from diamond to circular with a minimum weight per foot of 0.4 lbs./Ft., a 4-foot width minimum tensile yield strength (Horiz.) of 2000 psi, ultimate tensile strength of 2680 psi (Horiz.) and a maximum opening no greater than 2 inches.

2) Metal Posts

Steel pipe, tee posts, U posts or 2" x 4' timber posts, 5½ feet in length minimum, spaced no more than 8 feet on centers. Fabric to be secured to post by bands or wire ties.

703.3 - Construction Methods

Prior to commencing construction suitable "Barricades, signs and traffic handling" devices to be installed to protect workers and public. Safety fencing to be erected to lines and grades indicated. Excavations within 750 ft. of schools or day care centers require special attention by Contractor to secure entry while work is in progress. Fence to be installed prior to excavation and maintained until excavation is backfilled. Fence to be placed a minimum of 4 feet from edge of excavation. Posts to be driven in ground a minimum of 18 inches. At completion of each day's work, safety fencing to be pulled taut, and entry secured. When safety fence is no longer needed, Contractor to remove fence and posts and patch any damage to surfaces.

703.4 - Measurement

Safety fencing to be measured by linear foot of fence measured along ground; gates will not be measured separately.

703.5 - Payment

Work performed and materials furnished as prescribed by this item, measured as provided under "Measurement", to be paid for at the unit price bid for "Safety Fencing" which price to be full compensation for furnishing, installing and removing safety fencing and gates, including posts, bands or ties, and for manipulations, labor, tools, equipment and incidentals necessary to complete the work, removal and patching damaged surfaces.

Payment will be made under:

<b>Pay Item 703-A:</b>	Safety Fencing	Per Linear Foot
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**END**

## ITEM NO. 704 - METAL BEAM GUARD RAILING

### 704.1 - Description

This item shall consist of furnishing metal beam guard railing consisting of 1 line of metal beam rail element supported on timber or steel posts. Metal beam guard railing shall be constructed with materials and work quality indicated or approved by the Engineer.

### 704.2 - Materials

#### 1) Rail Elements

The rail elements, end shoes or terminal anchors shall be of the deep beam type fabricated to develop continuous beam strength and shall consist of a metal plate or sheet formed into a beam not less than 12 inches wide and 3 inches deep as indicated. The beam shall be free from warp. When tested with a straight edge or string along either edge of a 12½ foot sectional length of beam, the maximum deviation of the beam edges from the straight edge shall not exceed 1/2 inch at any point. The steel for the rail elements shall conform to AASHTO M-180. The rail shall be 12 gauge or as indicated.

The rail element may be galvanized before or after fabrication in accordance with the requirements of ASTM A 123 or A 525, whichever is applicable, except that the galvanized coating shall not be less than 1.8 ounces per square foot of double exposed surface (single spot test).

Rail elements shall contain no more than 0.04 percent phosphorous nor more than 0.05 percent sulfur.

#### 2) Posts

The posts shall be either timber or steel as indicated and shall meet one of the following requirements:

Timber posts and spacers, where required, shall be Southern Yellow Pine. All posts shall be round. Posts shall not be less than 7 inches in diameter. The diameter shall be determined by means of a circumference-diameter tape. The average diameter at the base of the dome shall not exceed the specified diameter by more than 1 inch. The diameter at the butt of any post shall not exceed the diameter at the base of the dome of that post by more than 2 inches. The supplier shall stencil on the butt of each post the nominal diameter of the top 7 inches. The stenciled numeral shall be 1 inch high. The length of the posts shall not vary more than 1 inch from the specified length. They shall be of the length indicated; the bottom and the top shall be fabricated as indicated.

All posts shall be domed at the top. The dome shall be approximately hemispherical in shape and the radius of the dome of each post shall be 1/2 the diameter of the posts at the base of the domed portion. The dome shall be smooth and the distance from the top of the dome to the base of the dome shall not vary more than 1 inch at any location. The posts shall be machine peeled and trimmed of all knots and knobs and shall be free from defects such as injurious ring shakes, unsound or loose knots or other defects which might impair their strength and durability. Sound knots will be permitted provided they are not in clusters and they do not exceed 1/3 of the small diameter or least dimension. Any defect or combination of defects which would be more injurious than the maximum allowable knot will not be permitted. A line drawn from the center of each end of the post shall not fall outside the center of the post at any point more than 1¼ required, shall be bored and cut to dimensions indicated before being treated. They shall be treated with 0.4 pounds/cubic foot, dry

pentachlorophenol treatment or ACA by assay. Posts and spacers, where required, shall be painted with two coats of good quality aluminum paint after the guard rail is erected unless otherwise indicated.

Steel posts and spacers, where required, shall be of the rolled sections as indicated. The posts and spacers, where required, shall be structural steel conforming to ASTM A 36. The top of all posts shall be beveled or square as required by detail and drilled or punched for bolts for rail attachments.

Steel posts and spacers, where required, shall be galvanized and shall conform to ASTM A 123.

Fittings shall consist of bolts, nuts and washers and shall conform to the details indicated and shall comply with the requirements as specified herein.

All bolts and nuts used with galvanized steel rail shall be made by either the open hearth or electric furnace process and shall conform to ASTM A 307. They shall be hot-dip galvanized to conform to ASTM A 153, Class C or D.

Unless otherwise indicated, the concrete for terminal anchor posts or for embedment or other posts in concrete, where required, shall meet the requirements for Class A Concrete, as specified in Item No. 403, "Concrete for Structures" and subsequent Special Provisions thereto. The rail element for the terminal anchor section shall be of the same materials as the rail element used throughout the project.

#### 704.3 - Sampling and Testing

A sample of the rail and terminal section may be taken for each project or for each shipment to a project. Samples of bolts and nuts may also be required. All samples shall be furnished to the City free of charge. The plate or sheet shall be sampled and tested in accordance with the requirements of ASTM E-8. For galvanized articles, the weight of the zinc coating shall be determined by stripping in accordance with ASTM A 90.

The uniformity of the zinc coating shall be determined by visual inspection. If, in the opinion of the Engineer, visual examination is not conclusive, the uniformity of the coating may be determined by magnetic thickness gauge measurement in accordance with ASTM Designation: E 376 or by the Preece Test as described in ASTM Designation: A 239. When the Preece Test is used, all items designated in ASTM A 153 as Class B-2, B-3, C and D shall withstand a minimum of 4 one-minute dips; all other items shall withstand a minimum of 6 one-minute dips.

The cleaned area shall be coated with 2 coats of zinc dust compound meeting Federal Specification 0-G-98 (stick only), applied in accordance with the manufacturer's recommendations.

#### 704.4 - Construction Methods

The posts shall be set plumb and firm to the line and grade indicated. Unless the plans call for setting in concrete, the posts shall be backfilled by thoroughly tamping the material in 4-inch layers. The rail elements shall be erected to produce a smooth, continuous rail paralleling the line and grade of the roadway surface or as indicated. The rail elements shall be joined end to end by bolts and lapped in the direction of traffic in the lane adjoining the guard fence. When indicated, the rail elements shall be curved before erection. Holes for special details may be field drilled or punched, when approved by the Engineer.

After erection, all parts of galvanized steel posts, spacers where required, bolts and rail elements on which the galvanizing has become scratched, chipped or otherwise damaged shall be thoroughly cleaned

by wire brushing the damaged area to remove all loose, cracked or bruised spelter coating. The cleaned area shall be painted with 2 coats of zinc dust-zinc oxide compound conforming to the requirements of Federal Specification TT-P-641b in accordance with the manufacturer's recommendations.

When fabrication is done after galvanizing and where indicated, the cut edges and bolt holes shall be cleaned by brushing and the cleaned area shall be painted with 2 coats of zinc dust-zinc oxide compound conforming to the requirements of the Federal Specification TT-P-641b or shall be repaired by application of galvanizing repair compounds in accordance with the manufacturer's recommendations.

No painting of galvanized steel rail members will be required.

#### 704.5 - Measurement

This item will be measured by the linear foot of rail, complete in place, measurement being made upon the face of the rail in place, from center to center of end posts, from terminal anchor sections or, in the case of structure railing connection, from the points indicated except as follows: Where bids are requested for "Terminal Anchor Sections", measurement will be made as each section, complete in place, each section consisting of a terminal anchor post and one 25 foot rail element, as indicated.

#### 704.6 - Payment

The work performed and material furnished as prescribed by this item, measured as provided under "Measurement" will be paid for at the unit price bid for "Metal Beam Guard Railing" or "Metal Beam Guard Railing, Terminal Anchor Sections", which price shall be full compensation for furnishing all materials, including necessary boring for preparation, hauling and erection and galvanizing of same; for setting posts in concrete when specified and spacers where required and for all labor, tools, equipment and incidentals necessary to complete the work, including driving posts, excavating, backfilling and disposing of surplus materials.

Payment will be made under one of the following:

<b>Pay Item No. 704-A:</b>	Metal Beam Guard Railing	Per Linear Foot.
<b>Pay Item No. 704-T:</b>	Metal Beam Guard Railing, Terminal Anchor Sections	Per Each.

**END**

ITEM NO. 705 - REMOVE AND RELOCATE EXISTING METAL BEAM GUARD RAILING

705.1 - Description

This item shall consist of removing and storing existing metal beam guard railing and posts and installing at the location indicated.

705.2 - Materials

Materials will be those salvageable from the existing "Metal Beam Guard Railing" and any new materials required for the completion of the work as indicated. New materials shall meet the requirements of Item No. 704, "Metal Beam Guard Railing", unless those requirements are waived by the Engineer.

705.3 - Construction Methods

The setting of posts and erection of the guard rail to be relocated as indicated shall be in accordance with the construction methods provided in Item No. 704, "Metal Beam Guard Railing". All salvageable material not needed for the relocated "Metal Beam Guard Railing" shall be stored on the project site as directed by the Engineer.

705.4 - Measurement

This item will be measured by the linear foot of rail, complete in its new location, measurement being made upon the face of the rail in place, from center to center of end posts.

705.5 - Payment

The work performed and new materials furnished as prescribed by this item, measured as provided under "Measurement" will be paid for at the unit price bid for "Remove and Relocate Existing Metal Beam Guard Railing", which price shall be full compensation for removing, salvaging, storing and handling all existing guard rail material, digging post holes, furnishing concrete for post footings, for all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item No. 705-A:</b>	Remove and Relocate Existing Metal Beam Guard Railing	Per Linear Foot.
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END

## ITEM NO. 706S - BRIDGE AND CULVERT RAILING

### 706S.1 - Description

This item shall govern the construction of concrete, steel, or pipe railing or a combination of these materials on bridges, walls or incidental structures as indicated on the Drawings.

In general, the railing shall include that portion of the structure erected on and above the roadway curb or along the edges of walks, curbs and/or slabs for the protection of traffic and pedestrians and the tie in anchorage to the approach railing erected on the embankment.

The railing, including the necessary anchorage, shall be constructed in accordance with the details indicated on the Drawings.

### 706S.2 - Submittals

The submittal requirements of this specification item include:

1. Shop fabrication details/drawings for metal railings.
2. Splice locations and details.
3. Radiographic results for castings.
4. Mill test reports for each casting lot (chemical composition, tensile strength, elongation, etc.).

### 706S.3 - Materials

All materials shall conform to Class H, Item No. 403S, "Concrete for Structures", Item No. 406, "Reinforcing Steel" and Item No. 720, "Metal for Structures" as appropriate.

### 706S.4 - Construction Methods

The railing shall meet the classification and type specified, conform with the requirements herein and be constructed in accordance with details indicated on the Drawings. It shall be constructed to the alignment, grade and camber indicated on the Drawings. Shop fabricated railing shall be uniform in configuration to insure good joints and continuous lines after erection on the structure.

Any appreciable amount of cutting, bending or filling required during erection to produce a reasonable fit would be cause for rejection of the rail. Unless otherwise provided, the railing shall not be placed until falsework, if any, for the span has been released. During construction, care shall be exercised to insure proper functioning of expansion joints.

Unless otherwise indicated on the Drawings, the rail posts shall be vertical. Fabrication and erection of metal for railing shall conform to Item No. 721, "Steel Structures" and to the requirements of this specification.

Splicing of members will be permitted only as provided by the contract Drawings. In general, splices shall be at rail posts. All splice locations and details shall be as indicated on the Drawings.

For metal railings, shop drawings shall be prepared and forwarded for review in accordance with Item No. 720, "Metal for Structures".

Welding shall conform to Item No. 723, "Structural Welding" and with applicable American Welding Society requirements.

Railing materials shall be stored above the ground on platforms, skids or other supports and kept free from grease, dirt and contact with dissimilar metals. Care shall be taken at all times to avoid scratching, marring, denting, discoloring or otherwise damaging the railing. Unpacking and storing of rail members at the job site shall be in accordance with manufacturer's recommendations.

#### A. Concrete Railing

For Portland Cement (PC) concrete portions of railings, the construction and removal of forms and the placement, curing and surface finishing shall conform to Standard Specification Item No. 410, "Concrete Structures" and to the requirements specified herein. Provisions shall be made in the construction of forms to provide for checking and correction of railing lines and grades after concrete has been placed, but before initial set. The finish floating of the railing tops shall not disturb the form alignment after the final check. Particular care shall be exercised in other construction operations to avoid disturbing or vibrating the span with the newly placed railing.

Construction joints at the bottom of rail posts or rail parapet shall conform to Standard Specification Item No. 410, "Concrete Structures".

Precast members shall conform to TxDOT Specification Item 424, "Precast Concrete Structural Members (Fabrication)". Care shall be taken to preserve true and even edges and corners of precast members. Any member, which becomes marred or cracked, will be rejected and shall be removed from the work.

Material requirements and storage, splicing, bending and placement of reinforcing steel for railing shall conform to the pertinent provisions of Standard Specification Item No. 406, "Reinforcing Steel".

#### B. Pipe Railing

Pipe shall be fabricated from the material and to the shape and dimensions indicated on the Drawings.

Pipe rail and posts shop fabricated into panels shall be mounted in a jig clamped in their true relative positions, accurately spaced with respect to each other and while assembled shall be completely welded or bolted, as the case may be. When indicated on the Drawings, as each rail section is completely assembled and connected, the adjacent section shall be set in its proper relative positions, with the ends engaged and remain in this position until completely connected. Each pair of sections shall be matchmarked so they may be erected in the same order in which they were fabricated.

#### C. Metal Rail

The fabricated elements shall conform to the dimensions and cross-section indicated on the Drawings. The rail shall be straight and free from warp.

Maximum deviation from straightness of either edge of a full-length section shall be 1/4 inch per ten feet.

Rail elements shall be jointed and connected to the rail posts as indicated on the Drawings. Lapped elements shall have the lap in the direction of traffic in the adjacent lane.



Unless indicated otherwise on the Drawings, bolts and nuts for the metal railing shall conform to ASTM A307 and shall be galvanized in accordance with TxDOT Specification Item 445, "Galvanizing".

#### D. Cast Rail Posts

Castings shall be true to pattern in form and dimensions and shall be of the materials indicated on the Drawings.

Castings shall be permanent mold castings of uniform quality and condition, free from cracks and shall be free of defects such as blow holes, porosity, hard spots or shrinkage effects which are extensive enough to materially affect their suitability for the intended use. The castings shall be free of all burrs, fins, discoloration and mold marks and shall, when finished, have a smooth and uniform appearance and texture.

Castings shall be produced under radiographic control to establish and verify a product free from harmful internal defects. Radiographic examination of production castings shall be made, as necessary, to ensure satisfactory quality.

When required, the castings shall be heat treated to produce material with the utmost uniformity conforming to the properties specified. The entire lot of castings shall be heat-treated to the specified temper.

All castings shall be permanently marked on the web or top of base with the lot number or the heat treat lot identification. Mill test reports shall be furnished showing the heat or lot number, chemical composition, tensile strength, elongation and number of pieces for each casting heat or lot. Such markings shall be sufficient to correlate the castings with the mill test reports.

To provide more uniform materials and to reduce the number of samples required to establish material compliance, the entire number of acceptable posts cast from each lot shall be furnished to the project, except where less than the complete lot is required or where a portion of a lot is required to complete the shipment. The mill test report shall indicate the number of posts represented by each lot and furnished to the project.

#### 706S.5 - Tests

For Metal Beam Rail, a sample of the rail and terminal may be taken from each project or from each shipment to a project. Samples of bolts and nuts may also be required. Physical tests shall be performed in accordance with TxDOT's Manual of Testing Procedures (ASTM E-8/E-8M) and tests for galvanized coatings shall be in accordance with ASTM A-90. Field testing of galvanized coating thickness shall be in accordance with TxDOT Test Method Tex-728-I.

#### 706S.6 - Protective Coating

Unless otherwise indicated on the Drawings, all portions of steel railing shall be galvanized. When painting is specified on the Drawings, the type and coating thickness shall be in accordance with the paint system shown on the Drawings and shall conform with Standard Specification Item No. 722, "Protective Coatings".

Galvanized railing shall be hot dip galvanized after fabrication. Any damaged galvanizing shall be repaired after erection. Galvanizing and repairs shall be done in accordance with TxDOT Specification

Item 445, "Galvanizing". Galvanized steel railing shall not require field painting. Prior to acceptance, extrusion marks, grease, dirt and grime shall be cleaned from the railing.

After erection, galvanizing on all parts of steel posts and rail elements which has become scratched, chipped or otherwise damaged shall be thoroughly cleaned, dry and free of oil, grease, welding slag or flux and corrosion products. The surface preparation shall be to near-white metal and shall extend into the undamaged galvanized coating to provide a smooth repair. Spray or brush apply the zinc-rich paint to the prepared area in accordance with the manufacturer's instructions to attain the required dry-film thickness.

After completion of the repair process, the coating thickness shall be measured in accordance with TxDOT Test Method Tex-728-I. The minimum coating thickness for repairs shall be the same, as that required for the specified galvanizing.

Where fabrication is done after galvanizing and when indicated, the cut edges and bolt holes shall be cleaned by brushing and the cleaned area shall be painted with zinc-rich paint to the prepared area in accordance with the manufacturer's instructions to attain the required dry-film thickness.

#### 706S.7 - Designation of Railing

Railing shall be designated by the general classification and type indicated on the Drawings.

#### 706S.8 - Measurement

Railing of the classification and type designated will be measured by the lineal foot (lineal meter), complete in place, in accordance with the dimensions and details indicated on the Drawings.

#### 706S.9 - Payment

The Work performed and materials furnished in accordance with this Specification Item and measured under Section 706S.7, 'Measurement', will be paid for at the unit bid price for "Railing" of the classification and type indicated on the Drawings. The unit bid price shall include full compensation for: furnishing all materials including concrete, expansion joint material, reinforcing steel, structural steel, cast steel, pipe, anchor bolts and all others required in the finished railing; all labor, tools, hardware, equipment, paint and painting, galvanizing; and all incidentals necessary to complete the work in the manner specified in this Specification Item and in accordance with the details specified in the contract Drawings.

For metal railing, the price paid shall be for the length of metal rail installed and shall not include concrete parapet walls or concrete wing terminal walls unless specifically designated on the Drawings.

Payment will be made under:

<b>Pay Item No. 706S-A:</b>	Bridge and Culvert Railing, Type _____	Per Lineal Foot.
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**END**

## ITEM NO. 720S - METAL FOR STRUCTURES

### 720S.1 - Description

This item shall govern all structural and miscellaneous steel, anchor bolts, and miscellaneous metals used in structures. Reinforcing steel (Item No. 406S) and other structural materials are not included.

### 720S.2 - Submittals

The submittal requirements of this specification item include:

1. Certification or mill test reports indicating that all materials supplied are in accordance with this specification.
2. Any material proposed for use and not designated herein, including type and trade name for any material not generically specified by the American Society for Testing and Materials (ASTM). Submittal shall include material specification and technical data as required to show that the proposed material meets the intent of those specified herein.
3. When SI unit bolts are proposed for use on a project, submit sizing of bolt(s) and the U.S. Customary Unit (USCU) bolt size(s) the SI unit bolt(s) will be substituted for. Note: although this specification includes ASTM standards for both USCU and SI, there is no conversion between these standards; each contains a different set of bolts with different physical size characteristics. When SI unit bolts are used, appropriately sized SI unit nuts and washers shall also be provided.

### 720S.3 - Structural Steel for Main Members

Unless otherwise indicated, structural steel for main members shall conform to the longitudinal Charpy V-notch (CVN) requirements in accordance with Table A. Sampling and testing shall be in accordance with ASTM A673 (A673M).

#### A. Structural Steel

When indicated as Structural Steel, the material shall conform to ASTM A 36 (A36M), with a minimum specified yield strength of 36 ksi.

#### B. High Strength Structural Steel (HS)

When indicated as Structural Steel-HS, the material shall have a minimum required yield strength of 50 ksi, conforming to one of the following ASTM specifications:

1. ASTM A 572 (A572M).
2. ASTM A 588 (A588M).
3. ASTM A709 (A709M).
4. ASTM A992 (A992M).

#### C. Extra High Strength Structural Steel (XHS)

When indicated as Structural Steel-XHS, the material shall have a minimum specified yield strength of 90 ksi, conforming to one of the following ASTM specifications:

1. ASTM A 514 (A514M). Structural shapes and seamless tubing, meeting the requirements of A514 (A514M) will be permitted with a maximum tensile strength of 140 ksi for structural shapes and 145 ksi for seamless tubing.
2. ASTM A 517 (A517M).  
ASTM A514 (A514M) and ASTM A517 (A517M) steels are considered weldable.

<b>TABLE A</b>				
Min. Spec. Yield Strength, F <sub>y</sub> [ksi]	Thickness, t [in.]	Welded	Mech. Fastened	Min. CVN Toughness [ft. lb. @ °F]
F <sub>y</sub> ≤ 40	t ≤ 4	X	X	15 @ 70
40 < F <sub>y</sub> ≤ 65	t ≤ 2	X	X	15 @ 70
	2 < t ≤ 4		X	15 @ 70
	>2 < t ≤ 4	X		20 @ 70
65 < F <sub>y</sub> ≤ 90 (Refer to note 3 below)	t ≤ 2.5	X	X	20 @ 50
	2.5 < t ≤ 4		X	20 @ 50
	2.5 < t ≤ 4	X		25 @ 50

Notes for Table A:

1. For F<sub>y</sub> ≤ 50 ksi, use the (H) frequency of testing in accordance with ASTM A673 (A673M).
2. For F<sub>y</sub> > 50 ksi, use the (P) frequency of testing in accordance with ASTM A673 (A673M).
3. If the yield strength of the material exceeds 90 ksi, the testing temperature shall be reduced 15°F per 10 ksi increment, or portion thereof.

720S.4 - Miscellaneous Steel

A. High Strength Bolts

High strength bolts shall conform to ASTM A325, A325M, A490, or A490M, unless otherwise indicated. For submittal requirements of SI unit bolts, refer to 720S.3 C. Nuts for high strength bolts shall conform to ASTM A563 or A563M and washers shall conform to ASTM F436 or F436M.

B. Unless otherwise indicated, structural steel for secondary members such as shoes, diaphragms, stiffeners, bearing stiffeners, lateral bracing, diagonals, armor joints, and finger joints shall conform to one of the following:

1. ASTM A36 (A36M), with a minimum specified yield strength of 36 ksi.
2. ASTM A500, with a minimum specified yield strength of 46 ksi.

Structural steels used for secondary or nonstress-carrying members will not be subject to impact requirements.

All steels greater than 0.5-inch in thickness used for structural supports for highway signs, luminaries, and traffic signals shall conform to the longitudinal Charpy V-notch requirements of Table A.

C. Stud shear connectors, slab anchors, and anchors on armor and finger joints shall conform to ASTM A108, Grades 1015, 1018, or 1020, either semi- or fully-killed, with a minimum specified yield strength of 50 ksi.

#### D. Piling

Steel piling shall conform to one of the following:

1. ASTM A36 (A36M), with a minimum specified yield strength of 36 ksi.
2. ASTM A252, greater than or equal to 10 gauge, with a minimum specified yield strength of 35 ksi.
3. ASTM A328 (A328M), with a minimum specified yield strength of 39 ksi.
4. ASTM A1011 (A1011M), with a minimum specified yield strength of 33 ksi.

#### E. Deck Plates

Material for deck plates shall be corrosive-resistant structural steel conforming to ASTM A242 (A242M). The material must be of weldable quality and shall contain alloying elements that furnish corrosion resistance at least twice that of copper bearing structural steel. The type and trade name shall be submitted for review.

#### F. Rail Posts

Material for rail posts shall conform to ASTM A36 (A36M), with a minimum specified yield strength of 36 ksi.

#### G. Forgings

Steel forgings from which pins, rollers, trunnions, or other forged parts are to be fabricated shall conform to ASTM A668 (A668M), class C, D, F, or G, with a minimum specified yield strength of 33 ksi. As an alternate for pins four (4) inches in diameter or less, ASTM A108, grades 1016-1030, with a minimum specified yield strength of 36 ksi may be used.

#### H. Castings

Steel castings shall conform to ASTM A27 (A27M), Grade 70-36, with a minimum specified yield strength of 36 ksi.

#### I. Anchor Bolts

Anchor bolts shall conform to one of the following:

1. Plain and threaded bars used for anchorage purposes, ASTM A36 (A36M).
2. Headed bolts and nuts, ASTM A307, Grade A.
3. High strength anchor bolts, ASTM A193 (A193M). Nuts for high strength anchor bolts shall conform to ASTM A194 (A194M).

Anchor bolts shall not be galvanized unless otherwise indicated. When galvanized, anchor bolts and nuts shall be tapped or chased after galvanizing.

When heat treated material is specified or required, the test report for certification shall include the necessary certification relative to the heat-treating process.

#### J. Steel Pipe

Steel pipe shall conform to Item No. 510, "Pipe".

## K. Tubing

Steel tubing shall conform to one of the following:

1. ASTM A500, Grade B.
2. API Standard 5L, Grade X52, except as noted herein, may be used if produced by a mill recognized as authorized to produce pipe with the API monogram and listed as such in the standard API specifications. Hydrostatic tests will not be required.

In lieu of the mill test report, a certificate from the manufacturer will be required for each lot or shipment certifying that the tubing meets the requirements stated above.

## L. Pipe Rail

Pipe rail shall be construed to include special extruded and bent shapes and shall be of the section indicated. Pipe may be rolled or extruded to the shape indicated or may be cold pressed from a round pipe or flat plate.

If cold pressed, the design of the press and dies shall result in a pipe of uniform section and free from die marks. After the pipe has been formed to the required section, it shall be cut to the lengths required. The end cuts and notches shall be made at such angles with the axis of the pipe as required to produce vertical end faces and plumb posts when indicated. Cutting and notching of pipe shall be done with a saw or machine guided torch or other means that will insure a neat and uniform finish.

## M. Deep Beam Rail

Deep beam rail shall conform to AASHTO M180, 10 or 12-gage (exclusive of protective coating). The terminal connector shall be of the same material, not less than 10-gage. Unless otherwise indicated, the rail element shall be galvanized.

## 720S.5 - Miscellaneous Metals

### A. Iron

All iron castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes, and other defects in positions affecting their strength and value for the service intended. Castings shall conform to the following ASTM designations:

1. Malleable iron, ASTM A47 (A47M), grade 35018.
2. Gray iron, ASTM A48 (A48M), class 30 or 35.
3. Ductile iron, ASTM A536, grade 60-40-18 or 65-45-12.

### B. Lead

Sheet lead shall conform to ASTM B29, refined lead or pig.

C. Copper

Copper strip or sheet shall conform to the following:

1. ASTM B100, alloy 510 or 511.
2. ASTM B152 (B152M).

D. Aluminum

Unless otherwise indicated, aluminum materials shall conform to the following:

1. Castings, ASTM B108, alloy A444-T4.
2. Extrusions, ASTM B221, alloy 6061-T6.
3. Sheet and plate, ASTM B209, alloy 2024-T3. If welding is required, alloy 6061-T6 can be substituted, but must be heat treated after fabrication and welding.
4. Deep beam rail, ASTM B209, alloy 2024-T3. The minimum thickness of the rail element shall be 0.156 inch (nominal) unless otherwise indicated.

E. Bronze

Bronze bearing and expansion plates shall conform to ASTM B22, alloy 911.

720S.6 - Fabrication, Erection and Painting

Fabrication, erection and painting of metal for structures shall conform to the following:

- A. Item No. 721S, "Steel Structures".
- B. Item No. 722S, "Protective Coatings". Aluminum or galvanized steel members shall not require painting.
- C. Item No. 723, "Structural Welding".

720S.7 - Galvanizing

Galvanizing, where indicated, shall conform to the following:

- A. Fabricated items, rolled, pressed or forged steel shapes, plates, pipes, tubular items, and bars, ASTM A123 (A123M).
- B. Steel or iron castings, ASTM A153 (A153M).
- C. Bolts, nuts, screws, washers, and other miscellaneous hardware, ASTM A153 (A153M), Class C or D or ASTM B695, Class 50.

The measurements of thickness and weight of galvanized coating shall be in accordance with TxDOT test method Tex-728-I.

720S.8 - Measurement

Measurement shall be in accordance with the following:

- A. Weights of supplied metal for structures shall be determined in accordance with Table B:

<b>TABLE B</b>	
<b>Material</b>	<b>Weight [lb./cu. ft.]</b>
Steel	490
Iron, cast	450
Iron, wrought	485
Lead	710
<b>TABLE B (continued)</b>	
<b>Material</b>	<b>Weight [lb./cu. ft.]</b>
Copper	556
Aluminum	165
Bronze	509

- B. Weights of bolts, nuts, and washers shall be in accordance with the American Institute of Steel Construction's "Steel Construction Manual".
- C. The quantity of metal for structures furnished and placed will be based on the weight of metal in the fabricated structure. The weight of erection bolts, paint or weld metal shall be excluded.
- D. The weights of secondary metals in steel or concrete structures (such as castings, bearing plates, anchor bolts, drains, deck plates, armor joints, and finger joints) for which no separate measurement is specified, shall be in accordance with this specification.
- E. The weights of rolled shapes and plates shall be computed on the basis of their normal weights and dimensions.
- F. The weights of castings will be computed from the dimensions indicated.
- G. Deductions will be made for all cuts, copes, perforations, and all holes except bolt holes.

Splices will be measured as follows:

- A. No additional weight will be allowed for weld metal in a welded splice.
- B. Where a bolted splice is permitted as an alternate for a welded splice, measurement will be made on the basis of a welded splice.
- C. Where a bolted splice is required, the weight of splice material, bolt heads, washers and nuts, with no deduction for holes, will be measured.

A change in design may be required and approved by the Engineer or designated representative, due to unforeseen conditions or other reason, which either increases or decreases the quantity of metal in the completed structure; the increase or decrease in weight will be measured in accordance with this specification and shall be included as a change from the original quantity computed. No adjustment will be made for a change which has not been approved by the Engineer or designated representative and which either increases or decreases the quantity of metal in the completed structure. These changes are subject to approval by the Engineer or designated representative nonetheless to assure that the completed structure is in accordance with the original design intent.



720S.9 - Payment

Structural steel for main members will be paid for at the unit price bid per pound for "Structural Steel", "Structural Steel-HS", "Structural Steel-XHS", or such other classification(s) of metal indicated.

Shipping invoice or acceptance slip weights will not be used as basis for payment.

Payment will be made based on the quantity indicated, except as may be modified by the following:

- A. Either party to the contract may request an adjustment of the quantities indicated (by each separate bid item), if the weights calculated in accordance with this specification vary from those indicated by more than the following:
1. Over 500 tons - 0.5 percent.
  2. 50 tons through 500 tons - 1 percent.
  3. Less than 50 tons - 1.5 percent.

When adjustment is required, the Contractor shall furnish the Engineer or designated representative three sets of shop bills showing the calculated weights of all parts of the structure. The weights shall be computed from the approved shop drawings, except as noted above. When this quantity is certified correct by the Engineer or designated representative, it will become the revised plan quantity. Quantities revised in this manner will not be subject to the provisions of the "General Conditions".

- B. When quantities are revised by a change in design, the plan quantity will be increased or decreased by the amount involved in the design change. Quantities revised in this manner will be subject to the provisions of the "General Conditions".

The unit bid price(s) shall include full compensation for furnishing all materials and for all fabrication, shopwork, transportation, erection, paint, painting, galvanizing, and for furnishing all equipment, tools, labor, and incidentals necessary to complete the work.

Payment, when included as a contract pay item, will be made under:

<b>Pay Item No. 720S-A:</b>	Structural Steel	Per Pound.
<b>Pay Item No. 720S-B:</b>	Structural Steel-HS	Per Pound.
<b>Pay Item No. 720S-C:</b>	Structural Steel-XHS	Per Pound.

END

## ITEM NO. 721S - STEEL STRUCTURES

### 721S.1 - Description

This item shall govern the furnishing, fabricating, erecting and painting steel and other metals for structures or portions of structures. The materials related to this specification are specified in Item No. 720S, "Metal for Structures" unless otherwise noted. Reinforcing steel (Item No. 406S) and other structural materials are not included.

### 721S.2 - Submittals

The submittal requirements of this specification item include:

#### A. Shop Drawings

1. The Contractor shall prepare and submit seven (7) copies of detailed shop drawings (or as required by the Contract Documents) for each detail of the Contract Drawings requiring the use of materials specified herein or in Item No. 720S, "Metal for Structures".
2. Shop drawings shall include complete details and schedules for fabrication and assembly, as well as camber and erection diagrams for all structures, bridges, plate girders, and other structural members as indicated on the drawings. The equipment, sequence of erection, location and type(s) of falsework (including calculations), location of splices, and proposed method of support to determine any overstress caused by the erection procedure shall also be included.
3. The drawings shall be prepared on sheets 22 x 36 inches (A1 sheet size) or larger. Each sheet shall include the following:
  - a. Project name and location
  - b. Name of structure or detail. For details, include structure name or location of detail within the project.
  - c. Fabricator name and person responsible for preparation of drawing.
  - d. Contractor name.
  - e. Sheet numbering.
4. Preparation and submission of shop drawings may be on 11x17-inch sheets (A3 sheet size) or full-size drawings may be reduced to half scale size if they are completely clear and legible.
5. Field Verification
  - a. The Contractor shall be responsible for field verification of design information and shall inform the Fabricator of any discrepancies with the Contract Documents.
  - b. When discrepancies are more than minor dimensional changes, the Contractor shall resolve with the Architect/Engineer.
  - c. Any changes from the Contract Documents due to field verification of information shall be clearly noted on the shop drawings.
6. All shop drawings shall be checked by the Fabricator before submitting them to the City of Pflugerville. The Contractor shall also be responsible for reviewing the shop drawings prior

to submittal to assure correctness and completeness and to coordinate shop fit and field connections. Resolution of problems and corrections to drawings, if necessary, shall be done prior to submittal.

7. Changes in section(s), as allowed per this specification (P721S.4 C), shall be clearly noted on the shop drawings.
  8. Color coding for any grade of steel to be used on the project and not listed in ASTM A6 (A6M).
- B. Painting shall conform to Item No. 722S, "Protective Coating". Submit any proposed shop primers or paints that are not otherwise specified.
- C. Connections
1. When structural members are to be fabricated by welding, a welding procedure shall be submitted. A welding procedure shall include the standard AWS symbol, size, length, type of weld, and any other pertinent information. Upon approval, the welding procedure will be assigned a Welding Procedure Number and the Shop Drawings shall include this number adjacent to the appropriate welding symbol.
  2. When structural members with calculated stress are to be fabricated by bolting, a fabrication procedure shall be submitted. A fabrication procedure shall include a list of equipment to be used, sequence of assembly, sequence and detail of connections made, special processes such as planing, facing, etc., detail of heat treating procedures, when applicable and any other information concerning fabrication, as may be required by the Engineer/Architect.
  3. Submit seven (7) copies of connection procedures along with the shop drawings.
  4. Provide calculations for all standard connections, sealed by a Licensed Professional Engineer registered in the state of Texas.
- D. Production Data
1. Submit product data for all items in accordance with this specification and those materials specified in Item No. 720S, "Metal for Structures". Include certification, mill test reports, or other data as required. Mill test reports will not be required for miscellaneous hardware.
  2. Quality Control
    - a. The Contractor shall provide, if requested, facilities in the shop and as many helpers as needed, for the Inspector to properly inspect the materials and work quality. The Inspector shall be allowed free access to the necessary parts of the work.
    - b. The Inspector will have the authority to reject any material or work which does not meet the requirement of this specification. In case of dispute, the Contractor may appeal to the Engineer or designated representative, whose decision will be final.
    - c. The acceptance of any material or finished members by the inspector will not prohibit subsequent rejection if found defective. Rejected material shall be replaced promptly or made good by the Contractor to the satisfaction of the Engineer or designated representative.

3. As materials are shipped, the Fabricator shall furnish the Engineer or designated representative with four (4) copies of the shipping invoice. The Fabricator's shipping invoice shall include:
  - a. Member piece mark identification.
  - b. Number of pieces shipped.
  - c. Total calculated or scale weight for each shipment per bid item.
4. Final payment for structural steel will not be made until shipping invoices indicating total weight of material used have been received and checked by the Engineer or designated representative. Shipping weights will not be used as measurement for payment.

E. Notice of Beginning Fabrication Work

1. The Contractor shall give the Engineer or designated representative seven (7) days' notice prior to the beginning of fabrication work in the shop.
2. No work shall be performed in the shop before the Engineer or designated representative has authorized fabrication. Any purchases of material prior to authorization shall be at the Contractor's risk.

F. Material Safety Data Sheets (MSDS)

Submit MSDS for materials as required and keep on the project job site.

G. Welder Certifications

Provide certification that welders working on the project have satisfactorily passed qualification tests in accordance with AWS D1.1 (D1.1M). If recertification is required, retesting will be at the Contractor's expense.

H. Repair Procedures

Submit repair procedures in accordance with the requirements herein.

721S.3 - Delivery, Storage, and Handling

A. Delivery

1. Deliver materials to the site at such intervals as required so as to ensure uninterrupted progress of work.
2. Anchor bolts, anchorages, and other embedded items shall be delivered to the site in ample time so as not to delay related work. Also, provide setting drawings, templates, and directions for installation as required to properly install these items.

B. Storage and Handling

1. Store materials so as to permit easy access for inspection and identification. Do not store materials in a manner that might cause distortion or damage to materials or support.
2. Keep materials off the ground using pallets, platforms or other supports.

3. Protect materials from corrosion and deterioration.
  4. If bolts and nuts become dry or rusty, clean and lubricate them before use.
- C. Repair or replace damaged materials, structures, or portions of structures as directed.
- D. The handling of material, fabrication, blocking of partially completed members, and movement of completed members shall be done in such a manner that the safety of workers and inspection personnel will not be impaired at any time.
- E. The storage, handling, and cleaning of corrosion resistant ("weathering") steel shall be in accordance with ASTM A242 (A242M), ASTM A588 (A588M), or the requirements of the proprietary manufacturer as applicable.

#### 721S.4 - Quality of Work

A. Fabrication and Assembly

1. Fabrication shall be in accordance with either AISC 325 or 360.
  2. Fabricate and assemble structural assemblies in the shop when possible. When shop fabrication is not practical, provide markings as required to facilitate assembly.
  3. Fabricate in such a manner so as to limit storage and handling and not to hinder construction progress.
- B. Fabrication tolerances for rolled shapes, plate girders, plates, bars, wide flange sections, and miscellaneous steel shall be in accordance with ASTM A 6 (A6M) or AWS D1.5 (D1.5M).
- C. Rolled fabricated sections of slightly different dimensions and weight than the standard sections shown will be acceptable, provided they have equal or greater Moment of Inertia and Section Modulus than the sections(s) detailed. Changes in section(s) shall be clearly noted on the shop drawings.
- D. Maximum deviation from flatness for webs of wide flange sections shall be the same as for built-up girders.
- E. Shoes shall be fabricated with a tolerance not greater than the following:
1. The top bolster shall have the center 75 percent of the long dimension true to 1/32-inch, with the remainder true to 1/16-inch and shall be true to 1/32-inch across its entire width in the short dimension.
  2. For a pin and rocker type expansion shoe, the axis of rotation shall coincide with the central axis of the pin.
  3. When the shoe is completely assembled and the top bolster is moved horizontally simulating the movement of the shoe in the finished structure, no point in the plane of the top bolster shall change elevation by more than 1/16-inch for the full possible travel of the rocker both ways from the neutral position nor shall the top bolster change inclination with respect to the horizontal by more than 1 degree during this same travel.

F. I-beams and girders shall be fabricated with a tolerance not greater than the following:

1. The plane of the bearing area of beams and girders shall be perpendicular to the vertical axis of the beam within 1/16-inch.
2. Correction of bearing areas of shoes, beams and girders to the above tolerances shall be with heat and/or external pressure. Grinding or milling will be permitted if reduction of required thickness of member is not reduced by more than 1/16-inch.
3. Rolled material must be straight before being laid off or worked.
4. If straightening is necessary, it shall be done by procedures submitted to and approved by the Engineer or designated representative. Sharp kinks and bends will be cause for rejection of the material unless corrected to the satisfaction of the Engineer or designated representative.

721S.5 - Execution

A. Finishing

1. Finishing details of materials specified herein and Item No. 720S "Metal for Structures", unless noted otherwise, shall be in accordance with AISC 325, Steel Construction Manual, and AISC 360, Specification for Structural Steel Buildings.
2. Surface finishes shall be in accordance with ASME B46.1 and as indicated in Table A:

<b>TABLE A</b>	
Condition	Roughness Value [micro inches]
Member ends not subject to calculated stress	2000
Cut surfaces 4 inches to 8 inches thick	1500
Cut surfaces up to 4 inches thick	1000
Milled ends of compression members, stiffeners, and fillers	500
Top surfaces of steel slabs, base plates, column cap plates, and pedestal cap plates	250
Surfaces of bearing plates intended for sliding contact, pins, and pin holes	125

3. Sheared edges of plates greater than 5/8 inch thickness and carrying calculated stress shall be planed to a depth of 1/4 inch.

4. Re-entrant cuts shall be filleted to a minimum radius of 3/4 inch, except for the corners of welding access cope holes adjacent to a flange.
5. Oxygen cutting shall be in accordance with AWS D1.1 and D1.5. Hand cutting shall be done only where approved by the Engineer or designated representative.
6. Edges of all main members, which are sheared or oxygen cut, and all other exposed edges to be painted shall be rounded or chamfered to an approximate 1/16-inch dimension by grinding.
7. Unless otherwise indicated, steel plates for main members shall be cut and fabricated so that the primary direction of rolling is parallel to the direction of the main tensile and/or compressive stresses.
8. In all oxygen cutting, the flame shall be adjusted and manipulated to avoid cutting inside the prescribed lines. Roughness exceeding the values of Table A and occasional notches or gouges not more than 3/16-inch deep on otherwise satisfactory surfaces shall be removed by machining or grinding. Cut edges shall be left free of slag. Correction of defects shall be faired to the oxygen cut edges with a slope not exceeding 1 in 10.
9. Air carbon-arc or oxygen gouging, oxygen cutting, chipping or grinding may be used for joint preparation or the removal of defective work or material. Oxygen gouging shall not be used on ASTM A 514 (A514M), A517 (A517M), A242 (A242M), and A588 (A588M) corrosion resistant ("weathering") steels.
10. The top and bottom surfaces of steel slabs, base plates and cap plates of columns and pedestals shall be planed or else the steel slabs and base plates hot-straightened. Parts of members in contact with plates shall be faced to fit.
11. In planning the surfaces of expansion bearings, the cut of the tool shall be in the direction of expansion.
12. Stiffeners shall provide an even bearing against flanges. Tight-fit, when indicated, shall have at least 1 point bearing on the flange surface and the remainder with a maximum clearance of 1/16 inch at any point. Where stiffeners are to be welded to the flange, the opening prior to shall not exceed 3/16 inch with the fillet weld size increased by the amount of the opening.
13. Structural members which are indicated on the Contract Documents to be annealed or normalized shall have finish machining, boring, and straightening done subsequent to heat treatment. Normalizing and annealing shall be as defined by ASTM A941. The temperatures during the heating and cooling process shall be maintained uniformly throughout the furnace so that the temperature at any two points on the member will not differ by more than 100°F at any one time.
14. Special requirements for ASTM A 514 (A514M) and A517 (A517M) shall be as follows:
  - a. Annealing and normalizing is not allowed.
  - b. Stress relieve only with the approval of the Engineer or designated representative.
  - c. Allowance for springback should be about three (3) times that of carbon steel.

- d. For break press forming, the lower die span should be at least sixteen (16) times the plate thickness.
  - e. If steel plates to be bent are heated to a temperature greater than 1125°F, they must be reannealed and tempered in accordance with the producing mill's practice.
  - f. The holding temperature for stress relieving shall not exceed 1100°F, except that 950°F shall be maximum for welds and six (6) inches surrounding welds.
15. Short radii on steel plates shall be hot bent at a temperature not greater than 1200°F.
16. When indicated, bridge shoes, pedestals or other parts which are built up by welding sections of plate together shall be stress relieved in accordance with approved procedures.

#### B. Repair of Defects

1. Correction of cutting defects and of occasional notches or gouges less than 7/16-inch deep for material up to 4 inches thick and less than 5/8-inch for material over 4 inches thick may be made on steel with yield strengths up through 65 ksi by welding.
2. Discontinuities or defects in plate edges which form the faces of groove welds shall be removed to a depth of 5/8-inch and repaired by welding. Laminations opening to these edges shall be removed. Weld repairs shall be made by suitably preparing the defect, welding in accordance with AWS D1.1 (D1.1M), and grinding the completed weld smooth and flush with the adjacent surfaces.
3. Occasional notches, gouges or defects in oxygen cut edges of ASTM A514 (A514M) and ASTM A517 (A517M) steel may be repaired by welding, when approved by the Engineer or designated representative under the following conditions:
  - a. Cutting defects not more than 3/16-inch deep in plate edges which will form the faces of a groove weld joint and which will subsequently be completely fused with the weld may be repaired by welding. Discontinuities or defects to these edges shall be removed to a depth of 1/4-inch below the surface by grinding or chipping and the gouge repaired by welding. Laminations opening to these edges shall be removed.
  - b. Cutting defects not more than 3/16-inch deep in plate edges which will form a fillet-welded corner joint shall be repaired by welding only on the part of the edge which will become the faying surface for the joint and the fusion zone of the fillet weld. The part of the defect outside the toe of the completed fillet weld shall be removed by machining or grinding and faired to the oxygen cut surface with a slope not exceeding 1 in 10. If the actual net cross-sectional area which would remain after removal of the discontinuity is 98 percent or greater than the area of the plate based on nominal dimensions, weld repairs shall be made as specified above using E-11018-M electrodes and grinding the completed weld smooth and flush with the adjacent surface to produce a proper finish.



#### 4. Straightening Bent Material

- a. The straightening of plates, angles, miscellaneous shapes, and built up members, when approved by the Engineer or designated representative be done by methods that will not produce fracture or other damage. A detailed procedure for straightening bent materials shall be submitted to the Engineer or designated representative for approval.
- b. Straightening of individual pieces shall be done prior to assembly into a built-up member.
- c. The temperature for heat straightening of steel members shall not exceed 1200°F.
- d. Heat straightening or correction of errors in camber of ASTM A514 (A514M) and A517 (A517M) steel members shall be done only under rigidly controlled procedures, each application subject to the approval of the Engineer or designated representative. The temperature shall not exceed 1100°F nor shall the temperature exceed 950°F at the weld metal or within 6 inches thereof.
- e. The temperature of the steel shall be controlled by approved temperature indicating devices, such as crayons, liquids or bimetal thermometers.
- f. Heat shall not be applied directly on weld metal.
- g. Following straightening, the metal shall be carefully inspected for evidence of fracture.

#### 5. Pins, Pinholes, and Rockers

- a. Pinholes shall be bored true to the specified diameter, smooth and straight, at right angles with the axis of the member and parallel with each other, unless otherwise indicated. Pins and pinholes shall be finished to an ASME B46.1 value of 125.
- b. The diameter of the pinhole shall not exceed that of the pin by more than 1/50-inch for pins 5 inches or less in diameter or 1/32-inch for larger pins.
- c. Rockers shall be finished to an ASME B36.1 value of 250.

#### 6. The limits of acceptability and repair of surface imperfections for all steels shall be in accordance with ASTM A6 (A6M).

#### 7. Discontinuities

- a. Roughness exceeding an ASME B46.1 value of 2000 in oxygen cut surfaces and occasional notches or gouges not more than 3/16-inch deep on otherwise satisfactory surfaces, shall be removed by machining or grinding to a slope not exceeding 1 in 10.
- b. In the repair and determination of limits of internal discontinuities visually observed on rolled, sheared or oxygen cut edges and caused by entrapped

slag or refractory, deoxidation products, gas pocket or blow holes, the metal removed shall be the minimum necessary to remove the defect or to determine that the permissible limit is not exceeded. All repairs made by welding shall be approved by the Engineer and shall conform to the applicable provisions of AWS D1.1 (D1.1M).

- c. The limits of acceptability and the repair of visually observed edge discontinuities in plates 4 inches or less in thickness shall be in accordance with Table B where the length of defect is the visible long dimension on the plate edge and the depth is the distance the defect extends into the plate from the edge.

<b>Table B</b>	
<b>Description of Discontinuity</b>	<b>Repair Required</b>
Any discontinuity 1 inch in length or less	None - need not be explored.
Any discontinuity over 1 inch in length and 1/8 inch maximum depth.	None - depth should be explored.
Any discontinuity over 1 inch in length with depth over 1/8 inch but not greater than 1/4 inch.	Remove - need not weld.
Any discontinuity over 1 inch in length with depth over 1/4 inch but not greater than 1 inch.	Completely remove and weld. Aggregate length of welding not over 20 percent of plate edge length being repaired.
Any discontinuity over 1 inch in length with depth greater than 1 inch.	Subject to approval by the Engineer. Gouge out to 1 inch and block off by welding. Aggregate length of welding not over 20 percent of plate edge length being repaired unless approved by the Engineer.

- d. Removal of metal by gouging shall be done in a manner assuring adequate width and slope for welding.
- e. Multiple discontinuities should be considered continuous when located in the same plane within 5 percent of the plate thickness and separated by a distance less than the length of the smaller of two adjacent continuities.

### C. Heat Curving

The Contractor shall submit a list of steel members proposed for heat curving and a detailed procedure for this work to be completed. Heat curving shall not proceed prior to written approval by the Engineer or designated representative.

#### D. Color Coding

1. For each steel approved for use on the project, a distinct color code shall be required. The color code shall be as specified in ASTM A6 (A6M). White shall be required for A 36 steel.
2. The color code used for any steels not specified by ASTM A6 (A6M) must be submitted to and approved by the Engineer or designated representative.
3. The appropriate color(s) shall be placed on the material upon entry into the shop and shall be carried on all pieces to final fabrication. Loss of color code marking on any piece and with no other positive identification shall require testing thereof prior to its use to re-establish positive identity of the material to the satisfaction of the Engineer or designated representative.

#### E. Shop Painting

Preparation of surfaces and shop painting shall conform to Item No. 722S, "Protective Coating."

#### F. Marking and Shipping

1. All structural members shall be marked in accordance with the erection diagram.
2. The markings shall be over the painted surface. In no case shall shop paint be left off in order to preserve original markings on steel to be painted.
3. Members weighing more than 3 tons (2.7 MT) shall have the weight marked thereon.
4. The loading, transporting, unloading and storing of material shall be conducted so it will be kept clean and free from injury.
5. Bolts of each length and diameter and loose nuts or washers of each size, shall be packed separately and shipped in boxes, crates, kegs or barrels. A list and description of the contents shall be plainly marked on the outside of each package.

### 721S.6 - Bolted Members

#### A. Detailing

Detailing of bolted connections, where not indicated on the drawings or specified herein, shall conform to the latest edition of AISC 325, Steel Construction.

#### B. Bolts

Bolts shall be in accordance with Item No. 720S, "Metal for Structures".

#### C. Bolt Holes

1. All holes for bolts shall be either punched or drilled. Material forming parts of a member composed of not more than five (5) thicknesses of metal may be punched 1/16 inch larger than the nominal diameter of the bolts, if the thickness of the metal is not greater than 3/4 inch for carbon steel, 5/8 inch for HS or 1/2 inch for XHS steel. For more than five (5) thicknesses or when any of the main material is thicker than shown herein, all the holes shall

be subpunched or subdrilled 3/16-inch smaller and after assembling, reamed 1/16-inch larger or drilled from the solid to 1/16-inch larger than the nominal diameter of the bolts.

2. For punched holes, the diameter of the die shall not exceed that of the punch by more than 1/16 inch. If any holes must be enlarged to admit the bolts, they shall be reamed. Holes shall be clean cut without torn or ragged edges. Poor matching of holes will be cause for rejection.
3. Reamed, punched and drilled holes shall be cylindrical, perpendicular to the member and 1/16-inch larger than the nominal diameter of the bolts. Reamers and drills shall be guided by mechanical means. Only holes which are not accessible to mechanically guided equipment shall be done by hand. Reaming and drilling shall be done with twist drills, except that for poorly aligned holes tapered reamers shall be used in conjunction with a template so placed and held so as to force the reaming to the best center of holes for that group. Connecting parts shall be assembled and held securely during reaming or drilling operations and match-marked before disassembling.

#### D. Preparation of Holes for Field Bolting

1. Holes in all field splices of main truss members, box girders, continuous I-beams and plate girders shall be subpunched and reamed while assembled or drilled full size with all parts assembled, taking into account their relative position in the finished structure due to grade, camber, and curvature. The assembly, including camber, alignment, accuracy of holes, and milled joints shall be approved by the Engineer before reaming or drilling full size is started.
2. All holes for floor beams and stringer end connections shall be subpunched and reamed to a steel template of not less than 1 inch thickness or reamed while assembled.
3. Holes for secondary members such as diaphragms, laterals, sway bracing, etc. may be punched full size unless subpunching or subdrilling.

#### E. Accuracy of Holes

1. Accuracy of all holes punched full size, subpunched, or subdrilled shall be such that a cylindrical pin 1/8 inch smaller in diameter than the nominal size of the punched hole may be entered perpendicular to the face of the member, without drifting, in at least 75 percent of the adjoining holes in the same plane after assembling and prior to any reaming. Pieces not meeting this requirement will be rejected. Any hole which will not pass a pin 3/16-inch smaller in diameter than the nominal size of the punched hole will be cause for rejection.
2. After reaming or drilling, 85 percent of the holes in any adjoining group shall show no offset greater than 1/32-inch between adjacent thickness of metal.
3. Layout of shop work shall be done so that gage lines for bolts shall not vary from plan dimensions more than 1/16-inch. Full size holes in any adjoining group or line shall not vary more than the following:
  - a. At least 8 percent of the holes shall be within 1/16-inch of plan gage.
  - b. Not more than 10 percent of the holes may vary as much as 1/8-inch from plan gage.
  - c. Holes varying more than 1/8-inch from plan gage will not be accepted.

## F. Shop Assembly

1. Each truss or box girder section shall be assembled in its relative position in the shop before reaming is started. Match-marks shall be stamped in the metal at all field connections, conforming to erection diagrams, at the time reaming is done.
2. Surfaces of metal to be in contact shall be cleaned before assembling.
3. Disassembling after reaming will be required to remove shavings, burrs, etc.
4. When bolting is required, shop or field, faying surfaces of all joints including splice plates, shall be cleaned in accordance with AISC 325, Steel Construction Manual, and AISC 360, Specification for Structural Steel Buildings.
5. The members shall be free from twists, bends and other deformations. In no case shall tack welding be used in assembly for bolting without prior approval of the Engineer or designated representative.
6. If necessary, the bolt holes shall be spear-reamed for the admission of bolts preparatory to the shop bolting of full-sized punched material. The spear reamer used for this purpose shall be not more than 1/16-inch larger than the nominal diameter of the bolts.
7. Parts not completely bolted in the shop shall be secured by temporary bolts, where practicable, to prevent damage in shipment and handling.
8. The drifting done during assembling shall be only that required to bring the parts into position and not sufficient to enlarge the holes or distort the metal. If any holes must be enlarged to admit bolts, they shall be reamed.

## G. Preparation and Fit of Members

1. When indicated, abutting joints shall be milled and brought to an even bearing. Where joints are not milled, the openings shall not exceed 1/4 inch.
2. Floor beams and girders with end connection angles shall be built to exact length back to back of connection angles. If end connections are faced, the finished thickness of the angles shall be not less than that indicated.

## 721S.7 - Welded Members

### A. General

1. All welding operations, processes, equipment, materials, qualifications of welders, quality of work, nondestructive testing, and inspection shall conform to Item No. 723S, "Structural Welding", AWS D1.1 (D1.1M), AWS D1.5 (D1.5M), and the Shop Drawings.
2. Unless otherwise indicated, nondestructive testing (magnetic particle and radiographic) required in the shop will be done by, and at the expense of, the Contractor. This will include furnishing all materials, equipment, tools, labor and incidentals necessary to perform the required testing.

3. All magnetic particle inspection and all radiographic inspection shall be done in the presence of and at the locations selected by the Engineer or designated representative. The Engineer or designated representative shall examine and interpret all tests made.
4. Magnetic particle inspection shall conform to ASTM E 709 and the following unless otherwise indicated:
  - a. For built-up members, 100 percent of the web to flange and bearing stiffener fillet welds on not less than 1 fabricated piece for each 15 pieces or fraction thereof when the maximum flange thickness is less than 2 ½ inches.
  - b. For built-up members, 100 percent of the web to flange and bearing stiffener fillet welds on not less than 1 fabricated piece for each 10 pieces or fraction thereof when the maximum flange thickness is 2 ½ inches or greater.
  - c. Welds requiring repairs shall be retested by magnetic particle inspection after the repairs are made.
  - d. No magnetic particle inspection will be required for rolled sections.
5. Radiographic inspection shall conform to ASTM E94, AWS B1.10, and the following unless indicated otherwise on the Drawings:
  - a. For shop welds of material 65 ksi yield strength and less, radiographic inspection will be made as follows:
    - i. The full flange width of 35 percent of all flange splices where the plate thickness at the weld is 2 inches or less.
    - ii. The full flange width of 50 percent of all flange splices where the plate thickness at the weld is greater than 2 inches.
    - iii. 1/5 the depth of the web of 50 percent of the web splices on each structure.
    - iv. If unacceptable work is found, additional radiographs will be made on sections welded by the same equipment and/or operator just prior to and just after the section containing the defect.
  - b. For shop welds of material greater than 65 ksi yield strength, radiographic inspection shall be made on all groove welds. These welds shall be inspected not less than 48 hours after they are completed.
  - c. Welds requiring repairs shall be retested by radiography after repairs are made. All radiographic inspection and necessary repairs shall be done prior to assembly.
  - d. When radiographic inspection of particular welds is required by the plans, this shall be in addition to the radiographic inspection required herein.

## B. Surface Preparation for Welding

1. Surfaces to be welded shall be smooth, uniform and free from fins, tears and other defects which would adversely affect the quality of the weld. Surfaces to be welded shall be free from loose scale, slag, rust, grease, or other material. Mill scale that withstands vigorous wire brushing or a light film of drying oil or rust inhibitive coating may remain. Finish of bevels of groove welds shall be milled or ground. Oxygen cut bevels without grinding will not be allowed.
2. When a zinc-rich paint is specified, surfaces within 4 inches of a groove weld joining main stress carrying members and within 2 inches of fillet welds joining diaphragms or lateral bracing to stiffeners or gusset plates shall be sandblast cleaned and coated with linseed oil. After welding is completed, the areas shall be sandblast cleaned and painted as required for the specified paint system.
3. For other paint systems, surfaces within 2 inches of any weld joining main stress carrying members shall be free from any paint or other material that would prevent proper welding.
4. Sheared plates for webs of built-up members shall be wide enough to allow for trimming of edges where built-in camber is required. Plates with rolled edges used for webs shall be trimmed by oxygen cutting.
5. The faying surfaces of the web and flange plates and the adjacent surfaces that are to be fillet welded shall be cleaned by grinding prior to assembly and welding of web to flange.

## C. Assembly of Parts

1. Parts to be joined by fillet welds shall be brought into as close contact as possible, with a maximum separation of 3/16 inch. If the separation is 1/16 inch or greater, the leg of the fillet weld shall be increased by an equivalent amount. The separation between faying surfaces of lap joints and of butt joints landing on a backing strip shall not exceed 1/16 inch. The fit of joints not sealed by welds throughout their length shall be close enough to exclude water after painting. Where irregularities in rolled shapes or plates after straightening prevents this, the procedure necessary to bring them within the above limits shall be approved by the Engineer or designated representative. The use of fillers is prohibited, except as indicated or as approved by the Engineer.
2. Members to be welded shall be brought into correct alignment and held in position by clamping, welding, or tacking until the joint has been welded.
3. Adequate clamps must be provided to prevent cupping or warping of the parts when welding them to the web. The clamping devices must be designed to not interfere with the operation or guiding of automatic welding equipment.
4. Temporary stiffeners used for jigs and/or warpage control shall not be tack welded to the flange material. Tacking to the web is permissible if the welds are at least  $d/6$  distance away from the flange, where "d" is the web depth. The tack weld shall be removed by grinding flush with the parent metal prior to acceptance.
5. Suitable allowance shall be made for shrinkage. The joint shall never be restrained on both sides when welding.

6. Abutting parts to be joined by groove welds shall be aligned carefully. All shop groove welds in flange plates shall be ground smooth and flush with the base metal on all surfaces. This shall apply both to parts of equal thickness and parts of unequal thickness.
7. The surfaces shall be ground so that the radii at the points of transition will be 4 inches minimum.
8. When groove welds are used to join materials of different thickness or width, there shall be a smooth transition between offset surfaces with a slope of not greater than 1 in 4 in thickness transition and to the proper radii in the case of width transition.
9. Groove welds in web plates need not be ground unless indicated.
10. Grinding shall be done in the direction of stress and in a manner that keeps the metal below the blue brittle range of 350°F.
11. Intermediate stiffeners within 12 inches of a splice point shall be shipped tack welded in place. Final welding shall be done in the field.

#### D. Surface Preparation and Shop Assembly for Field Welds

1. Ends of beams and girders shall be prepared in accordance with the requirements herein or as indicated. The centerline of the land of opposing web and flange bevels shall not deviate from each other by more than 1/16-inch.
2. For Shop Assembly, members should be brought into abutting contact in accordance with the shop drawings. Root faces shall not vary in excess of 1/16-inch from contact. Corrections by additional cutting and/or grinding shall be made to bring the splice within this tolerance. Finish of bevels for groove welds shall be milled or ground. Oxygen cut bevels without grinding will not be allowed.
3. Ends of beams or girders to be welded shall be prepared in the shop taking into account their relative positions in the finished structure due to grade, camber, and curvature. Each splice shall be completely shop assembled, checked and match-marked while assembled.

#### 721S.8 - Field Erection

##### A. General

1. Field erection shall be in accordance with the approved shop drawings. Such approval shall not relieve the Contractor of responsibility for the safety or adequacy of methods or equipment, or from carrying out the work in full as indicated. No work shall be done without the approval of the Engineer or designated representative.
2. Field erection plans for beam units will not be required unless indicated.
3. Spot welding for the purpose of eliminating field erection bolts or for holding steel parts together while bolting will not be permitted.
4. The Contractor shall provide falsework and all tools, machinery, and appliances (including drift pins and fit-up bolts) necessary for the expeditious handling of field erection work. Drift pins sufficient to fill at least 1/4 of the field holes for main connections shall be provided.



5. When railroad or roadway traffic must be maintained beneath girders or beams already placed, traffic shall be protected against falling objects during the erection of diaphragms and other structural members, during the placing of cast-in-place concrete, and during the erection and dismantling of forms thereof. The protection shall consist of safety nets of 1-inch mesh maximum or a flooring with openings not larger than 1 inch.

#### B. Storing, Handling, and Assembling Materials

1. All material shall be handled in a manner that prevents damage.
2. Stored material shall be placed on skids above the ground and kept clean and properly drained. Girders and beams shall be placed upright and shored. Long members, such as columns, shall be supported on skids placed closely enough to prevent excessive deflection.
3. The parts shall be match-marked and assembled accurately as indicated on the approved erection drawings.
4. Hammering which will injure or distort the members is not allowed.
5. All bearing and faying surfaces of structural steel in bolted connections shall be cleaned before the connection members are assembled. When ASTM A588 (A588M) steel is used these, surfaces shall receive a Class B blast cleaning conforming to Item No. 722S, "Protective Coating", prior to assembly of the connection members. The areas of the outside ply under washers, nuts, or bolt heads shall be cleaned prior to installation of the bolts.
6. Unless erected by the cantilever method, truss spans shall be erected on blocking located so as to provide proper camber. The blocking shall be left in place until the tension chord splices are fully connected and all other truss connections pinned and bolted. Main connections shall have 1/2 of the holes filled with bolts and erection pins (1/2 bolts and 1/2 pins) before swinging the span. Splices and connections carrying traffic during erection shall have 3/4 of the holes so filled.
7. Fit-up bolts shall be of the same nominal diameter as the connection bolts. Erection pins shall be 1/32-inch larger diameter.
8. There shall be no temporary welds for transportation, erection, or other purposes on main members, except at approved locations more than 1/6 the depth of the web from the flanges of beams and girders, unless otherwise approved by the Engineer or designated representative.

#### C. Falsework

1. Falsework shall be properly designed for the loads to be supported and shall be substantially constructed and properly maintained. The Contractor shall prepare and submit to the Engineer falsework plans, including calculations.
2. The falsework plans shall include all details of members, connections, equipment, etc., so that a structural check can be made of them.
3. Approval of the falsework plans does not relieve the Contractor of responsibility/liability for the falsework during field erection.

D. Welding and Nondestructive Testing

Welding and nondestructive testing shall conform to Item No. 723S, "Structural Welding".

E. Ancillary Items

All ancillary items such as castings, bearing plates, etc. shall be in accordance with the drawings or as specified elsewhere.

F. Errors in Shop Work

1. Any errors in shop work which prevent the proper assembling and fit-up of parts by the moderate use of drift pins or a moderate amount of reaming and slight chipping or cutting shall be reported immediately to the Engineer or designated representative, along with the proposed method(s) of correction.
2. Corrections of minor misfits and a reasonable amount of reaming will be considered a legitimate part of the work.
3. Corrections shall be made in the presence of the Engineer or designated representative, unless otherwise directed. Such work is to be done at the entire expense of the Contractor.

721S.9 - Paint and Painting

Unless otherwise indicated, painting shall conform to Item No. 722S, "Protective Coating".

721S.10 - Measurement and Payment

No direct compensation will be made for "Steel Structures". Measurement and payment for quantities of metals, concrete, reinforcement, railing, ancillary items, and other bid items which constitute the completed and accepted structure(s) shall conform to pertinent specifications.

**END**

## ITEM NO. 722S - PROTECTIVE COATINGS

### 722S.1 - Description

- A. This item shall govern protective coatings and their application for the following conditions:
1. Exterior surfaces.
  2. Interior surfaces.
  3. Anti-graffiti surfaces.
- B. "Protective coatings" shall be defined as any paint or paint system applied to a base material to provide protection from the elements, wear, or other harmful mechanisms of deterioration. The specified protective coating systems shall include primers or other layers as required to provide complete protection as intended.
- C. Also included are failure modes identification, cause, and repair.

### 722S.2 - Submittals

- A. Protective Coatings Schedule
1. Submit eight (8) copies of a protective coatings schedule which indicates the manufacturer and paint number, keyed to the drawings, prior to, or at the time of, submittal of samples required herein.
  2. The schedule shall indicate all shop and field coatings of items to receive protection, including all surfaces to be coated and the type and color to be applied to each. Identify each material by the manufacturer's catalog number and general classification. Where a color selection is required by the Owner, clearly mark on the submittal.
- B. Product Data
1. Product data must verify compatibility with substrates and conditions to be encountered. Provide manufacturer's technical information, including label analysis and instructions for handling, storing and application of each material proposed for use. List each material and cross-reference the specific coating, finish system and application. Identify each material by the manufacturer's catalog number and general classification.
  2. Submit a full range of color choices, sheen, and textures for final selection.
  3. Submit complete documentation for all protective coatings and systems proposed for use that are not in accordance with those specified herein. The Owner reserves the right to reject alternates proposed in lieu of those specified.
- C. Prepare and submit two (2) protective coatings samples of each finish, including all coats thereof, to the Engineer or designated representative for approval. The samples shall be clearly marked with the manufacturer's name and product identification and shall be submitted in sufficient time to allow for review, and, if necessary, resubmittal without delay to the project.

- D. Provide certification that the manufacturers' supplied products comply with state and federal regulations on controlling the use of Volatile Organic Compounds (VOC). "Low" (less than or equal to 50 g/l) or zero VOC products, where applicable, are recommended.
- E. The protective coatings applicator shall submit written documentation that they have a minimum of three (3) years' application experience with each product type and the equipment required to provide application.

#### 722S.3 - Cleaning and Preparation of Surfaces

- A. Surfaces to be coated, whether in the shop or field, shall be completely free of oil, grease, moisture, dirt, sand, overspray, welding contamination, loose or flaking mill scale, rust, or paint and free of any other conditions that will prevent the protective coating from forming a continuous, uniform tightly adhering film.
- B. Cleaning and surface preparation shall be in accordance with the Society for Protective Coatings (SSPC) requirements and as specified herein.
  - 1. SSPC-SP1, Solvent Cleaning. Solvent cleaning is a method for removing all visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants. Solvent cleaning does not remove rust or mill scale. Change rags and cleaning solution frequently so that deposits of oil and grease are not spread over additional areas in the cleaning process. Be sure to allow adequate ventilation. For complete instructions, refer to SSPC-SP1.
  - 2. SSPC-SP3, Power Tool Cleaning. Power tool cleaning removes all loose mill scale, loose rust, and other detrimental foreign matter. It is not intended that adherent mill scale, rust, and paint be removed by this process. Mill scale, rust, and paint are considered adherent if they cannot be removed by lifting with a dull putty knife. Before power tool cleaning, remove visible oil, grease, soluble welding residues, and salts by the methods outlined in SSPC-SP1. For complete instructions, refer to SSPC-SP3.
  - 3. SSPC-SP6, Commercial Blast Cleaning. A commercial blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except for staining. Staining shall be limited to no more than 33 percent of each square-inch of surface area and may consist of light shadows, slight streaks, or minor discoloration caused by stains of rust, stains of mill scale, or stains of previously applied paint. Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP1 or other agreed upon methods. For complete instructions, refer to SSPC-SP6.
  - 4. SSPC-SP7, Brush-Off Blast Cleaning. A brush-off blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose paint. Tightly adherent mill scale, rust, and paint may remain on the surface. Mill scale, rust, and coating are considered adherent if they cannot be removed by lifting with a dull putty knife. Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP1 or other agreed upon methods. For complete instructions, refer to SSPC-SP7.
  - 5. SSPC-SP10, Near-White Blast Cleaning. A near-white blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except for staining. Staining shall be

limited to no more than 5 percent of each square-inch of surface area and may consist of light shadows, slight streaks, or minor discoloration caused by stains of rust, stains of mill scale, or stains of previously applied paint. Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP1 or other agreed upon methods. For complete instructions, refer to SSPC-SP10.

6. SSPC-SP13, Concrete. SSPC-SP13 gives requirements for surface preparation of concrete by mechanical, chemical, or thermal methods prior to the application of bonded protective coating or lining systems. The requirements of this standard are applicable to all types of cementitious surfaces including cast-in-place concrete floors and walls, precast slabs, masonry walls, and shotcrete surfaces. An acceptable prepared concrete surface should be free of contaminants, laitance, loosely adhering concrete, and dust, and should provide a dry, sound, uniform substrate suitable for the application of protective coating or lining systems. Depending upon the desired finish and system, a block filler may be required. For complete instructions, refer to SSPC-SP13.

#### 722S.4 - Protective Coating

- A. Protective coatings and systems are specified herein. Submit complete documentation for all protective coatings and systems proposed for use that are not in accordance with those specified.
- B. Exterior Surfaces to be Coated
  1. Exterior protective coatings are specified herein. For additional products refer to TxDOT "DMS-8000, Maintenance Paints", "DMS-8101, Structural Steel Paints - Performance", and "DMS-8110, Coatings for Concrete".
  2. Exterior Condition 1 - Ferrous Metals other than Stainless Steel
    - a. EC-1a - Normal exterior exposure not exposed to chemical attack.
      - i. Surface preparation: SSPC-SP6.
      - ii. Primer: alkyd, 2 mils minimum dry film thickness.
      - iii. 2nd and 3rd coats: polyurethane modified alkyd, 2 mils minimum dry film thickness each coat.
    - b. EC-1b - Submerged or intermittently submerged in water, sludge, sewage, chemical or similar corrosive liquid; supports in contact with or attached to concrete.
      - i. Surface preparation: SSPC-SP10.
      - ii. Primer and 2nd coat: high solids, high-build cycloaliphatic amine epoxy, 10 mils minimum dry film thickness each coat.
    - c. EC-1c - Subject to corrosive atmosphere and condensation.
      - i. Surface preparation: SSPC-SP6.
      - ii. Primer: inorganic zinc, 3 mils minimum dry film thickness.

- iii. 2nd coat: high solids, high-build cycloaliphatic amine epoxy, 4 mils minimum dry film thickness.
- iv. 3rd coat: high-build aliphatic acrylic-polyester polyurethane, 3 mils minimum dry film thickness.

d. EC-1d - Galvanized.

- i. Surface preparation: in accordance with the manufacturer's recommendations for galvanized ferrous metal under service conditions.
- ii. Primer and 2nd coat: polyamide epoxy, 3 mils minimum dry film thickness each coat.

3. Exterior Condition 2 - Non-ferrous Metals

a. EC-2a - Non-ferrous metals other than aluminum.

- i. Surface preparation: SSPC-SP1 followed by SSPC-SP3 or SSPC-SP7 as required to establish a uniform anchor profile.
- ii. Primer: polyamide epoxy, 3 mils minimum dry film thickness.
- iii. 2nd coat: aliphatic acrylic polyurethane, 2.5 mils minimum dry film thickness.
- iv. 3rd coat (optional as required for color/gloss retention): high solids fluoropolymer, 2.5 mils minimum dry film thickness.

b. EC-2b - Aluminum.

- i. Surface preparation: SSPC-SP1 and sanding with approved pads as required to establish a uniform anchor profile of 1 mil.
- ii. Primer: polyamide epoxy, 2 mils minimum dry film thickness.
- iii. 2nd coat: aliphatic acrylic polyurethane, 2 mils minimum dry film thickness.
- iv. 3rd coat (optional as required for color/gloss retention): high solids fluoropolymer, 2.5 mils minimum dry film thickness.

4. Exterior Condition 3 - Concrete

a. EC-3a - Submerged or intermittently submerged in water, sludge, sewage, chemical or similar corrosive liquid.

- i. Surface preparation: Allow concrete to cure 28 days minimum and test for moisture in accordance with ASTM D4263. When concrete is ready, complete surface preparation in accordance with SSPC-SP13.
- ii. Primer: epoxy polyamide, 5 mils minimum dry film thickness.
- iii. 2nd and 3rd coats: coal tar epoxy, 8 mils minimum dry film thickness each coat.

- b. EC-3b - Subject to corrosive atmosphere and condensation.
  - i. Surface preparation: Allow concrete to cure 28 days minimum and test for moisture in accordance with ASTM D4263. When concrete is ready, complete surface preparation in accordance with SSPC-SP13.
  - ii. Primer and 2nd coat: cycloaliphatic amine epoxy, 4 mils minimum dry film thickness each coat.
  - iii. 3rd coat: high-build aliphatic acrylic-polyester polyurethane, 3 mils minimum dry film thickness.
- c. EC-3c - Concrete surfaces to be painted and not requiring service conditions of EC-3a or EC-3b.
  - i. Surface preparation: Allow concrete to cure 28 days minimum and test for moisture in accordance with ASTM D4263. When concrete is ready, complete surface preparation in accordance with SSPC-SP13.
  - ii. Primer and 2nd coat: waterborne acrylate (54% ± 2% solids volume), 8 mils minimum dry film thickness each coat.
- d. EC-3d - Concrete surfaces to be stained and not requiring service conditions of EC-3a or EC-3b.
  - i. Surface preparation: Allow concrete to cure 28 days minimum and test for moisture in accordance with ASTM D4263. When concrete is ready, complete surface preparation in accordance with SSPC-SP13.
  - ii. Final appearance of EC-3d will be clear, but slightly darkened.
  - iii. Primer: siloxane with diffused quartz carbide, 100 square feet per gallon application rate.
  - iv. 2nd coat: methylmethacrylate acrylic/hydrophobic fumed silica, 125 square feet per gallon application rate.

5. Exterior Condition 4 - Masonry

- a. EC-4a - Painted masonry surfaces.
  - i. Surface preparation: SSPC-SP13.
  - ii. Primer and 2nd coat: waterborne acrylate (54% ± 2% solids volume), 8 mils minimum dry film thickness each coat.
- b. EC-4b - Stained masonry surfaces.
  - i. Surface preparation: SSPC-SP13.
  - ii. Final appearance of EC-3d will be clear, but slightly darkened.

- iii. Primer: siloxane with diffused quartz carbide, 75 square feet per gallon application rate.
- iv. 2nd coat: methylmethacrylate acrylic/hydrophobic fumed silica, 100 square feet per gallon application rate.

#### C. Interior Surfaces to be Coated

1. Interior protective coatings are specified herein. For additional products refer to TxDOT "DMS-8000, Maintenance Paints", "DMS-8101, Structural Steel Paints - Performance", and "DMS-8110, Coatings for Concrete".
2. Interior Condition 1 (IC-1) - Ferrous, Non-ferrous, and Galvanized Metals
  - a. Surface preparation: SSPC-SP1 followed by SSPC-SP3 or SSPC-SP7 as required to establish a uniform anchor profile.
  - b. Primer: polyamide epoxy, 3 mils minimum dry film thickness.
  - c. 2nd coat: waterborne aliphatic polyurethane: 2 mils minimum dry film thickness.
3. Interior Condition 2 - Concrete
  - a. IC-2a - Vertical, non-traffic horizontal, and overhead surfaces.
    - i. Surface preparation: Allow concrete to cure 28 days minimum and test for moisture in accordance with ASTM D4263. When concrete is ready, complete surface preparation in accordance with SSPC-SP13.
    - ii. Primer: acrylic epoxy, 4 mils minimum dry film thickness.
    - iii. 2nd coat: waterborne aliphatic polyurethane, 2.5 mils minimum dry film thickness.
  - b. IC-2b - Floors.
    - i. Surface preparation: Allow concrete to cure 28 days minimum and test for moisture in accordance with ASTM D4263. When concrete is ready, complete surface preparation in accordance with SSPC-SP13.
    - ii. Primer and 2nd coat: waterborne epoxy-amine for horizontal surfaces, 3 mils minimum dry film thickness each coat.
4. Interior Condition 3 (IC-3) - Masonry
  - a. Surface preparation: SSPC-SP13.
  - b. Primer: Waterborne cementitious acrylic, 100 square per gallon application rate.
  - c. 2nd coat: acrylic epoxy, 4 mils minimum dry film thickness.
  - d. 3rd coat: waterborne aliphatic polyurethane, 2.5 mils minimum dry film thickness.



5. Interior Condition 4 (IC-4) - Wood and Drywall

- a. Primer: latex enamel, 1.1 mils minimum dry film thickness.
- b. 2nd and 3rd coats: acrylic enamel, 1.5 mils minimum dry film thickness each coat.

D. Surfaces to be Anti-graffiti

1. Anti-graffiti Condition 1 (AGC-1) - Sacrificial

- a. Acceptable for above-grade concrete, exposed aggregate concrete, CMU, brick, stone, painted steel, or aluminum.
- b. Sacrificial anti-graffiti coatings require a pressurized water wash for graffiti removal. Wash shall not exceed 1,500 psi and 180 F.
- c. Biodegradable formulation in accordance with TxDOT DMS-8111 "Anti-Graffiti Coatings", 3 mil minimum dry film thickness.

2. Anti-graffiti Condition 2 (AGC-2) - Permanent

- a. Acceptable for above-grade concrete, exposed aggregate concrete, CMU, brick, stone, painted steel, or aluminum.
- b. Permanent anti-graffiti coatings require the use of a solvent or chemical for graffiti removal. Damage or pigment loss shall not occur during removal.
- c. Aliphatic polyurethane in accordance with TxDOT DMS-8111 "Anti-Graffiti Coatings", 3 mil minimum dry film thickness.

722S.5 - Source of Supply

All protective coatings shall be furnished with the manufacturer's labels on each can. Primers shall be produced by the same manufacturer as finish coats. Use only thinners approved by paint manufacturer and use only within recommended limits.

722S.6 - Application of Protective Coatings

- A. The protective coatings applicator shall submit written documentation that they have a minimum of three (3) years' application experience with each product type and the equipment required to provide application.
- B. All equipment used for paint application shall be in accordance with the protective coating manufacturer's recommendations for the coating being applied. Brushes shall not exceed 4 inches in width, shall be springy and not flabby, and shall be kept free of contaminants. Equipment used for spraying shall have adequate provision for separation of moisture from any air stream in contact with the coating, shall be adequate for the type of coating being used, and shall be equipped with spray heads adequate to provide a smooth, uniform coating.

C. Application

1. Apply protective coatings in strict conformance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

2. Protective coatings shall not be applied closer than 12 inches to a surface which is to be cleaned.
3. Provide finish coats which are compatible with primers used.
4. Apply additional coats when undercoats or other conditions show through final coat, until all surfaces are of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
5. Coat surfaces behind movable equipment and furniture the same as similar exposed surfaces. Coat surfaces behind permanently fixed equipment or furniture with primer only before final installation of equipment.
6. Coat interior surfaces of ducts, where visible through registers or grilles, with a flat black paint.
7. Coat back sides of access panels and removable or hinged covers to match exposed surfaces.
8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
9. Each coat shall be applied so that it will dry to form a smooth, continuous, tightly adhering film of uniform thickness and appearance, free of brush marks, sags, runs, holidays, and overspray. Measure dry film coating thickness using an apparatus that can be adjusted to measure directly and exactly the known thickness of a shim placed on uncoated material similar to that bearing the coating to be measured. The apparatus shall be readable to at least  $\pm 0.1$  mil over the range of the instrument. Standard thickness shims shall be used for adjusting the apparatus and shall be made of non-magnetic material with a known thickness uniform over its entire area and accurate within the manufacturer's established tolerances.
10. Spray application of the first coat will be permitted only when the surfaces are cleaned by blasting. Any method of application approved by the Engineer or designated representative may be used to paint inaccessible areas.
11. Protective coatings shall not be applied to any surface containing moisture discernible with the eye or by the following test: if the temperature and humidity conditions are such that moisture is likely to condense upon the surface, a small area thereon shall be moistened with a damp cloth to apply a clearly defined, thin film of water. If this thin film evaporates within 15 minutes, the surface shall be considered safe to apply coatings from the standpoint of continued condensation at that particular time.
12. Protective coatings shall not be applied at an air temperature below 40 F nor when there is likelihood of change in weather conditions within 2 hours after application which would result in air temperatures below 40 F or deposition of moisture in the form of rain, snow, condensation, etc., upon the surface. The Engineer or designated representative reserves the right to require that no paint be applied when impending weather conditions might result in damage to fresh coatings.
13. If, in the opinion of the Engineer or designated representative, construction traffic produces an objectionable amount of dust, the Contractor shall, at the Contractor's expense, take

precautions necessary to prevent dust and dirt from coming in contact with freshly coated surfaces or with surfaces before the coating is applied.

14. After all fabrication work is completed and has been tentatively accepted, all surfaces to be coated shall be cleaned and coated with the required primer. Materials shall not be loaded for shipment until coatings are thoroughly dry. No coating work shall be done after material is loaded for shipment. Erection marks for field identification of members shall be coated upon previously coated surfaces. Surfaces to be in contact after shop riveting or bolting shall be cleaned but not coated. Unless otherwise indicated, the top flanges of girders and I-beams shall be coated.
15. Unless otherwise indicated or exempted, the surfaces to be shop coated shall include the rolling faces of rockers and base plates, all surfaces of bearing plates, and all surfaces of iron or steel castings, whether or not such surfaces are milled.
16. If concreting operations have damaged the protective coatings, the surface shall be re-cleaned and re-coated in accordance with the manufacturer's recommendations. Primed surfaces shall be cleaned to remove dirt, grease, or other foreign material prior to the application of the final coat(s). Coatings that have become defective shall be removed, the base material properly cleaned, and the required primer reapplied. Excessive amounts of coatings that fail to properly dry or that improperly cure shall be removed and replaced in accordance with the manufacturer's recommendations. In no case shall a succeeding coat be applied until the previous coat and all touch up has dried throughout the full thickness of the coating. At the time of acceptance, the protective coatings shall present an even and uniform appearance throughout.

#### D. Improperly Applied Protective Coatings

1. To uncover evidence of improperly applied protective coatings, the Engineer may, at any time during construction, explore underneath the surface of any coatings already applied.
2. All protective coatings which have been applied improperly, applied to improperly cleaned surfaces, fail to dry and harden properly, fail to adhere tightly to underlying material or other parts of the coating system, or do not evidence a normal workmanlike appearance in conformance with these specifications, shall be repaired or completely removed and replaced at.
3. When the final coat does not have a uniform color and appearance throughout, it shall be corrected.
4. Freshly applied coatings which have not yet set shall be removed with the use of suitable solvents.
5. All work required to correct improperly applied protective coatings shall be to the satisfaction of the Engineer or designated representative and at the expense of the Contractor.

#### 722S.7 - Protective Coatings for Existing Structures

Unless otherwise indicated, existing materials shall receive the same protective coatings as those required for new materials.

#### 722S.8 - Responsibility for Hazards

The Contractor is responsible for the safety of all protective coatings operations and personnel. The City of Pflugerville is thus absolved from liability in the event of harm to persons or property due to the Contractor's work specified herein.

722S.9 - Failure Modes - Causes, Identification, and Repair

Refer to Table A for identification, cause, and repair of common protective coatings failure modes.

<b>TABLE A</b>			
<b>Failure Mode</b>	<b>Identification</b>	<b>Cause</b>	<b>Repair</b>
Alligatoring	Very large macro-checking, usually with a cross-hatched pattern	Internal stresses where surface shrinks more rapidly than body of coating, hard topcoat over soft undercoat	Apply thin coats in accordance with manufacturer and thoroughly dry before applying additional coats
Biological failure	Softening or slime reaction, blotchy brown or black spots on coating surface causing poor/dirty appearance	Biodegradation of the coating by bacteria or fungi, coating is used as a source of nourishment	Use coatings that contain permanent fungicides, bactericides, or non-biodegradable modifiers
Brush marks	Linear hills and valleys with considerable difference in thickness from hills to valleys, rusting in valleys	Application of a very heavy-bodied coating	Brush coating out well, finishing by light brushing in one direction
Chalking	Surface soft and powdery, easily removed by wiping surface	Surface disintegration by the sun, improper pigmentation	Use coatings formulated with radiation-resistant resins and non-catalytic, non-chalking pigments
Checking	Uneven, small, non-continuous fissures that do not penetrate to the substrate	Surface stresses caused by shrinkage due to weathering and continued surface polymerization and oxidation	Use coatings formulated with weather resistant resins and inert reinforcing pigments, as well as non-catalytic colored pigments
Cracking	Small breaks in coating to substrate, may be linear, cross-hatched, or curved, may be continuous or not	Stress set up in coating due to continued polymerization and oxidation, improper pigmentation	Use coatings formulated with weather-resistant resins and inert reinforcing pigments, as well as non-catalytic colored pigments

**TABLE A (Continued)**

<b>Failure Mode</b>	<b>Identification</b>	<b>Cause</b>	<b>Repair</b>
Cratering	Pinpoint rust forming in thin areas of bug eyes, fish eyes, or craters randomly dispersed, may be more prevalent in thicker sections	Improper solvent mixture, surface contamination, oil in atomizing air, particulate fallout during application, high surface tension	Sand or roughen crater area, apply second coat by brush, working coating into cratered area
Discoloration	Yellowing, graying, or darkening of coating	Resin or pigment color change due to weather or chemical reaction	Use coatings formulated with both color-stable resins and pigments
Erosion	Similar to chalking, surface removed on high spots and brush marks to base coating or primer	Chalking mechanism with coating surface removed by weathering	Use chalk-resistant coatings with good flow out to a smooth film
Holidays	General corrosion in bare or thin areas that were uncoated, most often in difficult locations to coat	Poor, inconsistent application, lack of care	Apply in careful, consistent manner, making certain that no areas remain uncoated, overlap each pass 50%
Improper thickness	Areas of pinpoint corrosion between areas of solid coating, areas where coating is too thick, possible checking and cracking	Thin areas, spatter, holidays, runs, puddles, excessive number of spray passes in areas where coating is difficult	Careful application, even spray passes with each pass overlapped 50%, use cross-spray technique
Mud cracking	Fine to fairly large segments, flaking or curling from surface	Rapid drying, application of coating too heavy, rapid drying conditions	Use coatings with strong adhesion, apply under proper drying conditions, prevent sags, puddles, or excessive thickness
Overspray	Very rough coating surface, may appear like sand in surface, pinpoint corrosion throughout rough areas	Improper spraying technique, uneven spray passes with gun too far from surface	Apply with even, wet spray passes overlapped 50%, remove overspray before applying additional coats

TABLE A (Continued)			
Failure Mode	Identification	Cause	Repair
Pinholes	Small, visible holes - 1/32 inch- generally random and in concentrations, pinpoint corrosion in pinholes	Improper spray technique, spray gun too close to surface	Apply with spray gun at the optimum distance from the surface
Pinpoint rusting	Pinpoint spots of corrosion progressing from a small area to a larger area, early failure can ruin entire surface	Zinc pigment mask by other pigmentation or improper zinc-to-binder ratio, uneven coating thickness with thin areas failing first	Remove coating and reapply properly, apply maintenance coat at first sign of pinpoint failure
Runs, sags, and curtains	Heavy areas in coating that flow down vertical surface in streaks or curtains	Improper application	Remove runs and sags with a brush prior to initial set of coating, smooth area with light spray coat
Spatter coat	Pinpoint rusting in thin areas, small spots of coating that are non-continuous over substrate, in poor light may seem continuous	Inconsistent spray passes not overlapped 50%, spray gun flipped at end of spray passes	Use even, wet spray with each pass overlapped 50%, use cross-spray technique
Wrinkling	Furrows and ridges, may be linear or random, fine or quite large	Surface reaction where surface expands during drying more rapidly than the body of the coating	Use coatings with even, thorough drying characteristics, apply evenly, avoid excessive thickness

#### 722S.10 - Measurement

Unless otherwise indicated on the Drawings or contract bid form, individual items including the furnishing of all materials, equipment, supervision, labor, scaffolding, protection of traffic, and incidentals necessary to complete the work required by this item will not be measured for payment.

#### 722S.11 - Payment

The work performed as prescribed by this item will be paid for at the unit bid price per lump sum of "Protective Coating New Structures" and "Protective Coating Existing Structures". The bid price shall include full compensation for the cost of all individual items including the furnishing of all materials, equipment, supervision, labor, scaffolding, protection of traffic, and incidentals necessary to complete the work required by this item.

Payment will be made under:

<b>Pay Item No. 722S-A:</b>	Protective Coating New Structures	Lump Sum.
<b>Pay Item No. 722S-B:</b>	Protective Coating Existing Structures	Lump Sum.

**END**

DRAFT

## ITEM NO. 723 - STRUCTURAL WELDING

### 723.1 - Description

This item shall consist of field welding of structural steel and reinforcing steel.

Provisions are made herein for the welding of the types of steel listed in Table 2, using the manual shielded metal-arc process, semiautomatic (manual) gas metal-arc welding and flux cored arc welding processes. Other welding processes may be permitted with the specific approval of the Engineer and with qualification of the welding procedure.

Shop fabrication and welding shall conform to Item No. 721S, "Steel Structures" and TxDOT Bulletin C-5.

### 723.2 - General

All welds including tack welds to be incorporated shall be made by a certified welder. Tack welds shall be cleaned and fused thoroughly with the final weld. Defective, cracked or broken tack welds shall be removed.

Certification for welders shall conform to TxDOT Bulletin C-6. Miscellaneous welds may be made by a welder qualified conforming to "Welder Qualification", below.

Welds shall be as indicated. The location or size shall not be changed without approval of the Engineer.

The welder shall identify groove welds made by the welder with paint or indelible ink.

Welding will not be allowed when air temperature is lower than 20°F, surfaces are wet or exposed to rain, snow or wind or when operators are exposed to inclement conditions that will hamper their performance.

Moisture present at the point of welding shall be driven off conforming with Table 3, before welding commences. Wind breaks shall be required for the protection of all welding operations.

There shall be no temporary welds for transportation, erection or other purposes on main members, except at locations more than 1/6 the depth of the web from the flanges of beams and girders as indicated or as approved by the Engineer.

ASTM A 514/517 steels shall maintain all groove welds in main members and in flanges of beams and girders subject to tensile stress or reversals of stress shall be finished smooth and flush on all surfaces, including edges, by grinding in the direction of applied stress leaving the surface free from depressions. Chipping may be used provided it is followed by such grinding. Parts joined by groove welds connecting plates of unequal thickness or width shall have a smooth transition between offset surfaces at a slope not greater than 1 in 4 with the surface of either part. The surfaces shall be ground so that the radii at the points of transition shall be 4 inches minimum.

All groove welds, except when produced with the aid of backing, shall have the root of the initial weld gouged, chipped or other-wise removed to sound metal before welding is started from the second side, except that back gouging will not be required when welding steel piling or armor joints with E 6010 electrodes. The back side shall be thoroughly cleaned before placing backup pass.

When backing for welds is left in place to become a part of the structure, it shall be a single length insofar as possible. Where more than a single length is needed, they shall be joined by full penetration butt



welds. The surfaces of this butt weld shall be ground flush as necessary to obtain proper fit-up in the weld joint.

Before welding over previously deposited metal, all slag shall be removed, and the weld and adjacent base metal shall be cleaned. This requirement shall apply equally to successive layers, successive beads and the crater area.

Arc strikes outside the area of permanent weld must be avoided on all steels. Where they do occur, resulting cracks and blemishes shall be ground out to a smooth contour and checked to insure soundness.

Stringer bead technique shall be used where possible for groove welds on all types of steel. Weaving will not be permitted for ASTM A 514/517 steel except in vertical welding, where a weave not exceeding 2 electrode diameters is permissible for manual shielded metal-arc process.

In all welding processes the progression for all passes in vertical welding shall be upward using a back-step sequence.

Groove welds shall begin and terminate at the ends of a joint on extension bars. Edge preparation and thickness of extension bars shall be the same as that of the member being welded and shall extend a minimum of 3/4 inch beyond the joint. Extension bars shall be removed with a cutting torch or arc-air gouging upon completion of the weld and the flange edges shall be ground smooth.

Any defects exposed by the grinding shall be cleaned, filled with weld metal and reground to a uniform finish. All grinding shall be parallel to the flange. Excess grinding of the parent metal shall be avoided.

### 723.3 - Materials

Electrodes for manual shielded metal arc welding shall conform to the requirements of the latest edition of "Specification for Mild Steel Covered Arc-Welding Electrodes", AWS A5.1 or to the requirements of the latest edition of "Specifications for Low Alloy Steel Covered Arc-Welding Electrodes", ASW A5.5.

All electrodes and combination of electrode shielding for gas metal-arc welding for producing weld metal with a minimum specified yield point not exceeding 60,000 psi shall conform to the requirements in the latest edition, "Specification for Mild Steel Electrodes for Gas Metal-Arc Welding", AWS A5.18, AWS A5.28 or "Specification for Mild Steel Electrodes for Flux Cored Arc Welding", AWS A5.20, applicable for the classifications producing weld metal having a minimum impact strength of 20 ft/lb., Charpy V-notch, at a temperature of 0°F or below.

For weld metal with a minimum specified yield strength exceeding 60,000 psi, the Contractor shall demonstrate that each electrode and flux or combination of electrode and shielding medium proposed for use will produce low alloy weld metal having the mechanical properties listed in Table 1 in the as welded condition.

The mechanical properties shall be determined from a multiple pass weld made in accordance with the test requirements of the latest edition of AWS A5.18, AWS A5.20 or AWS A5.28 as applicable.

<b>Table 1 Required Mechanical Properties for GMAW and FCAW Electrodes</b>					
<b>GMAW Grade</b>	<b>FCAW Grade</b>	<b>Tensile Strength psi - Minimum</b>	<b>Yield Strength psi - Minimum</b>	<b>Elongation, % in 2 inches Minimum</b>	<b>Strength ft-lb at 0°F - Minimum</b>
ER80S	E80T	80,000	65,000	18	20
ER90S	E90T	90,000	78,000	17	20
ER100S	E100T	100,000	90,000	16	20
ER110S	E110T	110,000	98,000	15	20

The mechanical property tests for Grades ER100S, E100T and E110T shall be made using ASTM A 514/517 base metal.

All electrodes used on City projects shall be approved by the Engineer. Tests shall be made on electrodes of the same class, size and brand which were manufactured by the same process and with the same materials as the electrodes to be furnished. Tests must be made, and approval renewed every 12 months.

For sizes of electrodes not requiring tests by AWS Specifications, test reports shall be furnished for electrodes of the nearest size and of the same classification. The request for approval shall include the manufacturer's certification that the process and material requirements were the same for manufacturing the tested electrodes and those to be furnished and new test reports, shall be submitted if any changes are made in process or materials during the effective period.

Class of electrodes required will be shown in Table 2. Electrodes shall be used with the type of current, the polarity and in the positions permitted by AWS A5.1 and A5.5 for manual shielded metal-arc welding. AWS A5.18 or A5.20 and A5.28 Specifications shall govern for gas metal-arc welding and flux cored arc welding.

<b>Table 2 Classifications of Electrodes Permitted</b>					
<b>Type of Steel</b>	<b>Main Members Groove &amp; Fillet Welds</b>			<b>Secondary Members Groove &amp; Fillet Welds</b>	
	Steel Piling,	E6010	E60T-8	E60XX	E60T-8
A 53 Pipe,	E6011	E70S-1B	E70XX	E7XT-1	ER70S-3
A 500,	E7016	ER70S-2	E702-1B	E7XT-5	ER70S-6

A 501,	E7018	ER70S-3	E70S-2	E7XT-6	ER70S-7
<b>Table 2 (Continued)</b> <b>Classifications of Electrodes Permitted</b>					
<b>Type of Steel</b>	<b>Main Members Groove &amp; Fillet Welds</b>			<b>Secondary Members Groove &amp; Fillet Welds</b>	
Armor Joints		ER70S-6	E70S-3	E7XT-8	
		ER70S-7	E70S-6		
			E70U-1		
A 36,	E7016	ER70S-2	E7016	ER70S-2	
A 441,	E7018	ER70S-3	E7018	ER70S-3	
A 572 Grade 50	E7XT-1	ER70S-6	E7XT-1	ER70S-6	
A 588,	E7XT-5	ER70S-7	E7XT-5	ER70S-7	
A 242 Deck Plates	E7XT-6		E7xt-6		
API Pipe	E7XT-8		E7XT-8		
A 514/A 517	E10018M	ER1102	E11018M	ER110S	
2½ inches thick or less	E110T		E110T		
A 514/A 517	E10018M	ER100S	E10018M	ER100S	
Over 2 ½ inches thick	E100T		E100T		
A 588, A 242	E8018, C-3		E8018, C-3		
A 618 Weathering Steel	E80T(3)	ER80S(3)	E80T(3) ER80S(3)		
Reinforcing Steel	E7016	E7018			
A 572 Grades 60 and 65 for Light Towers	E8016				

E8018	E80T				
<b>Table 2 (Continued)</b> <b>Classifications of Electrodes Permitted</b>					
<b>Type of Steel</b>	<b>Main Members Groove &amp; Fillet Welds</b>			<b>Secondary Members Groove &amp; Fillet Welds</b>	
ER80S					
(1) Use of the same type electrode with the next higher mechanical properties, conforming to AWS A5.1 or A5.5, than those listed will be permitted.					
(2) In joints involving base metals of different yield points or strengths, low hydrogen electrodes applicable to the lower strength base metal may be used.					
(3) Deposited weld metal for weathering steel shall have the following chemical composition: C, maximum percent, 0.12; Minimum percent, 0.51/1.30; P, maximum percent, 0.03; S, maximum percent, 0.04; Si, percent 0.35/0.80; Cu, percent, 0.30/0.75; Ni, percent, 0.40/0.80; Cr, percent, 0.45/0.70.					

Before use, all electrodes with low hydrogen coverings conforming to AWS A5.1 shall be dried for not less than 2 hours between 450°F and 500°F and electrodes with low hydrogen coverings conforming to AWS 5.5 for not less than 1 hour at a temperature between 700°F and 800°F. Immediately after drying, electrodes shall be stored in ovens held at a temperature of at least 250°F. E70 electrodes not used within 4 hours, E80 within 2 hours, E90 within 1 hour, E100 and E110 within 30 minutes after removal from the storage oven shall be redried before use. Electrodes with flux which has been wet, cracked or otherwise damaged, shall not be used. When ASTM A 514/517 steel is used for welding, electrodes shall be dried at least 1 hour at temperatures between 700°F and 800°F before being used. Electrodes may be redried only once.

Suitable facilities for drying and storage of electrodes shall be furnished at the job site, along with thermometers for checking and controlling the oven temperature.

In humid atmospheres, the times allowed for use without redrying may be reduced.

When a gas or gas mixture is used for gas metal-arc or flux cored arc welding, it shall be of a welding grade having a dew point of -40°F or lower. The gas manufacturer shall furnish certification to the Engineer that the gas or gas mixture is suitable for the intended application and will meet the dew point requirements.

Welding wire coils removed from the original package shall be protected or stored to keep their characteristics or welding properties intact. Rusty coils or portions of coils that are rusty shall not be used.

Any deviation from the above electrode designation shall be approved by the Engineer.

#### 723.4 - Construction Methods

For any welding process, the parts to be joined by fillet welds shall be brought into as close as possible and shall not be separated more than 3/16 inch. If the separation is 1/16 inch or greater, the leg of the fillet weld shall be increased by the amount of the separation. The separation between faying surfaces of lap joints and of butt joints landing on backing strips shall not exceed 1/16 inch.

Splices of beams and girders joined by groove welds shall be carefully aligned with the center of gravity of both members coinciding or each flange vertically offset equally. Beams and girders with offset webs shall be fit with the webs aligned and the flanges offset laterally.

When flanges are offset or abutting parts differ a thickness or width by more than 1/8 inch, the joint shall be made with the slope of the weld metal to each surface, with a transition not exceeding 1 in 4.

Suitable allowance shall be made for shrinkage and the joint shall never be restrained on both sides in any welding process.

All butt splices shall be made before welding of diaframs or sway bracing in a particular section of a unit. Diaframs and sway bracing may be welded in a unit behind the splice welding to provide stability except where such welding interferes with butt splice adjustments such as at a drop-in segment of a continuous unit. All splices shall be made before welding of beams or girders to shoes.

For manual shielded metal-arc welding, the fit-up procedure listed below shall be used for manual shielded metal-arc welding of groove welds for butt joints:

Members shall be spaced to provide a 3/16 inch root opening at the nearest point. When at other parts of the joint the spacing provides up to and including a 7/16 inch opening correction may be made by buildup not exceeding 1/8 inch on each bevel nose. Openings exceeding 7/16 inch shall require re-beveling of the joint to bring it within the maximum buildup limits prescribed above. Build must be allowed to cool before proceeding with the welding.

All members shall be brought into correct alignment and held in position by acceptable clamps while being welded.

Deviations from the above fit-up procedure shall be approved by the Engineer.

#### 723.5 - Procedure

Shrinkage and distortion shall be controlled through the use of an approved procedure. Passes shall be made symmetrically and shall alternate between both sides of the joint.

For manual shielded metal-arc welding, beam and girder splices shall be made as indicated. Welds shall be alternated from side to side to prevent heat buildups on 1 flange edge. The passes must be arranged between the top and bottom flange to maintain balance and symmetry.

The sequence used in welding of splices in all I-beams shall be to first place 4 tacks (1½ to 2 inches) in the web.

For I-beam or for built-up girders, place passes 1, 2 and 3 in the top flange, followed by passes 4, 5 and 6 in the bottom flange.

Gouge out and replace passes 1 and 4, which always are placed in the over position before welding on the web. Next, place passes 7 and 8 in the web after aligning girder webs with short tacks at approximately 8 inches on centers.

Alignment clamps may be removed when sufficient weld has been placed to hold the members together and welding is completed using the sequence indicated.

When welding the root passes of beam and girder splices, E7010 electrodes may be used, provided the work is preheated conforming to Table 3. After the root passes are backed up, the E7010 electrode pass shall be completely removed by arc-air gouging and replaced using low hydrogen electrode.

When this procedure is used, it shall be a continuous operation and back gouging and rewelding shall be completed on each splice before starting on another one. The use of E7010 electrodes will not be permitted for welding ASTM A 514/A 517 steel.

For haunch girder splices adjacent to the haunch section, the welding, once started, shall be continuous until a minimum of 50 percent of the welding in both flanges is completed.

Deviation from the above sequence of weld passes shall be approved by the Engineer.

Procedures for all gas metal-arc and flux cored arc welding shall be submitted to the Engineer for approval and shall be qualified prior to any field welding.

All gas metal-arc and flux cored arc welding procedures shall be qualified conforming to Sections 5 and 7 of TxDOT Bulletin C-5. For each joint to be used in construction, the joint details, electrode classification or grade, electrode diameter, voltage, amperage, travel speed, order and relative position of passes, number and thickness of layers, gas flow, dew point of gas, back gouging, method of cleaning and other pertinent information shall be clearly presented in the Procedure Specification. Fillet welds shall conform to details indicated.

Procedures for welding on ASTM A 514/A 517 steel shall be qualified conforming to TxDOT Bulletin C-5 and approved by the Engineer prior to starting work. Variables to be reported shall include welding process, plate thickness, grade of steel, weld position, joint details, type and size of electrode, number and location of passes, welding sequence, back gouging, current and voltage per pass, welding speed, heat, input and maximum interpass temperature. The heat input and maximum interpass temperature shall not exceed the recommendations of the Steel Producer.

The classification and size of electrode, arc length, voltage and amperage shall be suitable for the thickness of the material, type of groove, welding positions and other circumstances attending the work.

#### **A. Manual Shielded Metal-Arc Welding Process**

1. The maximum size of electrode shall be as follows provided the welder has been certified for its use by the City:
  - a. 5/16 inch for all welds made in the flat position except root passes.
  - b. 1/4 inch for horizontal fillet welds.
  - c. 1/4 inch for root passes of fillet welds made in the flat position and of groove welds made in the flat position with backing and with a root opening of 1/4 inch or more.

- d. 5/32 inch for welds made with EXX14 and low hydrogen electrodes in the vertical and overhead positions.
    - e. 3/16 inch for root passes of groove welds and for all other welds not included under 1, 2, 3 and 4 above.
  2. The root pass size shall be large enough to prevent cracking. The maximum thickness of layers subsequent to the root pass in fillet welds and of all layers in groove welds shall be:
    - a. 1/4 inch for root passes of groove welds.
    - b. 1/8 inch for subsequent layers of welds made in the flat position.
    - c. 3/16 inch for subsequent layers of welds made in the vertical, overhead and horizontal positions.
  3. The maximum size fillet weld which may be made in one pass shall be:
    - a. 3/8 inch in the flat position.
    - b. 5/16 inch in horizontal or overhead positions.
    - c. 1/2 inch in the vertical position.

**B. Manual (Semiautomatic) Gas Metal-Arc Welding and Flux Cored Arc Welding Process**

1. The maximum size electrode used shall be as follows:
  - a. 5/32 inch for the flat and horizontal positions.
  - b. 3/32 inch for the vertical position.
  - c. 5/64 inch for the overhead positions.
2. The thickness of weld layers, except root and surface layers shall not exceed 1/4 inch. When the root opening of a groove weld is 1/2 inch or greater, a multiple pass split-layer technique shall be used. The split-layer technique shall be used. The split-layer technique shall be used in making all multiple pass welds when the width of the layer exceeds 5/8 inch for gas metal-arc welding or 3/4 inch for flux cored arc welding.
3. The welding current, arc voltage, gas flow, mode of metal transfer and speed of travel shall be such that each pass will have complete fusion with adjacent base metal and weld metal and there will be no overlap, excessive porosity or undercutting.
4. Gas metal-arc welding or flux cored arc welding with external gas shielding shall not be done in a draft or wind. An approved shelter of a material and shape capable of reducing the wind velocity in the vicinity of the welding to a maximum of 5 miles per hour shall be furnished by the Contractor
5. The maximum size of a fillet weld made in 1 pass shall be:
  - a. 1/2 inch for the flat and vertical position.
  - b. 3/8 inch for the horizontal position.

- c. 5/16 inch for the overhead position.

**C. Preheat**

Preheat ahead of welding both groove and fillet welds (including tack welding) will be required as shown in Table 3.

Preheat and interpass temperatures must be sufficient to prevent crack formation. The preheat temperatures shown in Table 3 are minimums and higher preheats may be necessary in highly restrained welds.

When the base metal is below the required temperature, it shall be preheated so the parts being welded are not less than the specified temperature within 3 inches of the point of welding.

For all groove welds, reheat temperature shall be measured on the side opposite to which the heat is applied at points about 3 inches away from the joint.

Preheating equipment shall be adequate to maintain the entire joint at or above the specified temperature. When possible, a joint shall be completely welded before it is allowed to cool below the specified temperature but shall always be welded sufficiently to prevent cracking before cooling is permitted.

Usually preheat and interpass temperatures shall not exceed 400 F for thickness up to 1 ½ inches and 450 F for greater thickness. These temperatures shall never be exceeded on ASTM A514/517 steels.

The welder shall have and use approved equipment for checking preheat and interpass temperatures at all times while welding is in progress.

<b>Table 3 Minimum Preheat and Interpass Temperature for Manual Shielded Metal-Arc Welding, Flux Cored Arc Welding or Gas Metal-Arc Welding</b>		
	<b>Manual or Semiautomatic Gas Metal-Arc Welding, Flux Cored Arc Welding or Manual Shielded Metal-Arc Welding with Low Hydrogen Electrodes</b>	
<b>Thickness of Thickest Part at Point of Welding</b>	<b>ASTM A 36; A 242; A 441 A 572 Grades 42, 45 and 50; A 588</b>	<b>ASTM A 514/517</b>
To 3/4 inch, incl.	50 F	50 F
Over 3/4 inch to 1 ½ inches, incl.	70 F	125 F
Over 1 ½ inches to 2 ½ inches, incl.	150 F	175 F
Over 2 ½ inches	225 F	225 F



1. These temperatures are the minimum required for the thinner material shown for each increment and higher preheat on a step basis will be required for the thicker material within each increment. Preheat and interpass temperatures must be sufficient to prevent crack formation and welding shall be carried continuously to completion or to a point that will assure freedom from cracking before the joint is allowed to cool below the minimum specified preheat and interpass temperature. Temperature above those shown may be required for highly restrained welds.
2. When E7010 electrodes are permitted for tacking or temporary root pass, the material shall be pre-heated according to the following:

Thickness of Thickest Part	Preheat for Tacking or Temporary Root Pass
1/2 inch and less	150°F
9/16 inch through 3/4 inch	200°F
13/16 inch through 1½ inches	300°F
Over 1½ inches	400°F

3. When joining steels of different strengths or thickness with groove welds, the preheat and interpass temperatures for the higher strength steel and the average plate thickness shall be used. For fillet welds, the preheat shall be used for the higher strength steel and the thickest plate being welded.
4. When the base metal temperature is below 32°F, preheat to at least 70°F and maintain this minimum temperature during welding.
5. Heat input when welding A 514/517 steel shall not exceed the steel producer's recommendations.
6. When moisture is present on the base metal it shall be preheated to 200°F before welding is started.

#### 723.6 - Quality of Welds

Weld metal shall be sound throughout.

There shall be no cracks in any weld or weld pass.

There shall be complete fusion between the weld metal and the base metal and between successive passes throughout the joint.

Welds shall be free from overlap and the base metal free from undercut more than 1/100-inch deep when its direction is transverse to the primary stress in the part that is undercut. Undercut shall not be more than 1/32-inch deep when its direction is parallel to the primary stress in the part that is undercut.

All craters shall be filled to the full cross section of the welds.

All welds on ASTM A 514/517 steel shall be visually examined for longitudinal or transverse cracks not less than 48 hours after completion of welding.

#### 723.7 - Corrections

When the weld quality is unsatisfactory, the following corrective measures will be required by the Engineer whose specific approval shall be obtained for making each correction.

When requirements prescribe the removal of part of the weld or a portion of the base metal, removal shall be by oxygen gouging or arc-air gouging.

Oxygen gouging shall not be used on ASTM A 514/517 steel or for A 588 weathering steel.

Backgouging of splices in beams and girders or cutouts of defective welds shall be done by arc-air gouging by a welder qualified to make beam and girder splices.

Where corrections require the deposition of additional weld metal, the sides of the area to be welded shall have sufficient slope to permit depositing new metal.

Defective or unsound welds shall be corrected either by removing and replacing the entire weld or as follows:

1. Excessive convexity. Reduce to size by grinding off the excess weld metal.
2. Shrinkage cracks. Cracks in base metal, craters and excessive porosity. Remove defective portions of base and weld metal down to sound metal and replace with additional sound weld metal.
3. Undercutting, undersize and excessive concavity. Clean and deposit additional weld metal.
4. Overlapping and incomplete fusion. Remove and replace the defective portion of weld.
5. Slag inclusions. Remove the parts of the weld containing slag and replace with sound weld metal.
6. Removal of adjacent base metal during welding. Clean and form full size by depositing additional weld metal.

Where corrections require the deposition of additional weld metal, the electrode used shall be smaller than that used for making the original weld. Surfaces shall be cleaned thoroughly before rewelding.

A cracked weld shall be removed throughout its length, unless the extent of the crack can be ascertained to be limited, in which case the weld metal shall be removed 2 inches beyond each end of the crack and repairs made.

Where work performed after the making of a deficient weld has made the weld inaccessible or has caused new conditions making the correction of the deficiency dangerous or ineffectual, the original conditions shall be restored by removal of welds or members or both, before making the necessary corrections or else the deficiency shall be compensated by additional work according to a revised design approved by the Engineer.

Improperly fitted and misaligned parts shall be cut apart and rewelded.

Members distorted by the heat of welding shall be straightened by mechanical means or by the carefully supervised application of a limited amount of localized heat. Heated areas shall not exceed 1200°F as measured by Tempil-sticks or other approved methods for steel up to 65,000 psi yield strength. Parts to be heat straightened shall be substantially free of stress from external forces, except when mechanical means are used in conjunction with the application of heat.

Heat straightening of A 514/517 steel shall be done only under rigidly controlled procedures, subject to the approval of the Engineer. In no case shall the maximum temperature of the steel exceed 1100°F. Sharp kinks and bends shall be cause for rejection of the material.

#### 723.8 - Radiographic Inspection

Radiographic testing required in the field shall be done at the expense of the Contractor by an approved laboratory as defined by "General Conditions" having prior approval of the Engineer. The testing shall include furnishing all materials, equipment, tools, labor and incidentals necessary to perform the required testing. The Owner may require further tests as necessary conforming to "General Conditions" and may perform additional testing including other types.

Radiographic equipment, procedures, resulting radiographs, identification marks, penetrameters, examination, reports and weld surface preparation shall conform to TxDOT Bulletin C-5. The Engineer will examine and interpret the resulting radiographs.

Radiography shall be done within the time interval specified by the Engineer. Field welds on ASTM A 514/517 steel shall not be radiographed until a minimum of 48 hours after completion of the weld.

When so indicated, welded butt splices shall be radiographed. Radiographic testing shall be as indicated in "Radiographic Inspection", above. Weld quality shall be as follows:

There shall be no cracks and the sum of the greatest dimension of porosity and fusion type defects shall not exceed 1/10 of the nominal bar diameter in inches. The Engineer will examine and interpret the resulting radiographs, which shall become the property of the Owner and remain with the Engineer.

For field welds of splices in material with a specified yield strength of less than 65,000 psi, radiographic inspection will be made of the full flange width of 25 percent of all flange splices and of 1/3 the depth of the web of 25 percent of all web splices on each structure (17 inches minimum length). If unacceptable work is found, an additional radiograph (penalty shot) shall be made on a section welded by the same operator just prior to and just following the section containing the defect. Welds requiring repairs shall be retested by radiography after repairs are made. Necessary repairs shall be made prior to any further work being done.

For field welds of splices in material with a specified yield strength greater than 65,000 psi, radiographic inspection shall be made on all flange and web splices. Welds requiring repairs shall be retested by radiography a minimum of 48 hours after repairs are made.

All radiography (penalty shots and retakes) required because of unacceptable welding shall be performed at the expense of the Contractor.

When radiographic inspection of particular welds is indicated, this shall be in addition to the radiographic inspection required herein.

All resulting radiographs shall become the property of the Owner and remain with the Engineer.

All groove welds designed to carry primary stresses shall be subject to radiographic inspection. When subjected to such inspections, the presence of any of the following defects in excess of the limits indicated will result in rejection of the defective weld until corrected.

1. Sections of welds shown to have any cracking, regardless of length or location, incomplete fusion, overlapping or inadequate penetration shall be judged unacceptable.
2. Inclusions less than 1/16-inch in greatest dimension including slag, porosity and other deleterious material, shall be permitted if well dispersed so that the sum of the greatest dimensions of the inclusions in any linear inch of welded joint shall not exceed 3/8-inch.
3. Inclusions 1/16-inch or larger in greatest dimension shall be permitted provided such defects do not exceed the limits indicated or described above.
4. There shall be no inclusion greater than 1/16-inch within 1 inch of the edge of part or member at the joint or point of restraint.

#### 723.9 - Reinforcing Steel

Provisions are made herein for the welding of reinforcing steel by the manual shielded metal-arc process. Other processes may be permitted with the specific approval of the Engineer or may be specified on the plans. When the Cadwell process is permitted, a "C" series splice shall be used with grade 40 reinforcing steel and a "T" series splice shall be used with grade 60 reinforcing steel, unless otherwise indicated.

##### A. Base Metal

Reinforcing steel to be welded shall be new billet steel conforming to ASTM A 615 and to the following chemical composition:

Maximum Carbon	0.40 Percent
Maximum Manganese	1.30 Percent

Mill test reports will be required conforming to Item No. 406S, "Reinforcing Steel".

##### B. Filler Metal

Low hydrogen electrodes as specified in Table 1 shall be required for all welding of reinforcing steel. Drying of electrodes shall be as specified in "Materials", above.

#### 723.10 - Preheat and Interpass Temperature

Minimum preheat and interpass temperatures shall be as shown in Table 4.

**Table 4**  
**Preheat and Interpass Temperature for Reinforcing Steel**

<b>Carbon Range</b>	<b>No. 7 &amp; Smaller</b>	<b>No. 8 &amp; Larger</b>
Up to and including 0.30	None	100
0.31 to 0.35 inclusive	None	150
0.36 to 0.40 inclusive	100	250
Unknown	250	400

For widening projects, use carbon content and bar size of new steel to determine preheat required.

#### 723.11 - Joint Types

For all bars No. 8 and larger, butt splices will be required. For No. 7 bars and smaller, lap splices will be required.

Fillet welds in lap splices shall be a minimum of 4 inches in length and shall be welded on each side of the lap joint. For bars No. 5 and smaller, welding from one side of the lap will be permitted by the Engineer, when it is impractical to weld from both sides of the joint, but in this case the weld shall be a minimum of 6 inches in length.

Lap welds shall conform to Table 5.

Where possible, all butt splices shall be made in the flat position. All welds for butt splices, except horizontal welds on vertical bars shall be as indicated. The backup strip will be required when access to the splice is from the top only. When bars may be rotated or access to the splice is available from two sides the double bevel splice may be made and this type weld requires gouging out the root pass similar to a flange splice on structural steel. The root pass may be made using E7010 electrodes for all double beveled splices and the root pass shall be completely removed prior to welding the opposite side. The steel shall be preheated to 400 F if E7010 electrodes are used. Horizontal splices, on vertical bars, shall be as indicated.

<b>Table 5</b>					
<b>Bar Size</b>	<b>a</b>	<b>b Maximum</b>	<b>t Minimum</b>	<b>c Maximum</b>	<b>Electrode Size</b>
No. 4	.04 inch	1/8 inch	1/8 inch	1/16 inch	1/8 inch
No. 5	.05 inch	1/8 inch	3/16 inch	1/16 inch	5/32 inch
No. 6	.06 inch	1/8 inch		1/16 inch	5/32 inch
No. 7	.07 inch	3/16 inch	5/16 inch	1/16 inch	5/32 inch

#### 723.12 - Widening Projects

In general, the new reinforcing steel shall be either lap or butt spliced directly to the bar to be extended. When the reinforcement in the old portion of a structure is found to be of the wrong spacing, dowel bars long enough to develop the welded lap or butt splice and also develop the bar in bond, conforming to Item No. 406S, "Reinforcing Steel", shall be welded to the old steel and the new reinforcement placed at the correct spacing without welding to the old steel. No measurement or payment will be made for the dowels but will be included in the unit price bid for other items in the contract.

Both old and new reinforcement shall be cleaned thoroughly prior to the preparation of the joint.

#### 723.13 - Welder Qualification

All welders shall be certified before working on any material which is to be incorporated into a City project, except for miscellaneous welds as defined below. Each welder must have certification papers conforming to TxDOT Bulletin C-6, showing the type of work the welder is certified to perform. The welder will only be permitted to do work covered by such papers.

Miscellaneous welds of the following types may be made by a welder who is certified for structural or reinforcing steel or a qualified welder:

Armor joints and their supports, Scribed Rail and Form Hanger Supports where permitted on Steel units, Reinforcing Steel to R-Bars for lateral stability between Prestressed Beams, Spirals or Bands to reinforcing Bars in Drilled Shaft cages, permanent Metal Deck forms, additional steel added in railing when slip form construction is used and other similar miscellaneous members that have no load carrying capacity in the completed structure.

A qualified welder is an experienced welder who is capable of making welds of sound quality but does not have certification papers. Prior to welding operations, the Engineer or a representative of the Engineer shall check the welder's ability by a job site Miscellaneous Weld Qualification Test. The Contractor shall furnish all of the material and equipment necessary for the test.

The miscellaneous Weld Qualification Test shall consist of the following:

The welder shall make a single pass fillet weld in the vertical position 1/4 inch maximum size approximately 2 inches long on 1/2 inch plate using 5/32-inch low hydrogen electrodes in the position indicated. The welder shall stop and start again within the 2-inch length of fillet weld.

The specimen shall be visually examined, and the fillet weld shall present a reasonably uniform appearance free of cracks, overlap and undercut. There shall be no porosity visible on the surface of the weld.

The specimen shall be ruptured as indicated by the application of a force or by striking with a hammer.

The fractured surface of the weld shall show complete penetration into the root of the joint and shall exhibit no incomplete fusion to the base metal nor any inclusion or porosity larger than 3/32-inch in its greatest dimension.

If a welder fails to meet the requirements of this test, a retest may be allowed under the following conditions:

An immediate retest may be made consisting of 2 test welds, as described above and both test specimens shall meet all of the requirements specified.

A retest may be made after 30 days, provided there is evidence that the welder has had further training or practice. In this case the test shall be a single specimen.

Qualification by the test herein specified for miscellaneous welding shall be effective immediately upon satisfactory completion thereof and shall remain in effect for the duration of the project.

Before welding on ASTM A 514/517 steel, a welder must present evidence, satisfactory to the Engineer, of at least 3 months satisfactory experience welding this type of steel over 1 inch thick. In lieu of such experience, a welder, previously qualified for welding with low-hydrogen electrodes or has used the proposed welding process, shall have completed a training course in welding ASTM A 514/517 steel prior to taking the welder qualification test.

Tests for certification of welders for manual shielded metal-arc welding shall conform to TxDOT Bulletin C-6. Tests shall be given by an approved laboratory. For field welding, certification by an approved laboratory will be accepted for a period of 1 month from the time of certification. During this period, the welder will be permitted to work on City projects provided the welder's work is satisfactory. If the welder's work is satisfactory during this period, the City will issue certification papers which will permit the welder to work on City projects, as long as the welder continues to do satisfactory work.

A welder must have passed the Basic Qualification Test for Structural Welding in the vertical (3G) and overhead position (4G) conforming to TxDOT Bulletin C-6 prior to welding on any load carrying members. Also, the welder must demonstrate to a City welding inspector a thorough knowledge of, and ability to consistently implement, the required welding procedures and make welds of sound quality and good appearance. Quality of the welds will be checked by radiography.

To work on field splices of beams and girders, a welder must be certified for and be capable of making groove welds in both the vertical and overhead position when using the manual shielded metal-arc process.

For manual (semiautomatic) gas metal-arc welding or flux cored arc welding, welder qualification tests for certification shall qualify conforming to TxDOT Bulletin C-5 and tested conforming to TxDOT Bulletin C-6 as follows:

1. Basic Test Certification for groove welds for unlimited thickness material will also qualify a welder for any equal or lower strength steel or for fillet welding in the position in which the welder is certified, using the same electrode and combination of shielding used for the test.
2. Welders shall be certified in the vertical and overhead position to work on field splices of beams or girders.
3. Tests for certification shall be given by an approved laboratory. Certification papers for gas metal-arc welding or flux cored arc welding issued by an approved laboratory will be handled in a manner similar to that used for the manual shielded metal-arc process.
4. Welders shall be qualified for each process to be used. Qualification for flux cored arc welding will not qualify a welder for gas metal-arc welding or vice versa.
5. Qualification for welding with any grade electrode will automatically qualify a welder for the use of lower grades of electrodes using the same process, i.e., qualification with Grade ER80S/E80S electrode will qualify for Grade ER70S, but not vice versa.

The certification papers issued by the City are the property of the City and may be canceled at any time.

Radiographic inspection shall be made of all qualification test plates of groove welds for the "Basic Qualification Test". If this inspection indicates any lack of fusion, incomplete penetration and defects 1/16 inch or larger in greatest dimension or if the sum of the greatest dimensions of defects less than 1/16 of an inch in greatest dimension exceeds 3/8-inch in any linear inch of weld, the weld shall be considered as failing the soundness test. This radiographic inspection shall apply only to that portion of the welds between the discard strips of the specimens as indicated in Figures 13 and 14 of Appendix B of TxDOT Bulletin C-6. The specimen plates shall be wide enough to provide a minimum of 6 inches of effective weld length for radiographic testing. Mechanical testing shall conform to TxDOT Bulletin C-6.

#### 723.14 - Measurement and Payment

Compensation will not be allowed under this item for the work prescribed but shall be included in the unit price item of construction in which the item is used.

**END**



## SERIES 800 - URBAN TRANSPORTATION (TRAFFIC SIGNS AND MARKINGS)

### ITEM NO. 801S - CONSTRUCTING A DETOUR

#### 801S.1 - Description

This item shall govern:

- The construction, manipulation, maintenance and removal, if required, of construction detours of the length and to the lines, grades and typical sections indicated on the Drawing;
- The provision for installation, movement, replacement, maintenance, cleaning and removal, as required, of all detour markers, signs, barricades and other devices used in traffic control and handling at the construction site upon completion of the work, as indicated on the Drawings or as directed by the Engineer or designated representative.

#### 801S.2 - Submittals

The submittal requirements of this specification item include:

- Type D HMAC mix design,
- Type and Construction of the barricade, and
- Identification of the type, source, mixture, Percent Live Seed (PLS) and rate of application of the seeding.

#### 801S.3 - Materials

##### A. Flexible Base:

Flexible Base shall conform to Standard Specification Item No. 210S, "Flexible Base".

##### B. Stabilized Base:

When an HMAC Type A or B stabilized base is indicated on the Drawings, it shall conform to Standard Specification Item No. 340S, "Hot Mix Asphaltic Concrete Pavement".

##### C. Prime Coat:

Prime Coat shall conform to Standard Specification Item No. 306S, "Prime Coat".

##### D. Tack Coat:

Tack Coat shall conform to Standard Specification Item No. 307S, "Tack Coat".

##### E. Seal Coat:

Seal Coat shall conform to Standard Specification Item No. 312S, "Seal Coat".

##### F. Hot Mix Asphaltic Concrete Pavement:

Hot Mix shall be Type C or D, as shown on the Drawings, conforming to Standard Specification Item No. 340S, "Hot Mix Asphaltic Concrete Pavement".

##### G. Construction Pavement Markings:

1. Traffic Tape shall conform to Standard Specification Item No. 864S, "Abbreviated Pavement Markings".
2. Pavement Paint shall conform to Standard Specification Item No. 860S, "Pavement Marking Paint".
3. Pavement Markers shall conform to Standard Specification Item No. 871S, "Reflectorized Pavement Markers".
4. Work Zone Pavement Markings shall conform to Standard Specification Item No. 870S, "Work Zone Pavement Markings".

#### H. Barricades, Signs and Traffic Handling

Barricades, Signs and Traffic Handling shall conform to Standard Specification Item No. 803S, "Barricades, Signs and Traffic Handling". All barricades shall be constructed with one of the following materials/combinations:

1. Steel
2. Plastic

#### I. Seeding

Seeding shall conform to Item No. 604S, "Seeding for Erosion Control".

#### 801S.4 - Construction Methods

The detours shall be constructed at the locations and to the lines and grades indicated on the Drawings. It shall be the entire responsibility of the Contractor to provide for the passage of traffic in comfort and safety without creating a dust problem.

Flexible base material shall be deposited on the prepared subgrade, sprinkled, bladed, compacted and shaped to conform to the typical sections indicated on the Drawings, conforming to the City of Pflugerville Standard Specification Item No. 210S, "Flexible Base". The finished base shall receive surfacing where indicated on the Drawings in accordance with the pertinent City of Pflugerville Standard Specification surfacing items.

After the detours are no longer needed for traffic, those materials, indicated for removal, shall become the property of the Contractor and shall be disposed of off the project. The site shall then either be restored to the original configuration and contours of the ground or to a landscape with a pleasing appearance that is composed of natural rounded slopes with re-vegetation / seeding.

All barricades, signs and other types of devices listed above shall conform to details indicated on the Drawings and/or in the City of Pflugerville Standard Details and shall comply with the Texas Manual on Uniform Traffic Control Devices (TMUTCD).

#### 801S.5 - Maintenance

It shall be the Contractor's responsibility to maintain the construction detour and to repair the surface markers, striping and storm water drainage system as long as the detour is required.

#### 801S.6 - Measurement

"Constructing a Detour," when included in the contract as a pay item, will be measured by the lump sum.

801S.7 - Payment

The work and materials presented herein will not be paid for directly but shall be included in the unit price bid for the item of construction in which the activity is used, unless included as a separate pay item in the contract.

When specified for payment in the contract bid form, it shall be paid at the lump sum bid for "Constructing a Detour." The price shall include full compensation for all work, herein, specified, including the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the work.

Payment, when included as a contract pay item, will be made under:

<b>Pay Item No. 801S-A:</b>	Constructing a Detour	Per Lump Sum.
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**END**

## ITEM NO. 802S - PROJECT SIGNS

### 802S.1 - Description

This item shall govern furnishing, fabricating, erecting, maintaining and removing Project Signs on Capital Improvement Projects (CIP), Bond Program Projects and for project identification at other construction sites, when required on the Drawings. The CIP signs shall be constructed in accordance with Standard City of Pflugerville CIP signs or as indicated on the Drawings.

### 802S.2 - Materials

#### A. Sign Face

Sign face shall be manufactured on standard exterior waterproof plywood sheets or other suitable material approved by the Engineer or designated representative. Unless indicated otherwise on the Standard Details or Drawings, the thickness of the plywood sheet shall be a minimum of 3/4 inches.

#### B. Posts

Lumber posts, of the size indicated on the Standard Details or on the Drawings, shall be pressure treated with pentachlorophenol.

#### C. Paint

Exterior oil base paint, colors as indicated on the Standard Details or on the Drawings.

#### D. Decals for Capital Improvement Projects and Bond Program Projects

City seal shall be in color using the 4-color process.

### 802S.3 - Installation

The signs shall be erected at each major entrance to the project for maximum public identification and exposure. At locations where construction is confined to a specific area, the installed sign size shall be 4-foot x 8-foot. At locations where CIP roadway construction is in progress, such as a street paving or construction of a sidewalk, the sign shall be 2-foot x 3-foot. Signs for Bond Program Projects shall be 3 x 4 foot.

The signs shall be posted on portable wood frames or stanchions and will be located in the proximity of the work area as construction progresses. All lumber shall be painted with two coats of paint as indicated herein, on the Standard Details or in the Drawings.

In special cases the size of the sign may be changed to meet special requirements, but general proportions shall be maintained.

It shall be the responsibility of the contractor to maintain and relocate signs, if necessary, during the progression of the project. Care shall be exercised to assure that placement of the signs does not interfere with or cause sight obstruction to vehicular and pedestrian traffic.

For projects located on a street with curb and gutter, signs shall be installed no closer than 2 feet from the face of curb on the street.

For projects located on a street without curb and gutter, signs shall be installed no closer than 6 feet from the edge of street pavement.

The contractor may install, at the Contractor's own expense, company signs to identify the contractor, architectural firm, etc. Signs are to be securely attached to the posts at locations indicated on the drawings and shall not be larger than 18 x 36 inches.

**802S.4 - Measurement**

In the CIP contract and/or Bond Program, signs shall be measured by either lump sum or per each.

**802S.5 - Payment**

The work performed and the materials furnished as prescribed by this item shall be paid for by lump sum or per each price bid only. The "lump sum" bid or "per each" price bid shall include full compensation for all work performed and all materials furnished in constructing, transporting, maintaining and removing the signs as specified on the Drawings and as directed by the Engineer or designated representative.

Payment will be made under one of the following:

<b>Pay Item No. 802S-BCIP:</b>	CIP Project Sign	Per Each.
<b>Pay Item No. 802S-BBOND:</b>	Bond Project Sign	Per Each.

**END**

## ITEM NO. 803S - BARRICADES, SIGNS AND TRAFFIC HANDLING

### 803S.1 - Description

This item shall govern for providing, installing, moving, replacing, maintaining, cleaning and removing upon completion of the work, all temporary or permanent street closure barricades, signs, cones, lights or other devices required to handle the traffic in conformance with the current edition of the Texas Manual of Uniform Traffic Control Devices for Street and Highways and as indicated on the Drawings or directed by the Engineer or designated representative.

Constructing a detour, if required, shall conform to Standard Specification Item No. 801S, "Constructing a Detour." Capital Improvement Project Signs shall conform to Standard Specification Item No. 802S, "Project Signs."

This item shall also include the installation of all required safety fencing as described in the latest adopted version of Standard Detail 804S-4 "Safety Fence".

### 803S.2 - Submittals

Within 10 days after the Notice to Proceed, the Contractor shall submit to the Engineer a site-specific Traffic Control Plan. The Traffic Control Plan shall be sealed by a Professional Engineer registered in the State of Texas as required by the Project Specifications, City, or Engineer.

Other submittal requirements of this specification item include:

- A. Type of Barricade and proposed materials and Construction of the barricade,
- B. Test results for Retro-Reflective sheeting.

### 803S.3 - Materials

All barricades, signs, cones, lights and other types of devices to handle traffic, as indicated on the Drawings or directed by the Engineer or designated representative, shall conform to details shown on the Drawings or those indicated in the Texas Manual on Uniform Traffic Control Devices (TMUTCD).

### 803S.4 - Construction Methods

Prior to commencement of construction, suitable "Barricades, Signs and Traffic Handling" devices shall be installed to protect the workers and the public.

The Contractor shall be responsible for the installation of all markers, signs and barricades in accordance with the Drawings and in conformance with the Texas Manual on Uniform Traffic Control Devices (TMUTCD) and/or as indicated on the Drawings or directed by the Engineer or designated representative. If, in the opinion of the Engineer or designated representative, additional markers, signs or barricades are needed in the interest of safety, the Contractor will install such as are required or as directed by the Engineer or designated representative. All changes and/or revisions to the detour/traffic control plan shall be approved by the Engineer or designated representative.

### 803S.5 - Maintenance

It shall be the Contractor's responsibility to maintain, clean, move and replace if necessary, barricades, signs and traffic handling devices during the time required for construction of the project. Permanent barricades shall be constructed as required after the completion of the street by drilling holes and placing

hot-dipped galvanized (wedge) anchor bolts designed for use in concrete foundations. Posts shall be bolted to the galvanized (wedge) anchor bolts. Foundation concrete shall be cured before the rails are attached. When no longer needed, all temporary Barricades, Signs and Traffic Handling Devices shall be removed, and the area restored to its original condition or as directed by the Engineer or designated representative.

#### 803S.6 - Measurement

The work performed and material furnished as prescribed by this item, City of Pflugerville Standard Details, details included on the Drawings or indicated in the TMUTCD shall be measured as follows:

##### A. Pavement Markings.

All pavement marking required for proper installation of the designated Traffic Control Plans and Details, as well as required removal of existing pavement marking, shall be measured and paid for under Standard Specification Item No. 870S, "Work Zone Pavement Markings" and Standard Specification Item No. 874S, "Eliminating Existing Pavement Markings".

##### B. Barricades, Signs and Traffic Handling.

All work performed and material furnished as prescribed by this item, City of Pflugerville Standard Details, details shown on the Drawings or indicated in the TMUTCD, that are not included in the above paragraph, shall be measured by the number of calendar days, working days or months of actual service.

Traffic control for the project will be measured and paid for once per contract defined time period, i.e. either per Calendar Day, Working day or Month at the contract rate, regardless of the number of set-ups, locations or streets under construction.

##### C. Safety Fencing

Safety fencing will be measured by the lineal foot.

#### 803S.7 - Payment

The work performed and materials furnished as prescribed by this item, measured as provided under section "803S.6 Measurement" shall be paid for at the contract unit price for barricades, signs and traffic handling. This unit price shall include full compensation for furnishing, placement and removal of all materials and for all labor, tools, equipment, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item No. 803S-CD:</b>	Barricades, Signs, and Traffic Handling	Per Calendar Day.
<b>Pay Item No. 803S-WD:</b>	Barricades, Signs, and Traffic Handling	Per Working Day.
<b>Pay Item No. 803S-MO:</b>	Barricades, Signs, and Traffic Handling	Per Month.
<b>Pay Item No. 803S-SF:</b>	Safety Fence	Per Lineal Foot.

END



## ITEM NO. 824S – TRAFFIC SIGNS

### 824S.1 – Description

- **Installation.** Furnish, fabricate, and erect aluminum signs. Sign supports are provided for under other Items.
- **Replacement.** Replace existing signs on existing sign supports.
- **Refurbishing.** Refurbish existing aluminum signs on existing sign supports.

### 824S.2 – Materials

- A. **Sign Blanks.** Furnish sign blank substrates in accordance with [DMS-7110](#), “Aluminum Sign Blanks,” and in accordance with the types shown on the plans. Use single-piece sheet-aluminum substrates for Type A (small) signs and extruded aluminum substrates for Type G (ground-mounted) or Type O (overhead-mounted) signs.
- B. **Sign Face Retroreflectorization.** Retroreflectorize the sign faces with flat surface reflective sheeting. Furnish sheeting that meets [DMS-8300](#), “Sign Face Materials.” Use retroreflective sheeting from the same manufacturer for the entire sign face background. Ensure that sign legend, symbols, borders, and background exhibit uniform color, appearance, and retroreflectivity when viewed both day and night.
- C. **Sign Messages.** Fabricate sign messages to the sizes, types, and colors shown on the plans. Use sign message material from the same manufacturer for the entire message of a sign. Use screen ink and background reflective sheeting that are from the same manufacturer when fabricating signs.
  - Ensure that the screened messages have clean, sharp edges and exhibit uniform color and retroreflectivity. Prevent runs, sags, and voids. Furnish screen inks in accordance with [DMS-8300](#), “Sign Face Materials.”
  - Fabricate colored, transparent film legend, and retroreflectorized sheeting legend from materials that meet [DMS-8300](#), “Sign Face Materials.”
  - Fabricate non-reflective black film legend from materials meeting [DMS-8300](#), “Sign Face Materials.”
  - Furnish direct-applied route markers and other attachments within the parent sign face unless otherwise specified on the plans.
- D. **Hardware.** Use galvanized steel, stainless steel, or dichromate-sealed aluminum for bolts, nuts, washers, lock washers, screws, and other sign assembly hardware. Use plastic or nylon washers to avoid tearing the reflective sheeting. Furnish steel or aluminum products in accordance with [DMS-7120](#), “Sign Hardware.”

When dissimilar metals are used, select or insulate metals to prevent corrosion.

### 824S.3 – Construction

- A. **Fabrication.** Sign fabrication plants that produce permanent highway signs must be approved in accordance with DMS 7390, “Permanent Highway Sign Fabrication Plant Qualification.” Furnish signs from prequalified fabrication plants listed in the Department’s MPL.

- **Sign Blanks.** Furnish sign blanks to the sizes and shapes shown on the plans and that are free of buckles, warps, burrs, dents, cockles, or other defects. Do not splice individual extruded aluminum panels.

Complete the fabrication of sign blanks, including the cutting and drilling or punching of holes, before cleaning and degreasing. After cleaning and degreasing, ensure the substrate does not come into contact with grease, oils, or other contaminants before the application of the reflective sheeting.

- **Sheeting Application.** Apply sheeting to sign blanks in conformance with the sheeting manufacturer's recommended procedures.

When using rotational sensitive white sheeting, fabricate signs by applying the sheeting for cut-out legend, symbols, borders, and route marker attachments within the parent sign face with the identification marks or other orientation features in the optimum rotation as identified by the sheeting manufacturer.

Clean and prepare the outside surface of extruded aluminum flanges in the same manner as the sign panel face.

Minimize the number of splices in the sheeting. Overlap the lap-splices by at least 1/4 in. for encapsulated glass bead sheeting unless otherwise recommended by the reflective sheeting manufacturer. Use butt splices for prismatic reflective sheeting. Provide a 1 ft. minimum dimension for any piece of sheeting. Do not splice sheeting for signs fabricated with transparent screen inks or colored transparent films.

- **Sign Assembly.** Assemble extruded aluminum signs in accordance with the details shown on the plans. Sign face surface variation must not exceed 1/8 in. per foot. Surface misalignment between panels in multi-panel signs must not exceed 1/16 in. at any point.
- **Decals.** Code and apply sign identification decals in accordance with TxDOT Specification Item No. 643, "Sign Identification Decals."

- B. **Storage and Handling.** Ship, handle, and store completed sign blanks and completed signs so that corners, edges, and faces are not damaged. Damage to the sign face that is not visible when viewed at a distance of 50 ft., night or day, will be acceptable. Replace unacceptable signs.

Store all finished signs off the ground and in a vertical position until erected. Store finished sheet aluminum substrate signs in a weatherproof building. Extruded aluminum substrate signs may be stored outside.

Stockpile salvageable materials at the location shown on the plans or as directed. Accept ownership of unsalvageable materials and dispose of them in accordance with federal, state, and local regulations

- C. **Cleaning.** Wash completed signs in the fabrication shop with a biodegradable cleaning solution acceptable to the manufacturers of the sheeting, colored transparent film, and screen ink to remove grease, oil, dirt, smears, streaks, finger marks, and other foreign material. Wash again before final inspection after erection.

- D. **Installation.** Install signs as shown on the plans or as directed.

- E. **Replacement.** Remove the existing signs from the existing supports and replace with new signs, including mounting hardware, as shown on the plans.
- F. **Refurbishing.** Refurbish existing signs by providing and installing new messages and mounting hardware. Install new retroreflectorized legend and supplemental signs as shown on the plans.
- G. **Documentation.** Provide the following documentation from the sign fabricator with each shipment of furnished signs:
- A notarized original of the Signing Material Statement (Form 2273) with the proper attachments for verification of compliance, and
  - A notarized certification stating that the completed signs were fabricated in accordance with this Item and the plans.

#### 824S.4 – Measurement

Signs installed or replaced will be measured by the square foot of the sign face. Signs refurbished will be measured by each sign.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

#### 824S.5 – Payment

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Aluminum Signs," "Replacing Existing Aluminum Signs," or "Refurbishing Aluminum Signs," of the type specified.

- A. **Installation.** This price is full compensation for furnishing and installing new signs and hardware; fabrication of sign panels; treatment of sign panels required before application of the background materials; application of the background materials and messages to the sign panels; furnishing and fabricating frames, wind beams and stiffeners; furnishing bolts, rivets, screws, fasteners, clamps, brackets, and sign support connections; assembling and erecting the signs; preparing and cleaning the signs; and materials, equipment, labor, tools, and incidentals.
- B. **Replacement.** This price is full compensation for furnishing and installing new aluminum signs and hardware; removal of existing signs; fabrication of sign panels; treatment of sign panels required before application of the background materials; application of the background materials and messages to the sign panels; furnishing and fabricating frames, wind beams and stiffeners; furnishing bolts, rivets, screws, fasteners, clamps, brackets, and sign support connections; assembling and erecting the signs; preparing and cleaning the signs; salvaging and disposing of unsalvageable materials; and materials, equipment, labor, tools, and incidentals.
- C. **Refurbishing.** This price is full compensation for modifying existing sign messages; removing and replacing existing route markers, reflectorized legend, or supplemental signs attached to the parent sign; preparing and cleaning the signs; furnishing sheeting and hardware; salvaging and disposing of unsalvageable materials; and materials, equipment, labor, tools, and incidentals.

## ITEM NO. 827S - DESIGNATED BICYCLE LANE SIGNING

### 827S.1 - Description

This item shall govern the signage for Designated Bicycle Lanes of the types, sizes and placement indicated on the Drawings. Designated Bicycle Lanes shall be for the exclusive use of bicycle traffic.

### 827S.2 - Submittals

The submittal requirements of this specification item include:

- Identification of the types of materials proposed for each type of bicycle lane sign (i.e. face, post, clamps, etc).
- Results of any State or Federal tests for sign faces (reflectance, diffuse day color, specific intensity brightness, Weather-O-meter, etc.) performed on their products,
- Construction details (Portland Cement (PC) concrete mix, reinforcing steel, etc.) for signpost PC foundation

### 827S.3 - Materials

The sign posts and support foundation, as well as sign blanks and sign face reflective sheeting for the Bicycle Lane Signage shall conform to Standard Specification Item No. 824S, "Traffic Signs".

### 827S.4 - Installation

#### A. General

Designated Bicycle Lanes shall be delineated with appropriate signs to alert the automobile/truck driver of the possibility of the presence of bicyclists. Preferential Lane markings and symbols shall be installed in conformance with Standard Specification Item No. 829S, "Designated Bicycle Lane Markings". Signs shall be placed as described herein, as indicated on the Drawings and/or directed by the Engineer or designated representative.

#### B. Signage

A 'Bicycle Lane Ahead' sign (Texas MUTCD designation R3-16) shall be installed in advance of the beginning of the bicycle lane and a 'Bicycle Lane Ends' shall be placed prior to the end of the lane as identified in the Drawings or directed by the Engineer or designated representative. The 'Bicycle Lane Ends' sign shall be a modified Texas MUTCD designation R3-16 in which 'Ends' replaces 'Ahead' in the sign legend.

A 'Bicycle Lane Ends' sign should only be used at the end of the last segment of a stretch of bicycle lanes and should not be placed at a street intersection where the bicycle lane continues beyond the intersection.

The placement of 'Right Lane Bicycles Only' signs shall be coordinated with the installation of Preferential Lane markings. 'Right Lane Bicycles Only' signs should be placed at the beginning of the Designated Bicycle Lane and at the minimum spacing designated on the Drawings may be used on one-way streets where the left portion of the street is designated for bicycle traffic only. The 'Left Lane Bicycles Only' sign shall be a modified Texas MUTCD designation R3-17 in which 'Left' replaces 'Right' in the sign legend.

The sign configuration and the lateral/vertical placement of sign face with respect to the outer edge of the bicycle lane as identified in the Drawings and shall conform to the requirements of Texas MUTCD, Part IX.

#### 827S.5 - Construction Methods

Signs will be installed as indicated on the Drawings or as directed by the Engineer or designated representative. The installation as a whole shall be carried out in conformance with requirements herein stated and with details and dimensions indicated on the Drawings. Upon completion, the work shall present a neat and uniform appearance.

The sign supports shall be located as indicated on the Drawings, except that the Engineer or designated representative may shift a sign support where necessary to secure a more desirable location. The Engineer or designated representative will approve all sign support locations.

Sign supports shall be erected at the direction of the Engineer or designated representative so that the sign faces will normally be vertical and, if necessary, angled sufficiently away from a position perpendicular to the roadway, when attached to the supports, to prevent specular glare. If specular glare is apparent on the mounted signs during nighttime inspection, corrective adjustments in the sign orientation shall be made at the direction of the Engineer or designated representative.

The length of each traffic sign post, that is indicated on the Drawings, shall be verified by the Contractor in order to meet the existing field conditions and to conform with sign mounting heights indicated on the Drawings. If it is necessary to field cut a steel post to shorten it, the cut end shall be placed in the PC concrete foundation.

The pipe stub post shall be bolted to the anchor bolts in the foundation, and if directed by the Engineer or designated representative, it shall be held in place by an approved form or template before the PC concrete for the foundation is placed. The forms and templates, if used, shall not be removed until the PC concrete has aged at least 24 hours.

No sign shall be attached to the posts until the PC concrete has aged at least 2 days of curing or until otherwise directed by the Engineer or designated representative. A curing day shall be as defined in Standard Specification Item No. 410S, "Concrete Structures". Springing or raking of posts to secure proper alignment will not be permitted.

Any part of the pipe post, that displays exposed bare metal or from which the galvanizing has been knocked or chipped off down to bare metal during fabrication, transit or erection, shall be repaired, in accordance with the manufacturer's recommendations, by application of galvanizing repair compounds meeting Federal Specification O-G-93 (stick only) or zinc dust-zinc oxide meeting Federal Specification TT-P-641b.

The message as indicated on the Drawings shall be screened on the reflective sheeting in accordance with the sheeting producer's recommended practices utilizing screen inks approved by the Engineer or designated representative. Screen inks shall conform to TxDOT Departmental Materials Specification [DMS-8300](#), "Flat Surface Reflective Sheeting".

Before application, the surface must be prepared to the satisfaction of the Engineer or designated representative in accordance with the manufacturer's instructions. Whenever the sign is applied over expansion joints, deep cracks or seams, it shall be slit to avoid tearing or lifting. Any applied sign, that has

wrinkles, air pockets, ragged edges, tears or bends, shall be removed and replaced at the sole cost of the Contractor.

827S.6 - Measurement

This Standard Specification Item will be measured by sign type or by any other unit as shown on the Drawings. Payment for revised quantities will be paid for at the unit price bid for that bid item.

827S.7 - Payment

The work performed and materials furnished in accordance with this Standard Specification Item and measured as provided under "Measurement" will be paid for at the Unit bid price for "Bicycle Lane Signs" of the type and shapes specified. The unit bid prices shall include full compensation for furnishing all materials, labor, tools, equipment and incidentals necessary to place, maintain and remove, when required, the signs.

Payment will be made under one or more of the following:

<b>Pay Item 827S-A:</b>	'Bicycle Lane Ahead' sign	per each.
<b>Pay Item 827S-B:</b>	'Bicycle Lane Ends' sign	per each.
<b>Pay Item 827S-C:</b>	'Right Lane Bicycles Only' sign	per each.
<b>Pay Item 827S-DL:</b>	'Left Lane Bicycles Only' sign	per each.

**END**

## ITEM NO. 829S - DESIGNATED BICYCLE LANE MARKINGS

### 829S.1 - Description

This item shall govern the markings for Designated Bicycle Lanes of the colors, types and sizes required in Standard Detail No. 829S-1A, "Bicycle Lane Markings" and/or indicated on the Drawings. Designated Bicycle Lanes shall be for the exclusive use of bicycle traffic.

### 829S.2 - Submittals

The submittal requirements of this specification item include:

- Identification of the types of marking materials (thermoplastic or preformed) materials proposed for each type of lane marking (i.e. lane striping, words and symbols).
- Guidemark layout and installation plan.

### 829S.3 - Materials

The bicycle lane markings (i.e. lane striping, words and symbols) shall conform to the requirements of Standard Specification Item No. 871S, "Reflectorized Pavement Markings".

### 829S.4 - Installation

#### A. General

Designated Bicycle Lanes shall be delineated with appropriate lane markings and symbols to alert the automobile/truck driver of the possibility of the presence of bicyclists. Preferential Lane markings and symbols shall be installed in conformance with this specification item, as indicated on the Drawings and/or directed by the Engineer or designated representative. Signs shall be installed in conformance with Standard Specification Item No. 827S, "Designated Bicycle Lane Signing".

Under inclement weather conditions the placement of pavement markings as shown on the Drawings shall be delayed until the time that weather conditions allow the application of pavement lane markings, symbols and words.

#### B. Lane striping

The lateral extent (or width) of a Designated Bicycle Lane shall be defined by solid white edge striping with a minimum width of 4 inches that separates the bicycle lane from the adjacent traffic lane. With the exception of potential conflict areas, the edge striping shall be continuous throughout the length of the Designated Bicycle Lane. The edge striping may be broken in a 1 to 3 segment-to-gap ratio, with a nominal 3-foot segment and a 9-foot in potential conflict areas including marked or unmarked pedestrian crosswalks, congested intersections and shared vehicular turning lanes at intersections. The striping shall be installed in conformance with Standard Specification Item No. 871S, "Reflectorized Pavement Markings", as identified in the Drawings or as directed by the Engineer or designated representative.

#### C. Symbols

Marking of a Designated Bicycle Lane shall include the installation of Preferential Lane (directional arrow) and Bicycle Rider Symbols, as indicated on Standard Detail 829S-1A, "Bicycle Lane Markings". A combination of Preferential Lane and Bicycle Rider symbols shall be installed after

each street intersection with the bicycle lane and at a maximum distance of 1000 feet along the bicycle lane. The Preferential Lane Symbols shall be spaced a maximum distance of 250 feet apart. The striping shall be installed in conformance with Standard Specification Item No. 871S, "Reflectorized Pavement Markings", as identified in the Drawings or as directed by the Engineer or designated representative.

#### 829S.5 - Maintenance of Markings

The Contractor shall be responsible for maintaining all bicycle lane markings for 30-calendar days after installation. Lane markings, that fail to meet the requirements of this specification for 30 calendar days from the date of installation, shall be removed and replaced by the Contractor at the Contractor's expense. The 30-calendar day maintenance requirement will be required for replaced markings from the time the original markings were installed.

#### 829S.6 - Construction Methods

##### A. Placement and Maintenance

When required by the Engineer, the Contractor and the Engineer shall review the sequence of Work to be followed and the estimated progress schedule.

The Contractor shall exercise due diligence in the selection of materials and placement of bicycle lane markings. The Contractor at its own expense shall maintain lane markings to the satisfaction of the Engineer or designated representative in accordance with this Specification Item.

Markings may be placed on streets either free of traffic or open to traffic. On streets already open to traffic, the markings shall be placed under traffic conditions that exist with a minimum of interference to the operation of the facility. Traffic control shall be as shown on the Drawings or as approved in writing by the Engineer or designated representative. All markings placed under open-traffic conditions shall be protected from traffic damage and disfigurement.

Guidemarks to mark the lateral location of pavement markings shall be in proper alignment with the final location of future standard markings as shown on the Drawings or as directed by the Engineer or designated representative. The Contractor shall establish the pavement marking guide and the Engineer or designated representative will verify the location of the guides. Any guidemarks, which are not in alignment with standard markings, shall be removed by the Contractor at its own expense.

Markings shall essentially have a uniform cross-section. The density and quality of markings shall be uniform throughout their thickness. The applied markings shall have no more than five percent, by area, of holes or voids and shall be free of blisters.

Unless otherwise shown on the Drawings, pavement markings may be applied by any method that will yield markings meeting the requirements of the Specification Item.

Unless approved otherwise in writing by the Engineer or designated representative, all Portland Cement (PC) concrete pavement surfaces shall have standard markings in place prior to opening to traffic.

All asphaltic surfaces, which are scheduled for opening to traffic, shall be marked with guidemarks immediately following placement and final rolling of any course. Guidemarks shall consist of a single temporary flexible-reflective street marker tab or a single temporary construction raised reflective pavement marker at 40-foot spacings.



The standard lane markings shall be installed in accordance with the Texas Manual on Uniform Traffic Control Devices for Streets and Highways (Texas MUTCD) and as shown on the Drawings.

Surfaces to receive surface treatments (Specification Item No. 320S "Two Course Surface Treatment") shall be marked in accordance with the Drawings. Unless otherwise shown on the Drawings, the standard pavement markings shall be placed in accordance with Texas MUTCD, no sooner than three days nor later than two weeks after the placement of the surface treatment.

**B. Marking Removal**

Any bicycle lane markings placed by the Contractor that conflict with any succeeding lane markings shall be removed by the Contractor at its own expense in accordance with Standard Specification Item No. 874S, "Eliminating Existing Pavement Markings and Markers", except for measurement and payment.

**829S.7 - Measurement**

This Standard Specification Item will be measured by material type (i.e. Type I or Type II) in lineal foot of standard lane marking (striping), by each symbol and by each letter of word markings, or by any other unit as shown on the Drawings. Where double stripes are placed, each stripe will be measured separately.

**829S.8 - Payment**

The work performed and materials furnished in accordance with this Standard Specification Item and measured as provided under "Measurement" will be paid for at the Unit bid price for "ReflectORIZED Bicycle Lane Pavement Markings" of the various types, shapes, sizes, widths and thickness (Type I markings only) specified. The unit bid prices shall include full compensation for furnishing all materials, labor, tools, equipment and incidentals necessary to place, maintain and remove, when required, the markings, except as described below.

Removal of existing markings will be paid for under Specification Item No. 874S, "Eliminating Existing Pavement Markings and Markers".

Payment will be made under one or more of the following:

<b>Pay Item 829S-A:</b>	Type I Bicycle Lane Markings, ___inches in width, white in color	per lineal foot
<b>Pay Item 829S-B:</b>	Type I Bicycle Lane Preferential (directional arrow) Symbols, white in color	per each
<b>Pay Item 829S-C:</b>	Type I Bicycle Lane (Bike Rider) Symbol, white in color	per each
<b>Pay Item 829S-D:</b>	Type I Bicycle Lane Letters, white in color	per each
<b>Pay Item 829S-E:</b>	Type II Bicycle Lane Markings, ___ inches in width, white in color	per lineal foot

<b>Pay Item 829S-F:</b>	Type II Bicycle Lane Preferential (directional arrow) Symbols, white in color	per each
<b>Pay Item 829S-G:</b>	Type II Bicycle Lane (Bike Rider) Symbol, white in color	per each
<b>Pay Item 829S-H:</b>	Type II Bicycle Lane Letters, white in color	per each

**END**



ITEM NO. 860S - PAVEMENT MARKING PAINT

860S.1 - Description

This item shall govern the installation of reflectorized paint pavement marking. The width of the line shall be 4 inches and the color as indicated on the Drawings.

860S.2 - Submittals

The submittal requirements of this specification item include:

- Proposed paint color(s), brand names, raw materials and products for traffic paint.
- Sampling and testing procedures and specific test results for pigment, calcium carbonate, acrylic resins and other materials used in the traffic paints.
- Proposed shipping requirements including container type(s) (drums and/or buckets) and labeling.
- Manufacturer's recommendations for mixing, storage and application of the traffic glass beads and traffic paint.
- All applicable Materials Safety data Sheets for the traffic paint.

860S.3 - Materials

A. Traffic Stripe Reflective Glass Traffic Beads

1. The glass spheres shall not contain more than 30 percent (by weight) irregular shaped particles when tested in accordance with TxDOT Test Method-832-B. The no. 20 sieve shall have a maximum of 35% by weight allowed irregular particles, based on a visual inspection.

Unless noted otherwise on the Drawings or designated in writing by the Engineer or designated representative, the application rate of the glass traffic beads shall not be less than 6 pounds per gallon. Glass traffic beads shall be essentially free of sharp angular particles and particles showing milkiness or surface scarring or scratching. Glass traffic beads shall be water white in color.

2. The glass traffic beads shall meet the following gradation requirements when tested in accordance with TxDOT Test Method Tex-831-B:

US Sieve	% weight retained
# 20	3 to 10
# 30	20 to 40
# 40	30 to 50
# 50	15 to 35
# 80	0 to 10

3. **Index of Refraction:** The glass traffic beads, when tested by the liquid immersion method at 77°F, shall show an index of refraction within the range of 1.50 to 1.53.
4. **Wetting:** The glass traffic beads shall be capable of being readily wet with water, when tested according to TxDOT Test Method Tex-826-B.
5. **Stability:** The glass traffic beads shall show no tendency toward decomposition, surface etching, change in retroreflective characteristics or change in color after
  - a. One-hour exposure to concentrated hydrochloric acid at 77°F,
  - b. 24 hours exposure to weak acids, weak alkali, and
  - c. 100 hours of weather-o-meter (Atlas, Sunshine Type) exposure, ASTM G-23, Method 1, Type EH.
6. **Contaminants:** Glass traffic beads shall:
  - a. contain less than 1/4 of 1 percent moisture by weight.
  - b. free of trash, dirt, etc.
  - c. show no evidence of objectionable static electricity when flowing through a regular traffic bead dispenser.
7. Sampling and Testing (TxDOT Test Method Tex-801-B) shall be in accordance with the latest applicable procedures included in the TxDOT Manual on Testing. Applicable test methods include but are not limited to the following:
  - a. Tex 806-B, "Method for Determining Grind and Oversize Pigment Particles"
  - b. Tex-810-B, "Test Method for Color and Color Stability of Opaque Colored Pigments"
  - c. Tex-811-B, "Skinning Characteristics of Coatings"
  - d. Tex-822-B, "Method for Determining Refractive Index of Glass Beads"
  - e. Tex-826-B, "Water Absorption Test of Beads"
  - f. Tex-828-B, "Determining Functional Characteristics of Pavement Markings"
  - g. Tex-830-B, "Method for Sampling Traffic Stripe Beads"
  - h. Tex-831-B, "Method for Determining The Gradation of Glass Traffic-Stripe Beads"
  - i. Tex-832-B, "Methods for Determining the Roundness of Glass Spheres"

## B. Pavement Marking Paint

### 1. Functional Requirements

- a. All paint-type materials that are applied at ambient or slightly elevated temperatures shall conform to TxDOT Departmental Materials Specifications DMS-8200 "Traffic Paint", YPT 10 and/or WPT-10 and DMS-8290 "Glass Traffic Beads".
- b. The paint shall be homogenous, well ground to a uniform and smooth consistency and shall not skin nor settle badly nor cake, liver, thicken, curdle or gel in the container.
- c. The paint, when applied to a bituminous pavement surface under normal field conditions at the required rate of .015-inch wet film thickness, shall have a maximum "no pickup" drying time of 15 minutes to prevent displacement or discoloration under traffic.

- d. In preparation of the paint, the pigments shall be dispersed in the vehicle by appropriate methods so that a fineness reading of not less than 4 is obtained with a Hegman grind gauge.
- e. Consistency viscosity, measured with a Krebs-Modified-Stormer Viscometer at 77°F, shall be from 80-90 K.U (with water deleted).
- f. A thin film of paint spread on a glass plate and allowed to dry thoroughly shall not darken or show any discoloration when subjected to ultraviolet rays for a period of 5 minutes.

2. Material Requirements

a. Raw Materials

- 1. The exact brands and types of raw materials used in the wet standards are listed for the purpose of facilitating the selection of parallel materials that are equal, not only in quality and composition but also in physical and chemical behavior after aging in the finished product.
- 2. After proposed brand names and types of raw materials by the City of Pflugerville, no substitution will be allowed during the manufacture without prior agreement with the City.
- 3. It shall be the responsibility of the Contractor to utilize materials that not only meet the individual raw material specification, but that also produce a coating that meets the specific formula requirements.
- 4. All materials required to meet TxDOT, Federal and ASTM specifications must meet the latest specification as indicated on the Drawings in effect on the date of the proposal or invitation to bid.

b. Pigments

1. Titanium Dioxide:

Titanium Dioxide shall meet ASTM D-476, Type II requirements.

2. Yellow Pigment:

<b>Yellow Pigment CI 65 (Reddish Yellow)</b>	
Characteristic	Values
Specific Gravity	1.74 to 1.76
Oil Absorption	20 to 30%
Moisture	0.5% maximum
Pigment retained on #325 sieve	0.1% maximum
CI Number	11740
Heat Stability	266°F

In addition to the requirements identified above, evidence shall be provided that the infrared spectrum matches the standard spectrum on file with TxDOT's Construction Division, Materials Section (CSTM).

3. Calcium Carbonate: Calcium Carbonate shall conform to ASTM D-1199, Type GC, Grade I, with a minimum of 95% CaCO<sub>3</sub> and Type PC, with a minimum of 98% CaCO<sub>3</sub>.
- c. Acrylic Traffic Resins: The acrylic traffic resin shall be similar and equal to the standard sample submitted by the manufacturer. The resin shall be approved prior to the contract award for the proposed use of the pavement paint.

<b>Acrylic Traffic Emulsion</b>	
Characteristic	Values
Solids Content	49.5 to 50.5
Viscosity, #2 Spindle, 60 rpm, 77°F, cps	250 maximum
pH	10.0 to 10.6
Film appearance, 3 mil dry	Smooth, clear, continuous

In addition to the requirements identified above, evidence shall be provided that the infrared spectrum matches the standard spectrum on file with TxDOT's Construction Division, Materials Section (CSTM)

- d. **Miscellaneous Materials:** These materials shall be similar and equal to the standard sample submitted by the vendor. The specific materials shall be approved prior to the contract award for the proposed use of the pavement paint.
  1. Dispersant
    - Byk 156
    - Tamol 850
    - Colloids 226/35
  2. Surfactant
    - Triton X-405
    - Colloids CA-407
  3. Defoamer
    - Foamaster 111
    - Drew 493
    - Colloids 654

4. Hydroxy Ethyl Cellulose

- Natrosol 250 HBR
- Bermocoll E431FQ
- Cellosize QP - 30,000

5. Coalescent

- Texanol
- Exxate 1200

6. Preservative

- Troysan
- Dowicil 75
- Nuosept 101

7. Methyl Alcohol

- ASTM D-1152, 1.3320 maximum

e. Standard Formulae:

The following tables represent the Standard Formulae to be followed by the manufacturer when manufacturing paint to be used by the Contractor on City of Pflugerville paint striping contracts.

**Formula: White Traffic Paint**

<b>WPT-11 - LEAD FREE WHITE TRAFFIC PAINT</b>	
Component	Pounds
Acrylic Emulsion, 50% Solids, Fastrack 2706	540.
Coalescent, Texanol	20.
Titanium Dioxide, Rutile, Type II, Tiona RCL-9	100.
Calcium Carbonate, Type PC, Mississippi M-60	150.
Calcium Carbonate, Type GC, Hubercarb M-4	440.
Hydroxy Ethyl Cellulose, Natrosol 250 HBR (*)	0.5
Defoamer, Foamaster 111	5.
Dispersant, Colloids 226/35	9.
Surfactant, Triton X-405	2.
Methyl Alcohol	30.
Preservative, Troysan 192	2.
Water, Potable (**)	18.**
<b>TOTALS</b>	<b>1316.5</b>

(\*) The Hydroxy Ethyl Cellulose amount may be varied up to two (2) pounds

(\*\*) Only 10 pounds shall be used in the actual manufacture of the pavement paint. The remaining 8 pounds shall be used as a drum float.

**Formula: Yellow Traffic Paint**

<b>YPT-11 - LEAD FREE YELLOW TRAFFIC PAINT</b>	
Component	Pounds
Acrylic Emulsion, 50% Solids, Fastrack 2706	540
Coalescent, Texanol	20
CI Pigment Yellow 65, Sunglow Yellow 1244	30.
Titanium Dioxide, Rutile, Type II, Tiona RCL-9(***)	20.
Calcium Carbonate, Type PC, Mississippi M-60	150
Calcium Carbonate, Type GC, Hubercarb M-4	450
Hydroxy Ethyl Cellulose, Natrosol 250 HBR (*)	0.5
Defoamer, Foamaster 111	5.
Dispersant, Colloids 226/35	9.
Surfactant, Triton X-405	2.
Methyl Alcohol	30.
Preservative, Troysan 192	2.
Water, Potable (**)	18.**
<b>TOTALS</b>	<b>1276.5</b>

**Additional Criteria for Pavement Paint**

<b>Item</b>	<b>Requirements</b>
Grind Particles:	4 minimum, 8 maximum (TxDOT Test Method Tex-806-B)
Gallon Weight:	± 0.10 lbs. of theoretical gallon weight
Consistency:	80 to 90 K.U.
PH:	a minimum of 9.6
Skinning:	No skinning within 48 hours (TxDOT Test Method Tex-811-B)

(\*) The Hydroxy Ethyl Cellulose amount may be varied up to two (2) pounds

(\*\*) Only 10 pounds shall be used in the actual manufacture of the pavement paint. The remaining 8 pounds shall be used as a drum float.

(\*\*\*) Titanium Dioxide, Rutile, Special, Hilox will be allowed as a substitute in the YPT-11 formula only.



f. Container and Marking

1. **Shipment:** Shipment shall be made in suitable, strong, well-sealed containers that meet this specification, State of Texas, and federal requirements and are sufficiently sturdy to withstand normal shipping and handling.
2. **Drum Package Requirements.** The paint shall be provided in a new, serviceable, non-leaking, 55-gallon lined, steel drum meeting all applicable federal regulations. Drums are to be non-returnable with full removable heads, three (3) rolling hoops and 12 gauge locking rings with 5/8-inch locking nut bolt. The nominal metal thickness is to be 0.044 inch. Each drum is to be equipped with a natural sponge-rubber cord, high-density gasket. The rubber shall be approximately 0.4375 inch thick. The gasket, when compressed, shall produce an airtight closure when the drum is sealed.

When a locking nut is used on drum rings, the locking nut shall be in a non-locking position while tightening the ring. After the ring is tight, the locking nut shall be secured in the locking position.

A seal shall be affixed to each drum in a manner that the contents of the drum cannot be adulterated without destroying the seal.

3. **Bucket Packaging Requirements:** Paint is to be furnished in new 5 gallon lined, 24-gauge steel, non-leaking buckets.
4. **Filling Instructions:** The paint drums will be filled at 54.5 gallons by weight with a water float of 0.53 gallons.

The paint buckets will be filled at 4.95 gallons by weight with a water float of 0.05 gallons.

5. **Labeling:** Finished paint product containers and cases shall be plainly and securely labeled with:
  - City of Pflugerville
  - Name and designation of the product,
  - Requisition number,
  - Batch number,
  - Manufacturing date,
  - Gross weight, and
  - Manufacturer's name.

Labeling shall be prominently displayed on the sides of containers and cases and must be moisture resistant to withstand outdoor storage for a minimum of one year. When the finished product is palletized for shipment, the labels shall be displayed on the outside for easy identification. Once the finished product has been labeled properly, the label shall not be modified or changed in any manner without specific approval from the City of Pflugerville. (Note: The material manufacturer shall supply a Materials Safety Data Sheet to comply with OSHA's "Hazard Communication Standard 29 CFR § 1910.1200").

#### 860S.4 - Construction Methods

The Contractor shall use a crew, that is experienced in the work of installing pavement markings and in the necessary traffic control for such operations on the roadway surface, and shall supply all the equipment, personnel, traffic control and materials necessary for the placement of the pavement markings as indicated on the Drawings or directed by the Engineer or designated representative. All work shall conform to the current edition of the Texas Manual of Uniform Traffic Control Devices (TMUTCD), Standard Details 804S-3, and this standard specification item.

The pavement surface to receive the pavement markings shall be thoroughly cleaned of all dirt, organic growth or other material that will prevent adhesion of the paint to the roadway surface.

The pavement markings shall be placed in the proper alignment with guides established on the roadway. Deviation from the alignment established shall not exceed 2 inches and in addition, the deviation in alignment of the markings being placed shall not exceed 1 inch per 200 feet of roadway nor shall any deviation be abrupt.

When deemed necessary by the Engineer or designated representative, the Contractor, at the Contractor's expense, shall place any additional pilot markings required to facilitate the placement of the permanent markings in the alignment specified. Any and all additional markings placed on the roadway for alignment purposes shall be temporary in nature and shall not establish a permanent marking on the roadway.

Materials used for pilot markings and equipment used to place such markings shall be approved by the Engineer or designated representative.

Paint markings on the roadway that are not in alignment or sequence as indicated shall be totally and completely removed by any effective method approved by the Engineer or designated representative, except that grinding will not be permitted.

Paint shall be applied at a rate of not less than 15 gallons nor more than 20 gallons per mile of solid 4-inch stripe. Application rate for solid 8-inch stripe shall be between 30 and 40 gallons per mile. (These rates yield wet film thickness from 15 to 20 mils.)

Beads shall be applied to the paint markings at a uniform rate sufficient to achieve the retroreflective characteristics specified when observed conforming to TxDOT Test Method Tex-828-B. All markings placed shall have uniform and distinctive retroreflective characteristics.

Applied markings shall be protected from traffic until they have dried sufficiently so as not to be damaged or tracked by normal traffic movements.

#### 860S.5 - Equipment

Paint striping equipment used to place 4 inch solid or broken lines shall have the capability of placing a minimum of 60,000 linear feet of marking per working day. Equipment used for placing markings in widths other than 4 inches shall have capabilities similar to 4 inch marking equipment and shall be capable of placing linear markings up to 8 inches in width in 1 pass.

The equipment shall be maintained in satisfactory operating condition. The equipment shall be equipped so that one 4-inch broken line and either 1 or 2 solid lines can be placed at the same time in alignment and spacing as indicated on the drawings. Four inch marking equipment will be considered as

unsatisfactorily maintained if it fails to attain an average hourly placement rate of 7000 linear feet in any 5 consecutive working days of 7 hours or more.

The equipment shall be equipped with an automatic cutoff device (with manual operating capabilities) to provide clean, square marking ends and to provide a method of applying broken line in a stripe to gap ratio of 15 to 25. The length of the stripe shall not be less than 15 feet nor longer than 15.5 feet. The total length of the stripe-gap cycle shall not be less than 39.5 feet nor longer than 40.5 feet in variance from one cycle to the next nor shall the average total length of a cycle for a road mile of broken line exceed 40.5 feet or be less than 39.5 feet.

The equipment shall be capable of placing lines of all widths with clean edges and of uniform cross section. Four-inch lines shall be 4 inches plus or minus 1/8 inch. Eight-inch lines shall be 8 inches minimum and 8 ¼ inches maximum in width.

The equipment shall be equipped with an outrigger or outriggers as required to place edge-lines as called for in the plans.

The equipment shall be equipped with traffic glass bead dispensers, 1 for each paint spray gun, placed on the equipment so that beads are applied to the paint almost instantly as the marking is being placed on the roadway surface. The traffic glass bead dispensers shall be designed and aligned so that the beads are applied uniformly to the entire surface of the marking. The traffic glass bead dispensers shall be equipped with automatic cutoff controls, synchronized with the cutoff of the marking equipment. Paint pots or tanks shall be equipped with an agitator that will keep the paint thoroughly mixed and may be either a pressurized or non-pressurized type.

**860S.6 - Measurement**

Work for Pavement Marking Paint lines will be measured by the lineal foot of the various widths. Work for pavement marking, paint letter or figures will be measured by the square foot.

**860S.7 - Payment**

Work performed as prescribed by this item, measured as provided under "Measurement", shall be paid for at the unit bid price for "Pavement Marking Paint" per lineal foot or square foot of the various widths specified. This price shall include full compensation for furnishing all labor, tools, equipment, materials and incidentals necessary to complete the work specified.

Payment will be made under one of the following:

<b>Pay Item No. 860S-A:</b>	Pavement Marking Paint, _____ In.	Per Lineal Foot.
<b>Pay Item No. 860S-B:</b>	Pavement Marking Paint	Per Square Foot.
<b>Pay Item No. 860S-C:</b>	Pavement Marking Paint (Reflectorized), _____ In.	Per Lineal Foot.
<b>Pay Item No. 860S-D:</b>	Pavement Marking Paint (Reflectorized)	Per Square Foot.

**END**

## ITEM NO. 862S - TEMPORARY REMOVABLE PAVEMENT MARKINGS

### 862S.1 - Description

This item shall govern furnishing, placement and removal of prefabricated removable pavement markings of the types, colors, shapes and sizes indicated on the Drawings or as directed by the Engineer or designated representative.

### 862S.2 - Submittals

The submittal requirements of this specification item include:

- List of temporary, removable, pavement markings, shapes, words, etc. with associated manufacturer.
- Manufacturer's recommended preparation, cleaning, placement and installation instructions.
- Type of adhesive and application recommendations.

### 862S.3 - Materials

The prefabricated pavement marking materials shall conform to TxDOT Departmental Material Specification DMS-8240 "Permanent Prefabricated Pavement Markings". The materials shall be stored in a weatherproof enclosure in such a method that will prevent damage.

### 862S.4 - Sampling

Sampling will be conducted in accordance with TxDOT Test method Tex-732-1.

### 862S.5 - Construction Methods

#### A. General

Guides to mark the lateral location of pavement markings shall be established as indicated on the Drawings or as directed by the Engineer or designated representative. The Contractor shall establish the pavement marking guides and the Engineer or designated representative will verify the location of the guides prior to installation of final striping.

The pavement markings shall be placed in proper alignment with the guides. The deviation rate in alignment shall not exceed one (1) inch per 200 feet of roadway. The maximum deviation shall not exceed two (2) inches nor shall any deviation be abrupt.

#### B. Seasonal Limitation

Unless directed otherwise in writing by the Engineer or designated representative, temporary pavement marking materials shall not be placed between September 30 and March 1, subject to any specified temperature and moisture limitations.

#### C. Dimensions

Markings shall be in accordance with the color, length, width, shape and configuration indicated on the Drawings. The alignment and location shall be as indicated on the Drawings or as directed in writing by the Engineer or designated representative.

D. Methods

All material placement shall be in accordance with the material manufacturer's instructions, unless otherwise directed in writing by the Engineer or designated representative. In addition to the manufacturer's instructions, material placement shall be in accordance with surface condition, moisture and temperature requirements specified within this item.

E. Surface Preparation

Surface preparation shall be accomplished by any cleaning method, approved by the Engineer or designated representative, that effectively removes contaminants and loose materials and corrects existing conditions considered deleterious to proper adhesion. Surface preparation utilizing blast cleaning will only be required if indicated on the Drawings.

Surfaces shall be further prepared after cleaning by sealing or priming, as recommended by the manufacturer of the temporary pavement marking materials or as directed in writing by the Engineer or designated representative.

Adhesive, when required, shall be of the type and quality recommended by the manufacturer of the temporary pavement marking material. Portland cement concrete pavement surfaces shall not be cleaned by grinding.

F. Moisture

The pavement surface on which the marking material is to be placed shall be completely dry. A pavement shall be considered dry, if on a sunny day after observation for 15 minutes, condensation does not develop on the underside of a one (1) foot square piece of clear plastic, which has been placed on the pavement and weighted down on the edges.

G. Temperature

The pavement and ambient air temperature requirements, which are recommended by the material manufacturer, shall be followed. If no temperature requirements are established by the material manufacturer, the material shall not be placed if the pavement surface temperature is below 50°F or above 130°F.

862S.6 - Performance Requirements

A. Adhesion

Installed pavement markings shall not lift, shift, smear, spread, flow or tear by traffic action.

B. Appearance

Pavement markings shall present a neat, uniform appearance, free of excessive adhesive, ragged edges and irregular lines or contours.

C. Visibility

Installed pavement markings shall have uniform and distinctive retro-reflectance when observed in accordance with TxDOT Test Method Tex-828-B.

D. Observation Period

The Contractor shall be responsible for maintaining at its own expense all temporary pavement markings from the time of installation until completion and acceptance of the Work in accordance with this Item and to the satisfaction of the Engineer or designated representative. Pavement markings, that fail to meet the requirements of this specification shall be removed and replaced by the Contractor at the Contractor's expense.

862S.7 - Measurement

Measurement of the markings shall be made for each color by the lineal foot of the various widths; by each for word(s), shape or symbol or by any other unit as indicated on the Drawings, complete in place.

862S.8 - Payment

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement," will be paid for at the unit bid price for "Temporary Removable Pavement Markings" of the various types, colors, shapes and sizes indicated on the Drawings. This price shall include full compensation for: cleaning the pavement surface by any suitable means other than blast cleaning; for furnishing, placing and removal of all materials; and for all labor, tools, equipment and incidentals necessary to complete the work.

Payment for Temporary Removable Pavement Markings will be made under the following:

<b>Pay Item No. 862S-4Y:</b>	4" yellow Markings,	Per Lineal Foot.
<b>Pay Item No. 862S-24W:</b>	24" yellow Markings,	Per Lineal Foot.
<b>Pay Item No. 862S-TSH:</b>	Shape(s) of _____ color	Per Each.
<b>Pay Item No. 862S-TSY:</b>	Symbol(s) of _____ color	Per Each.
<b>Pay Item No. 862S-TW:</b>	Word(s) of _____ color	Per Each.

END

## ITEM NO. 863S - REFLECTORIZED PAVEMENT MARKERS

### 863S.1 - Description

This item governs reflectORIZED pavement markers to be used to delineate traffic lanes or fire hydrants.

### 863S.2 - Submittals

The submittal requirements of this specification item include:

- List of specific application(s) [i.e. type: (reflectORIZED Type I-A, I-C or II-A-A, II-B-B or II-C-R)] and applicable epoxy system and adhesive types [867S.5].
- Specific manufacturer with test results and technical specifications for proposed pavement markers.
- Manufacturer's recommendations for surface preparation, cleaning, placement temperatures and installation instructions.
- Adhesive components and mixing recommendations.

### 863S.3 - Materials

All materials shall meet the requirements as specified below and indicated on City of Pflugerville Standard Detail 863S-1, "Pavement Markers (ReflectORIZED - Type I & II)". The pavement markers shall comply with TxDOT Departmental Materials Specifications DMS-4210 "Snowplowable Pavement Markers".

#### A. Design and Shape

The outer surface of the marker shall be smooth, and all corners and edges exposed to traffic must be rounded. The base of the marker shall have a width of 4.0 inches + 1/2 inch and shall have a minimum area exposed to traffic of 12.5 square inches. The maximum height shall be 3/4 inch. The maximum slope of the reflector face or faces shall be not more than 30 degrees from the horizontal.

The bottom surface of the markers shall be of a design for adhesion with epoxy adhesives to comply with TxDOT Test Method Tex-611-J.

The marker shall be designed to show no change in shape or color when subjected to the requirements of TxDOT Test Method Tex-846-B, at a temperature of 140°F with the marker in a vertical position.

#### B. Optical

##### 1. Definitions

- a. Horizontal entrance angle is defined as being in a plane parallel to the base of the road marker, between a line in the direction of the incident light and a line that is perpendicular to the leading edge of the reflective surface.
- b. Divergence angle shall mean the angle at the reflector between observer's line of sight and the direction of the light incident on the marker.
- c. Specific intensity shall mean candle power of the returned light at the chosen divergence and entrance angles for each footcandle of incident light per reflective face. TxDOT Test Method Tex-842-B will be used to determine specific intensity.

## 2. Performance

For the pavement markers the specific intensity of the reflecting surface at a 15-degree divergence angle shall be not less than the following when the incident light is parallel to the base of the marker.

Horizontal Entrance Angle, Degrees	Specific Intensity	
	Crystal	Amber
0	3.0	2.0
20	1.5	1.0

The specific intensity of the marker shall not be less than 80 percent of the above minimum values after being subjected to heat test of TxDOT Test Method Tex-846-B.

### C. Pavement Marker Types

Pavement markers shall be of the following types:

1. Type I-A shall contain an approach face that reflects amber light. The body, other than the reflective face, shall be yellow.
2. Type I-C shall contain an approach face that reflects white light. The body, other than the reflective face, shall be white, silver white or light gray.
3. Type II-A-A, shall contain two reflective faces (approach and trailing), each of which shall reflect amber light. The body, other than the reflective faces, shall be yellow.
4. Type II-B-B shall contain two reflective faces (approach and trailing) with glass covered pneumatic reflective faces, each of which shall reflect blue light. The body, other than the reflective faces, shall be blue.
5. Type II-C-R shall contain two reflective faces (approach and trailing), one of which reflects white light and one of which reflects red light. The body, other than the reflective faces, shall be either white, silver white or light gray or one-half white, silver white or light gray on the side that reflects white light and one-half red on the side that reflects red light.

The reflective faces of the Type II markers shall be located so that the direction from one face shall be directly opposite the direction of reflections of the other face.

### 863S.4 - Sampling

Sampling will be conducted in accordance with TxDOT Test Method Tex-729-I.



## 863S.5 - Testing

The Contractor shall certify that the markers meet the requirements defined in the specification and meet or exceed the applicable tests required. All testing will be in accordance with the TxDOT manual of Testing Procedures. Applicable tests shall include the following:

- Tex-611-J: Adhesion Requirements
- Tex-842-B: Light Retroreflectivity
- Tex-846-B: Heat Resistance

Blue markers' color will conform to Fire Department requirements.

## 863S.6 - Construction Methods

The Contractor shall use a crew experienced in the work of installing reflectorized pavement markers and in the necessary traffic control for such operations on the roadway surface and shall supply all the equipment, personnel, traffic control and materials necessary for the placement of the pavement markings as indicated on the Drawings or as directed by the Engineer or designated representative. All work shall conform to the current edition of the Texas Manual of Uniform Traffic Control Devices (TMUTCD) and Standard Detail 863S-1 "Pavement Markers (Reflectorized – Type I & II)".

All reflectorized pavement markers shall be from the same manufacturer. Surfaces to which markers are to be attached by an adhesive shall be prepared by any method approved by the Engineer or designated representative to ensure that the surface is free of dirt, curing compound, grease, oil, moisture, loose or unsound pavement markings and any other material which would adversely affect the adhesive bond. Unless indicated otherwise on the Drawings, surface preparation for installation of raised reflectorized pavement markers will not be paid for directly but shall be included in the unit price bid for this specification item.

Guides to mark the lateral location of pavement markings shall be established as indicated on the Drawings or as directed by the Engineer or designated representative. The Contractor will establish the pavement marking guides and the Engineer or designated representative will verify the location of the guides prior to final installation.

The pavement markers shall be placed in proper alignment with the Guides. The deviation rate in alignment shall not exceed 1 inch per 200 feet of roadway. The maximum deviation shall not exceed 2 inches, nor shall any deviation be abrupt.

Markers placed which are not in alignment indicated on the Drawings shall be removed by the Contractor at the Contractor's expense. Removal shall be in accordance with Specification Item No. 874S "Eliminating Existing Pavement Markings and Markers" except for measurement and payment. Guides placed on the roadway for alignment purposes shall not establish a permanent marking on the roadway.

The Reflectorized Pavement Markers shall be applied using an approved epoxy adhesive (City of Pflugerville Standard Specification Item No. 867S "Epoxy Adhesive") to the lines and spacings as indicated on the Drawings or as directed by the Engineer or designated representative. The adhesive shall be applied in sufficient quantity to ensure that 100 percent of the bonding area of the pavement markers shall be in contact with the adhesive. The adhesive shall be applied in accordance with the manufacturer's recommendations.

Pavement markers shall be placed immediately after the adhesive is applied and shall be firmly bonded to the pavement. Adhesive or any other material that impairs functional reflectivity will not be acceptable.

When deemed necessary by the Engineer or designated representative, the Contractor, at the Contractor's expense, shall place any additional pilot markings required to facilitate the placement of the permanent markings in the alignment specified. Any and all additional markings placed on the roadway for alignment purposes shall be temporary in nature and shall not establish a permanent marking on the roadway. Materials used for pilot markings and equipment used to place such markings shall be approved by the Engineer or designated representative.

**863S.7 - Measurement**

Reflectorized Pavement Marker will be measured as per each, complete in place.

**863S.8 - Payment**

Payment will be made at the unit bid price per each. The price shall include full compensation for all work performed and all materials furnished in constructing, transporting and placing the markers.

Payment will be made under:

<b>Pay Item No. 863S-1:</b>	Reflectorized Pavement Markers (Type I-A)	Per Each.
<b>Pay Item No. 863S-2:</b>	Reflectorized Pavement Markers (Type I-C)	Per Each.
<b>Pay Item No. 863S-3:</b>	Reflectorized Pavement Markers (Type II-A-A)	Per Each.
<b>Pay Item No. 863S-4:</b>	Reflectorized Pavement Markers (Type II-B-B)	Per Each.
<b>Pay Item No. 863S-5:</b>	Reflectorized Pavement Markers (Type II-C-R)	Per Each.

**END**

## ITEM NO. 864S - ABBREVIATED PAVEMENT MARKINGS

### 864S.1 - Description

This item shall govern the placement, maintenance and removal of temporary abbreviated markings, which are to be placed on all roadways, that are open to traffic and that do not have standard markings in place.

### 864S.2 - Submittals

The submittal requirements of this specification item include:

- Specific applications and color of traffic markings.
- Specific manufacturer with test results and technical specifications.
- Manufacturer's recommendations for surface preparation, cleaning, placement temperatures and installation instructions.

### 864S.3 - Materials

The pavement-marking material shall consist of an adhesive-backed reflective tape, which can be applied to the pavement. Markings shall be of good appearance, have straight, unbroken edges and have a color that complies with all federal regulations.

#### A. Color

The markings, as well as retroreflected light from the markings, shall be white or yellow as indicated on the Drawings or provided in writing by the Engineer or designated representative.

#### B. Visibility

The pavement markings (during daylight hours) shall be distinctively visible for a minimum of 300 feet unless sight distance is restricted by geometric roadway features.

The pavement markings (when illuminated by automobile lowbeam headlights at night) shall be distinctively visible for a minimum of 160 feet unless sight distance is restricted by geometric roadway features.

The day and night visibility requirements, which are specified above, shall be met when viewed from an automobile traveling on the roadway.

### 864S.4 - Construction Methods

The Contractor shall use a crew experienced in the work of installing pavement markings and in the necessary traffic control for such operations on the roadway surface and shall supply all the equipment, personnel, traffic control and materials necessary for the placement of the pavement markings as indicated on the Drawings or as directed by the Engineer or designated representative. All work shall conform to the current edition of the Texas Manual of Uniform Traffic Control Devices (MUTCD) and Standard Detail 804S-3 "Temporary Traffic Control Pavement Markings" series.

Abbreviated markings, which meet all specification requirements, shall be in place on all roadways on which traffic is allowed and where suitable standard pavement marking is not in place. The transverse

location of the line(s) formed by the markings shall be as indicated on the Drawings or determined by the Engineer or designated representative.

Unless otherwise indicated, the abbreviated markings shall be placed as follows:

<b>Condition</b>	<b>Spacing</b>	<b>Length of Stripe</b>
Straight	20 feet approximately	24 inches
Curve greater than 2 degrees	20 feet maximum	24 inches
Curve less than or equal 2 degrees	10 feet	24 inches

Pavement markings shall be a minimum of 3 7/8 inches wide. Lengths and spacings will be in accordance with these specifications.

The spacing of stripes may be modified by the Engineer or designated representative. However, the maximum spacing specified above shall not be exceeded in any case.

The Contractor will be responsible for maintaining the abbreviated pavement markings until standard pavement markings are in place.

Abbreviated pavement markings shall be removed after all permanent markings have been placed.

#### 864S.5 - Performance

Installed abbreviated pavement markings shall meet all requirements of this specification for a minimum of seven (7) days after installation of the abbreviated markings is complete. Pavement markings that fail to meet all requirements of this specification shall be removed and shall be replaced at the sole expense to the Contractor with pavement markings that meet the requirements of this specification.

#### 864S.6 - Measurement and Payment

Abbreviated pavement markings will not be measured for payment but shall be included in the unit price bid for the item of construction for which abbreviated pavement markings are indicated on the drawings.

**END**

## ITEM NO. 866S - JIGGLE BAR TILE

### 866S.1 - Description

This item shall govern the materials, composition, quality, sampling and testing of jiggle bar tile of either ceramic or plastic resin body construction, reflectorized or nonreflectorized types as described herein.

### 866S.2 - Submittals

The submittal requirements of this specification item include:

- List of specific application(s) [i.e. designation and type: (reflectorized Type I-A, I-C or II-A-A; nonreflectorized-Type W or Y)] and applicable epoxy system and adhesive types [Standard Specification Item Section 867S.5].
- Specific manufacturer with test results and technical specifications for proposed jiggle bar tile
- Manufacturer's recommendations for surface preparation, cleaning, placement temperatures and installation instructions.
- Adhesive components and mixing recommendations.

### 866S.3 - Materials

Jiggle bar tiles shall be either ceramic body or plastic resin body construction and shall be either reflectorized or nonreflectorized as indicated on the Drawings. Jiggle bar tiles furnished for any one project shall be of the same material and manufacturer. The Jiggle Bar Tile shall comply with TxDOT Departmental Materials Specifications DMS-4100 "Jiggle Bar Tiles".

#### A. Types of Jiggle Bar Tile

1. Reflectorized jiggle bar tiles shall be of the following types:
  - a. Type I-A shall contain an approach face that reflects amber light and the body other than the reflective face shall be yellow.
  - b. Type I-C shall contain an approach face that reflects white light. The body, other than the reflective face, shall be white.
  - c. Type II-A-A shall contain 2 reflective faces (approach and trailing) each of which shall reflect amber light. The body, other than the reflective faces, shall be yellow. The direction of the reflection of the trailing face shall be directly opposite to the direction of reflection of the approach face.
2. Nonreflectorized jiggle bar tiles shall be of the following types:
  - a. Type W shall have a white body.
  - b. Type Y shall have a yellow body.

#### B. Appearance Requirement

The top and sides of the jiggle bar tile shall be smooth and free from surface irregularities, pits, cracks, checks, chipping, discoloration and any other defects which adversely affect appearance and application.

The bottom of the jiggle bar tile may be of a rough texture, free from gloss, glaze or any other substance that may reduce its bond to the adhesive. It shall be shaped such that any air, which may be entrapped during installation, will not impair adhesion. Exclusive of any irregularities that are intentionally manufactured as functional characteristics of the tile, the bottom shall not deviate from a true plane by more than 1/16 inch.

C. Color Requirements

The diffuse day color shall comply with the specified color requirements. Color requirements are defined by an enclosed area formed by using the following CIE Chromaticity Coordinates as corner points and the listed Y reflectance limits.

<b>CHROMATICITY COORDINATES AND REFLECTANCE LIMITS</b>			
<b>Color</b>	<b>Chromaticity Points</b>		<b>Reflectance Limits</b>
	<b>x</b>	<b>y</b>	<b>y</b>
White	0.290	0.316	70 minimum
	0.310	0.296	
	0.330	0.321	
	0.310	0.342	
Yellow	0.448	0.455	38.0 - 60.0
	0.468	0.420	
	0.544	0.456	
	0.516	0.484	

Individual yellow jiggle bar tiles in any shipment or lot shall not have a variance in chromaticity coordinates x and y greater than 0.025 units nor shall the variance in reflectance exceed 6.0 units. Color shall be determined in accordance with TxDOT Test Method Tex-839-B.

D. Optical Requirements for Reflectorized Jiggle Bar Tiles

1. Reflective Device(s)

Reflective jiggle bar tiles shall have an approved reflective device(s) inserted in a protective ramp and adhered to a recess in the ramp base. The reflective device(s) shall be as indicated on the Drawings.

## 2. Optical Performance

The reflective device(s) shall be capable of providing reflection of amber, red or white light as indicated. The reflective light of each reflective face shall conform to the minimum reflective intensity requirements as follows:

<b>Specific Intensity per Reflective Face At 0.2 Degrees Observation Angle</b>		
<b>Horizontal Entrance Angle</b>	<b>Crystal</b>	<b>Amber</b>
4 Degrees	3.00	2.00
20 Degrees	1.50	1.00

Horizontal entrance angle shall mean the angle, in a plane parallel to the base of the marker, between a line in the direction of the incident light and a line perpendicular to the leading edge of the reflective surface.

Observation angle shall mean the angle at the reflector between observer's line of sight and the direction of the light incident on the jiggle bar tile.

Specific intensity shall mean candlepower of the returned light at the chosen observation and entrance angles for each foot-candle of incident light per reflective face. TxDOT Test Method Tex-842-B will be used to determine specific intensity.

### E. Physical Requirements for Ceramic Jiggle Bar Tiles

#### 1. Appearance

The top and sides of the ceramic jiggle bar tile shall be smooth and free from surface irregularities, pits, cracks, checks, chipping, discoloration and any other defects which adversely affect appearance and application.

The bottom of the ceramic jiggle bar tile may be of a rough free from gloss, glaze or any other substance that may reduce its bond to the adhesive. Excluding any protrusions, which are intentionally manufactured as functional characteristics of the jiggle bar tile, the base shall not deviate from a true plane by more than 1/16 inch.

#### 2. Glaze Thickness

The glazed surface shall have a mean thickness not less than 0.005-inch when measured not closer than 1/4-inch from the edge of the jiggle bar tile. The thickness shall be measured on a fractured edge with a calibrated scale microscope.

#### 3. Autoclave

The ceramic glaze shall not discolor, craze, spall or peel when subjected to 1 cycle of the autoclave test ASTM Designation: C-424 at 250 psi.

4. Water Absorption

The water absorption of the jiggle bar tile shall not exceed 1.0 percent of the original dry weight when tested in accordance with ASTM Designation: C-373. Specimens may be broken pieces taken from the strength test.

5. The compressive strength of ceramic tiles shall be as follows:

- a. 6000 psi, minimum average of 5 units.
- b. 5000 psi, minimum for any individual unit.

Compressive strength shall be determined on a 1-inch diameter right cylinder test specimen cut through the center portion of the tile by core drilling. Specimen ends shall be ground or lapped to form plane and parallel faces. The faces shall be capped with high strength capping compound to make them perpendicular to the axis of the specimen. The specimen shall be loaded in accordance with TxDOT Test Method Tex-418 A.

6. Adhesion

The ceramic jiggle bar tile shall be tested in accordance with TxDOT Test Method Tex-611-J. Unless otherwise specified, the following shall be the criteria for acceptance:

The 5 specimens tested must evidence a minimum average bond strength of 500 psi. In addition, no more than 1 individual specimen may evidence a bond strength less than 500 psi. If the average bond strength is less than 500 psi or 2 or more individual specimens evidence a bond strength less than 500 psi, the lot represented by the samples shall be rejected.

F. Physical Requirements of Plastic Resin Jiggle Bar Tiles

1. Appearance

Plastic jiggle bar tiles may contain inert fillers and coloring pigments. Except for the base filler, the plastic jiggle bar tile shall be of the same material throughout.

2. Hardness

Plastic jiggle bar tiles shall have a Shore Durometer Hardness (Type D) of 70 minimum conforming to ASTM Designation: D-2240.

3. X-Ray Analysis

Plastic jiggle bar tiles shall match the X-ray analysis of previously approved jiggle bar tiles.

4. Infrared Analysis

Plastic jiggle bar tiles shall match the infrared analysis of previously approved jiggle bar tiles.

5. Adhesion

Plastic jiggle bar tiles shall meet the same requirements as ceramic jiggle bar tile unless otherwise specified or indicated on the Drawings.



#### 866S.4 - Construction Methods

The Contractor shall use a crew experienced in the work of installing jiggle bar tile and in the necessary traffic control for such operations on the roadway surface and shall supply all the equipment, personnel, traffic control and materials necessary for the placement of the pavement markings as indicated or as directed by the Engineer or designated representative. All work shall conform to the current edition of the Texas Manual of Uniform Traffic Control Devices (TMUTCD) and Standard Detail Series 804S-3 "Temporary Traffic Control Pavement Markings".

The jiggle bar tile shall be installed to the lines and spacings where indicated on the Drawings or as directed by the Engineer or designated representative. Guides to mark the lateral location of jiggle bar tile shall be established as indicated on the Drawings or as directed by the Engineer or designated representative. The Contractor will establish the pavement marking guides and the Engineer or designated representative will verify the location of the guides prior to final installation.

The pavement markers shall be placed in proper alignment with the Guides. The deviation rate in alignment shall not exceed 1 inch per 200 feet of roadway. The maximum deviation shall not exceed 2 inches nor shall any deviation be abrupt.

Markers placed which are not in alignment indicated on the Drawings shall be removed by the Contractor at the Contractor's expense. Removal shall be in accordance with Specification Item 874S "Eliminating Existing Pavement Markings and Markers" except for measurement and payment. Guides placed on the roadway for alignment purposes shall not establish a permanent marking on the roadway.

When deemed necessary by the Engineer or designated representative, the Contractor, at the Contractor's expense, shall place any additional pilot markings required to facilitate the placement of the permanent markings in the alignment specified. Any and all additional markings placed on the roadway for alignment purposes shall be temporary in nature and shall not establish a permanent marking on the roadway. Materials used for pilot markings and equipment used to place such markings shall be approved by the Engineer or designated representative.

The surface on which tiles are to be placed shall be dry and shall be prepared by any method approved by the Engineer or designated representative to remove all forms of grease, oil, dirt and other materials deleterious to proper adhesion. Unless indicated otherwise on the Drawings, surface preparation for installation of jiggle bar tile will not be paid for directly but shall be included in the unit price bid for this specification item.

Epoxy adhesive shall conform to the requirements of City of Pflugerville Specification Item 867S "Epoxy Adhesive". The wet epoxy shall be machine mixed and applied in sufficient quantity so as to insure the following:

100 percent of the bonding area of the tile shall be in contact with the epoxy.

The tile itself shall not contact the pavement surface but shall sit on an epoxy "cushion".

When the tile is pressed onto the pavement, adhesive shall be forced out around its entire perimeter.

Any excess adhesive or other foreign material on or in front of the reflective face(s) of the tile shall be removed so that reflectivity will not be impaired. Any individual jiggle bar tile placed that does not conform to the requirements of this specification and/or as indicated on the Drawings shall be removed and replaced with tile conforming to these requirements at the Contractor's expense.

866S.5 - Measurement

Jiggle Bar Tile will be measured as each jiggle bar tile complete in place.

866S.6 - Payment

The work performed under this item and measured as provided under "Measurement" shall be paid for at the unit bid price for "Jiggle Bar Tile", of the type, color and material specified on the Drawings. The unit bid price shall include full compensation for all labor, materials, incidentals and services necessary to complete the work.

Payment will be made under one of the following:

<b>Pay Item No. 866S-1:</b>	Jiggle Bar Tile (Type I-A)	Per Each.
<b>Pay Item No. 866S-2:</b>	Jiggle Bar Tile (Type I-C)	Per Each.
<b>Pay Item No. 866S-3:</b>	Jiggle Bar Tile (Type II-A-A)	Per Each.
<b>Pay Item No. 866S-4:</b>	Jiggle Bar Tile (Type W)	Per Each.
<b>Pay Item No. 866S-5:</b>	Jiggle Bar Tile (Type Y)	Per Each.

END

## ITEM NO. 867S - EPOXY ADHESIVE

### 867S.1 - Description

This item shall govern the various types of epoxy materials suitable for the construction and maintenance of streets and roads indicated on the Drawings or considered in the Item.

All of these materials shall consist of a resin component and a hardener component, which must be mixed immediately prior to use to produce the finished epoxy. Unless otherwise indicated on the Drawings, these materials should not be used if the substrate temperature is below 50°F. The specific materials covered by this item are as follows:

- Traffic marker adhesives
- Concrete adhesives
- Binder for epoxy grout or concrete
- Epoxy for crack injection
- Epoxy coating for concrete
- Surface sealing of cracks

### 867S.2 - Submittals

The submittal requirements of this specification item include:

- List of specific application(s) [i.e. items A through F in Section 867S.1] and applicable epoxy system and adhesive types [Section 867S.5].
- Manufacturer's recommendations for surface preparation, cleaning, placement temperatures and installation instructions.
- Adhesive components and mixing recommendations.

### 867S.3 - Epoxy Materials Requirements

#### A. General

Epoxy materials described herein shall be in accordance with TxDOT Departmental Material Specification DMS-6100 "Epoxies and Adhesives". Additional information regarding epoxy characteristics and copies of specification DMS-6100 are available from the TxDOT Materials and Tests Division, 125 East 11th Street, Austin, Texas 78701-2483.

#### B. Packaging, Labeling and Storage

The components shall be packaged in suitable, well-sealed containers clearly labeled as to the type material and the ratio of the components to be mixed by volume. Any special instructions regarding mixing shall be included. The label shall show resin or hardener component, the brand name, name of manufacturer, lot or batch number, date of packaging and the quantity contained therein. Caution warnings regarding contact of the epoxy with skin and eyes, shelf life and vapor warning must be included on the labels.

The epoxy components must be stored at temperatures between 60°F and 100°F. Any material which shows evidence of crystallization, lumps, skinning, extreme thickening or settling of pigments which cannot be readily redispersed with normal agitation shall not be used.

### C. Mixing

Prior to use, each component shall be stirred to re-disperse any settling or separation of the fillers and liquid portions. The components shall then be placed immediately in the proper reservoir when used in automatic mixing and dispensing equipment. For application by other means, the components must be properly proportioned and mixed until a uniform color and appearance are obtained. Unless otherwise indicated by the manufacturer or approved by the Engineer or designated representative no addition of solvents is allowed.

#### 867S.4 - Application and Surface Preparation

Requirements on application and preparation of the surface upon which the epoxy is to be placed shall be in accordance with manufacturer's recommendation and applicable specification items.

#### 867S.5 - Epoxy System

The various types of materials and their intended use are described below.

##### A. Traffic Marker Adhesive System

This system consists of five basic types of epoxy adhesive for bonding ceramic, plastic or metal traffic markers to roadway, bridge, or other concrete surfaces.

1. Types I and I-M

Rapid Setting Marker Adhesive for use when a very fast set is required or if markers must be placed when pavement temperature is below 50°F.

2. Types II, II-M and II-MA

Medium Setting Marker Adhesive

3. Types III and III-M

Standard Setting Marker Adhesive

4. Types IV and IV-M

Slow Setting Marker Adhesive for use where setting time is not a consideration.

Those adhesives designated as Types I through IV are intended for hand mixing and application. On projects where the adhesive is to be handled by automatic metering, mixing and application equipment, Types I-M through IV-M, which are designed specifically for machine application, shall be used. Type II- MA adhesive is designed for placement of all-weather markers. For all types of marker adhesives, the resin component shall be pigmented white and the hardener component black.

The type of adhesive to be used for placing ceramic or plastic markers on a specific project shall be designated by the Contractor and approved by the Engineer or designated representative, based upon the setting time required under the prevailing weather and traffic conditions.

## B. Concrete Adhesives System

This system consists of three types of epoxy adhesive with different viscosities designed to bond fresh Portland Cement (PC) concrete to existing PC concrete, hardened concrete to hardened concrete and steel to fresh or hardened concrete.

### 1. Type V

Standard (medium viscosity) for applying to horizontal and vertical surfaces. This material is suitable for surface sealing of fine cracks in concrete and setting of dowels in accordance with Specification Item No. 410, "Concrete Structures".

### 2. Type VI

Low viscosity for application with spray equipment to horizontal surfaces.

### 3. Type VII

Paste consistency for overhead application and where a high build-up is required. This material is suitable for surface sealing of cracks in concrete, which are veed out prior to sealing and for grouting of dowel bars where clearance is 1/16 inch or less.

Any specific coloring of resin and hardener components shall be as directed by the Engineer or designated representative.

## C. Epoxy Binder System (Type VIII)

This system is intended for mixing with selected aggregates to produce an epoxy mortar or concrete for grouting dowel bars or repairing spalls and other defects in existing PC concrete. Type VIII shall comply with the requirements for Type VI epoxy except that the mixing ratio of resin and hardener shall be as specified by the manufacturer and the requirement for ability to bond fresh PC concrete to hardened concrete does not apply.

The aggregates used with the epoxy binder to form the epoxy mortar or concrete must be clean and surface dry. Siliceous aggregates are required unless otherwise approved by the Engineer or designated representative.

## D. Crack Injection (Type IX)

This system is a low viscosity epoxy material designed for pressure injection into cracks in existing concrete to restore the structural integrity. The system shall be capable of bonding to damp surfaces.

## E. Epoxy Coating (Type X)

This is a high-solids epoxy used for waterproofing columns, caps, etc. The material is designated for application by brush or roller but can also be applied by airless spray by addition of a maximum of 5 percent toluene solvent at the direction of the Engineer or designated representative. This material may also be used to coat the interior concrete block walls and as a coating for concrete picnic tables and benches.

867S.6 - Measurement and Payment

The work performed, the materials furnished and all labor, tools, equipment and incidentals necessary to complete the work under this item will not be measured for payment, but shall be included in the unit price bid for the particular bid items indicated on the Drawings or included in the Contract.

**END**

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## ITEM NO. 870S – WORK ZONE PAVEMENT MARKINGS

### 870S.1 - Description

Furnish, place, and maintain work zone pavement markings.

### 870S.2 - Materials

Provide thermoplastic, paint and beads, raised pavement markers (RPMs), prefabricated pavement markings, temporary flexible reflective roadway marker tabs, or other approved materials for work zone pavement markings.

Supply materials meeting:

- [DMS-4200](#), "Pavement Markers (Reflectorized),"
- [DMS-4300](#), "Traffic Buttons,"
- [DMS-8200](#), "Traffic Paint,"
- [DMS-8220](#), "Hot Applied Thermoplastic,"
- [DMS-8240](#), "Permanent Prefabricated Pavement Markings,"
- [DMS-8241](#), "Temporary (Removable) Prefabricated Pavement Markings,"
- [DMS-8242](#), "Temporary Flexible, Reflective Roadway Marker Tabs," and
- [DMS-8290](#), "Glass Traffic Beads."

- A. **Nonremovable Markings.** Use hot-applied thermoplastic or permanent prefabricated pavement markings for nonremovable markings. Paint and beads or other materials are not allowed for nonremovable markings unless shown on the plans.
- B. **Removable and Short-Term Markings.** Use RPMs, removable prefabricated pavement markings, temporary flexible reflective roadway marker tabs, or other approved materials for removable and short-term markings. Do not use hot-applied thermoplastic or traffic paint for removable markings. Use removable prefabricated pavement markings on the final pavement surface when the plans specify removable markings.

### 870S.3 - Construction

Apply pavement markings in accordance with the following Items.

- TxDOT Specification Item No. 666, "Retroreflectorized Pavement Markings"
  - TxDOT Specification Item No. 668, "Prefabricated Pavement Markings"
  - TxDOT Specification Item No. Item 672, "Raised Pavement Markers"
- A. **Placement.** Install longitudinal markings on pavement surfaces before opening to traffic. Maintain lane alignment traffic control devices and operations until markings are installed. Install markings in proper alignment in accordance with the TMUTCD and as shown on the plans. Short-term markings will be allowed when standard markings (removable or nonremovable) cannot be placed before opening to traffic, if shown on the plans or directed.

When short-term markings are allowed for opening to traffic, place standard longitudinal markings no later than 14 calendar days after the placement of the surface. When inclement weather prohibits placement of markings, the 14-day period may be extended until weather permits proper application.

Place standard longitudinal markings no sooner than 3 calendar days after the placement of a surface treatment, unless otherwise shown on the plans.

Apply thermoplastic markings to a minimum thickness of 0.060 in. (60 mils). When paint and beads are allowed, apply to a minimum dry thickness of 0.012 in. (12 mils).

Place short-term markings in proper alignment with the location of the final pavement markings. Remove and replace short-term markings not in alignment at the Contractor's expense.

For removable placements, use of RPMs to simulate longitudinal markings is at the Contractor's option. Use side-by-side RPMs to simulate longitudinal lines wider than 4 in. Do not use RPMs for words, symbols, shapes, or diagonal or transverse lines.

- B. **Marking Removal.** Remove markings that conflict with succeeding markings in accordance with TxDOT Specification Item No. 677, "Eliminating Existing Pavement Markings and Markers." Remove short-term markings that interfere or conflict with final marking placement immediately before placing final pavement markings, unless otherwise directed. Remove the remainder of the short-term markings before final acceptance.

Remove all temporary markings with minimal damage to the roadway to the satisfaction of the Engineer.

- C. **Performance Requirements.** Ensure all markings are visible from a distance at least 300 ft. in daylight conditions and at least 160 ft. in nighttime conditions when illuminated by automobile low-beam headlights. Determine visibility distances using an automobile traveling on the roadway under dry conditions.

Maintain the markings for 30 calendar days after installation. The end of the 30-day maintenance period does not relieve the Contractor from the performance deficiencies requiring corrective action identified during the 30-day period. Remove and replace markings at the Contractor's expense if they fail to meet the requirements of this Item during the 30-day period. The 30-calendar day performance requirement will begin again after replacement of the markings.

Ensure daytime and nighttime reflected color of the markings are distinctly white or yellow. Ensure markings exhibit uniform retroreflective characteristics.

#### 870S.4 - Measurement

This Item will be measured by the foot or each word, shape, symbol, or temporary flexible reflective roadway marker tab. Each stripe will be measured separately. RPMs used to simulate a marking will be measured by the foot of marking or each RPM.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

#### 870S.5 - Payment

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Work Zone Pavement Markings" of the type and color specified and the shape, width, and size specified as applicable. This price is full compensation



for furnishing, placing, maintaining, and removing work zone pavement markings and for materials, equipment, labor, tools, and incidentals.

Elimination of nonremovable markings will be paid for under TxDOT Specification Item No. 677, "Eliminating Existing Pavement Markings and Markers." Removal of short-term and removable markings will not be paid for directly but will be subsidiary to this Item.

Type II work zone pavement markings (paint and beads) used as a sealer for Type I pavement markings (thermoplastic) will be paid for under this Item.

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## ITEM NO. 871S – REFLECTORIZED PAVEMENT MARKINGS

### 871S.1 – Description

Furnish and place retroreflectorized, non-retroreflectorized (shadow) and profile pavement markings.

### 871S.2 - Materials

- A. **Type I Marking Materials.** Furnish in accordance with [DMS-8220](#), “Hot Applied Thermoplastic.”

Furnish pavement marking material used for Type I profile markings and shadow markings that have been approved by the Construction Division, and in accordance with [DMS-8220](#), “Hot Applied Thermoplastic.”

- B. **Type II Marking Materials.** Furnish in accordance with [DMS-8200](#), “Traffic Paint.”

- C. **Glass Traffic Beads.** Furnish drop-on glass beads in accordance with [DMS-8290](#), “Glass Traffic Beads” or as approved. Furnish a double-drop of Type II and Type III drop-on glass beads where each type bead is applied separately in equal portions (by weight), unless otherwise approved. Apply the Type III beads before applying the Type II beads.

- D. **Labeling.** Use clearly marked containers that indicate color, mass, material type, manufacturer, and batch number.

### 871S.3 - Equipment

- A. **General Requirements.** Use equipment that:

1. Is maintained in satisfactory condition,
2. Meets or exceeds the requirements of the national board of fire underwriters and the Texas Railroad Commission for this application,
3. Applies beads by an automatic bead dispenser attached to the pavement marking equipment in such a manner that the beads are dispensed uniformly and almost instantly upon the marking as the marking is being applied to the road surface. The bead dispenser must have an automatic cut-off control, synchronized with the cut-off of the pavement marking equipment,
4. Has an automatic cut-off device with manual operating capabilities to provide clean, square marking ends,
5. Is capable of producing the types and shapes of profiles specified, and
6. Can provide continuous mixing and agitation of the pavement marking material. The use of pans, aprons, or similar appliances which the die overruns will not be permitted for longitudinal striping applications.

Provide a hand-held thermometer capable of measuring the temperature of the marking material when applying Type I material.

When pavement markings are required to meet minimum retroreflectivity requirements on the plans:

1. Use a mobile retroreflector approved by the Construction Division and certified by the Texas A&M Transportation Institute Mobile Retroreflector Certification Program.
2. Use a portable retroreflector that:
  - a. Uses 30-meter geometry and meets the requirements described in ASTM E1710;
  - b. Has either an internal global positioning system (GPS) or the ability to be linked with an external GPS with a minimum accuracy rating of 16 ft. 5 in., in accordance with the circular error probability (CEP) method (CEP is the radius of the circle with its origin at a known position that encompasses 50% of the readings returned from the GPS instrument);
  - c. Can record and print the GPS location and retroreflectivity reading for each location where readings are taken.

**B. Material Placement Requirements.** Use equipment that can place:

1. At least 40,000 ft. Of 4-in. Solid or broken non-profile markings per working day at the specified thickness;
2. At least 15,000 ft. Of solid or broken profile pavement markings per working day at the specified thickness;
3. Linear non-profile markings up to 8 in. Wide in a single pass;
4. Non-profile pavement markings other than solid or broken lines at an approved production rate;
5. A centerline and no-passing barrier-line configuration consisting of 1 broken line and 2 solid lines at the same time to the alignment, spacing, and thickness for non-profile pavement markings shown on the plans;
6. Solid and broken lines simultaneously;
7. White line from both sides;
8. Lines with clean edges, uniform cross-section with a tolerance of  $\pm 1/8$  in. Per 4 in. Width, uniform thickness, and reasonably square ends;
9. Skip lines between 10 and 10-1/2 ft., a stripe-to-gap ratio of 10 to 30, and a stripe-gap cycle between 39-1/2 ft. And 40-1/2 ft., automatically;
10. Beads uniformly and almost instantly on the marking as the marking is being applied;
11. Beads uniformly during the application of all lines (each line must have an equivalent bead yield rate and embedment); and
12. Double-drop bead applications using both type ii and type iii beads from separate independent bead applicators, unless otherwise approved by the engineer.

## 871S.4 - Construction

Place markings before opening to traffic unless short-term or work zone markings are allowed.

- A. **General.** Obtain approval for the sequence of work and estimated daily production. Minimize interference to roadway operations when placing markings on roadways open to traffic. Use traffic control as shown on the plans or as approved. Protect all markings placed under open-traffic conditions from traffic damage and disfigurement.

Establish guides to mark the lateral location of pavement markings as shown on the plans or as directed, and have guide locations verified. Use material for guides that will not leave a permanent mark on the roadway.

Apply markings on pavement that is completely dry and passes the following tests:

1. **Type I Marking Application**—Place a sample of Type I marking material on a piece of tarpaper placed on the pavement. Allow the material to cool to ambient temperature, and then inspect the underside of the tarpaper in contact with the pavement. Pavement will be considered dry if there is no condensation on the tarpaper.
2. **Type II Marking Application**—Place a 1-sq. ft. piece of clear plastic on the pavement, and weight down the edges. The pavement is considered dry if, when inspected after 15 min., no condensation has occurred on the underside of the plastic.

Apply markings:

1. That meet the requirements of [Tex-828-B](#),
2. That meet minimum retroreflectivity requirements when specified on the plans (applies to Type I markings only),
3. Using widths and colors shown on the plans,
4. At locations shown on the plans,
5. In proper alignment with the guides without deviating from the alignment more than 1 in. Per 200 ft. Of roadway or more than 2 in. Maximum,
6. Without abrupt deviations,
7. Free of blisters and with no more than 5% by area of holes or voids,
8. With uniform cross-section, density and thickness,
9. With clean and reasonably square ends,
10. That are retroreflectorized with drop-on glass beads, and
11. Using personnel skilled and experienced with installation of pavement markings.

Remove all applied markings that are not in alignment or sequence as stated on the plans, or in the specifications, at the Contractor's expense in accordance with TxDOT Specification Item No. 677, "Eliminating Existing Pavement Markings and Markers," except for measurement and payment.

- B. **Surface Preparation.** Prepare surfaces in accordance with this Section unless otherwise shown on the plans.
1. **Cleaning for New Asphalt Surfaces and Retracing of All Surfaces.** Air blast or broom the pavement surface for new asphalt surfaces (less than 3 years old) and for retracing of all surfaces to remove loose material, unless otherwise shown on the plans. A sealer for Type I markings is not required unless otherwise shown on the plans.

2. **Cleaning for Old Asphalt and Concrete Surfaces (Excludes Retracing).** Clean old asphalt surfaces (more than 3 years old) and all concrete surfaces in accordance with TxDOT Specification Item No. 678, "Pavement Surface Preparation for Markings," to remove curing membrane, dirt, grease, loose and flaking existing construction markings, and other forms of contamination.
  3. **Sealer for Type I Markings.** Apply a pavement sealer to old asphalt surfaces (more than 3 years old) and to all concrete surfaces before placing Type I markings on locations that do not have existing markings, unless otherwise approved. The pavement sealer may be either a Type II marking or an acrylic or epoxy sealer as recommended by the Type I marking manufacturer unless otherwise shown on the plans. Follow the manufacturer's directions for application of acrylic or epoxy sealers. Clean sealer that becomes dirty after placement by washing or in accordance with Section 666.4.2.1., "Cleaning for New Asphalt Surfaces and Retracing of All Surfaces," as directed. Place the sealer in the same configuration and color (unless clear) as the Type I markings unless otherwise shown on the plans.
- C. **Application.** Apply markings during good weather unless otherwise directed. If markings are placed at Contractor option when inclement weather is impending and the markings are damaged by subsequent precipitation, the Contractor is responsible for all required replacement costs.
1. **Type I Markings.** Place the Type I marking after the sealer cures. Apply within the temperature limits recommended by the material manufacturer. Flush the spray head if spray application operations cease for 5 min or longer by spraying marking material into a pan or similar container until the material being applied is at the recommended temperature.

Apply on clean, dry pavements passing the moisture test described in Section 666.4.1., "General," and with a surface temperature above 50°F when measured in accordance with [Tex-829-B](#).

- a. **Non-Profile Pavement Markings.** Apply Type I non-profile markings with a minimum thickness of:
  - 0.100 in. (100 mils) for new markings and retraining water-based markings on surface treatments involving TxDOT Specification Item No. 316, "Seal Coat,"
  - 0.060 in. (60 mils) for retraining on thermoplastic pavement markings, or
  - 0.090 in. (90 mils) for all other Type I markings.

The maximum thickness for Type I non-profile markings is 0.180 in. (180 mils). Measure thickness for markings in accordance with [Tex-854-B](#) using the tape method.

- b. **Profile Pavement Markings.** Apply Type I profile markings with a minimum thickness of:
  - 0.060 in. (60 mil) for edgeline markings, or
  - 0.090 in. (90 mil) for gore and centerline/no-passing barrier line markings.

In addition, at a longitudinal spacing indicated on the plans, the markings must be profiled in a vertical manner such that the profile is transverse to the longitudinal marking direction. The profile must not be less than 0.30 in. (300 mil) nor greater than 0.50 in. (500 mil) in height when measured above the normal top surface plane of the roadway. The transverse width of the profile must not be less than 3.25 in., and the longitudinal width not less than 1 in., when measured at the top surface plane of the profile bar. The profile may

be either a 1 or 2 transverse bar profile. When the 2 transverse bar profile is used, the spacing between the bases of the profile bars must not exceed 0.50 in. The above transverse bar width is for each 4 in. of line width.

2. **Type II Markings.** Apply on surfaces with a minimum surface temperature of 50°F. Apply at least 20 gal. per mile on concrete and asphalt surfaces and at least 22 gal. per mile on surface treatments for a solid 4-in. line. Adjust application rates proportionally for other widths. When Type II markings are used as a sealer for Type I markings, apply at least 15 gal. per mile using Type II drop-on beads.
  3. **Bead Coverage.** Provide a uniform distribution of beads across the surface of the stripe for Type I and Type II markings, with 40% to 60% bead embedment.
- D. **Retroreflectivity Requirements.** When specified on the plans, Type I markings must meet the following minimum retroreflectivity values for edgeline markings, centerline or no passing barrier-line, and lane lines when measured any time after 3 days, but not later than 10 days after application:
- White markings: 250 millicandelas per square meter per lux (mcd/m<sup>2</sup>/lx)
  - Yellow markings: 175 mcd/m<sup>2</sup>/lx
- E. **Retroreflectivity Measurements.** Use a mobile retroreflectometer for projects requiring minimum retroreflectivity requirements to measure retroreflectivity for Contracts totaling more than 200,000 ft. of pavement markings, unless otherwise shown on the plans. For Contracts with less than 200,000 ft. of pavement markings or Contracts with callout work, mobile or portable retroreflectometers may be used at the Contractor's discretion.
1. **Mobile Retroreflectometer Measurements.** Provide mobile measurements averages for every 0.1 miles unless otherwise specified or approved. Take measurements on each section of roadway for each series of markings (i.e., edgeline, center skip line, each line of a double line, etc.) and for each direction of traffic flow. Measure each line in both directions for centerlines on two-way roadways (i.e., measure both double solid lines in both directions and measure all center skip lines in both directions). Furnish measurements in compliance with Special Specification, "Mobile Retroreflectivity Data Collection for Pavement Markings," unless otherwise approved. The Engineer may require an occasional field comparison check with a portable retroreflectometer meeting the requirements listed above to ensure accuracy. Use all equipment in accordance with the manufacturer's recommendations and directions. Inform the Engineer at least 24 hr. before taking any measurements.

A marking meets the retroreflectivity requirements if:

- the combined average retroreflectivity measurement for a one-mile segment meets the minimum retroreflectivity values specified, and
- no more than 30% of the retroreflectivity measurement values are below the minimum retroreflectivity requirements value within the one-mile segment.

The Engineer may accept failing one-mile segments if no more than 20% of the retroreflectivity measurements within that mile segment are below the minimum retroreflectivity requirement value.

The one-mile segment will start from the beginning of the data collection and end after a mile worth of measurements have been taken; each subsequent mile of measurements will be a new segment. Centerlines with 2 stripes (either solid or broken) will result in 2 miles of data for each mile segment. Each centerline stripe must be tested for compliance as a stand-alone stripe.

Restripe at the Contractor's expense with a minimum of 0.060 in. (60 mils) of Type I marking if the marking fails retroreflectivity requirements. Take measurements every 0.1 miles a minimum of 10 days after this second application within that mile segment for that series of markings.

If the markings do not meet minimum retroreflectivity after 10 days of this second application, the Engineer may require removal of all existing markings, a new application as initially specified, and a repeat of the application process until minimum retroreflectivity requirements are met.

2. **Portable Retroreflectometer Measurements.** Take a minimum of 20 measurements for each 1-mi. section of roadway for each series of markings (i.e., edgeline, center skip line, each line of a double line, etc.) and direction of traffic flow when using a portable reflectometer. Measure each line in both directions for centerlines on two-way roadways (i.e., measure both double solid lines in both directions and measure all center skip lines in both directions). The spacing between each measurement must be at least 100 ft. The Engineer may decrease the mileage frequency for measurements if the previous measurements provide satisfactory results. The Engineer may require the original number of measurements if concerns arise.

Restripe once at the Contractor's expense with a minimum of 0.060 in. (60 mils) of Type I marking material if the average of these measurements fails. Take a minimum of 10 more measurements after 10 days of this second application within that mile segment for that series of markings. Restripe again at the Contractor's expense with a minimum of 0.060 in. (60 mils) of Type I marking material if the average of these measurements fall below the minimum retroreflectivity requirements. If the markings do not meet minimum retroreflectivity after this third application, the Engineer may require removal of all existing markings, a new application as initially specified, and a repeat of the application process until minimum retroreflectivity requirements are met.

3. **Traffic Control.** Provide traffic control, as required, when taking retroreflectivity measurements after marking application. On low volume roadways (as defined on the plans), refer to the figure, "Temporary Road Closure" in Part 6 of the *Texas Manual on Uniform Traffic Control Devices* for the minimum traffic control requirements. For all other roadways, the minimum traffic control requirements will be as shown on the Traffic Control Plan (TCP) standard sheets TCP (3-1) and TCP (3-2). The lead vehicle will not be required on divided highways. The TCP and traffic control devices must meet the requirements listed in TxDOT Specification Item No. 502, "Barricades, Signs, and Traffic Handling." Time restrictions that apply during striping application will also apply during the retroreflectivity inspections except when using the mobile retroreflectometer unless otherwise shown on the plans or approved.

- F. **Performance Period.** All markings must meet the requirements of this specification for at least 30 calendar days after installation. Unless otherwise directed, remove pavement markings that fail to meet requirements, and replace at the Contractor's expense. Replace failing markings within 30 days of notification. All replacement markings must also meet all requirements of this Item for a minimum of 30 calendar days after installation.

#### 871S.5 - Measurement

This Item will be measured by the foot; by each word, symbol, or shape; or by any other unit shown on the plans. Each stripe will be measured separately.

This is a plans quantity measurement item. The quantity to be paid is the quantity shown in the proposal unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

Acrylic or epoxy sealer, or Type II markings when used as a sealer for Type I markings, will be measured by the foot; by each word, symbol, or shape; or by any other unit shown on the plans.

#### 871S.6 - Payment

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Pavement Sealer" of the size specified, "Retroreflectorized Pavement Markings" of the type and color specified and the shape, width, size, and thickness specified as applicable, "Retroreflectorized Pavement Markings with Retroreflective Requirements" of the types, colors, sizes, widths, and thicknesses specified or "Retroreflectorized Profile Pavement Markings" of the various types, colors, shapes, sizes, and widths specified.

This price is full compensation for application of pavement markings, materials, equipment, labor, tools, and incidentals.

Surface preparation of new concrete and asphalt concrete pavements more than 3 years old, where no stripe exists, will be paid for under TxDOT Specification Item No. 678, "Pavement Surface Preparation for Markings." Surface preparation of all other asphalt and old concrete pavement, except for sealing, will not be paid for directly but is subsidiary to this Item.

Work zone pavement markings (Type II, paint and beads) used as a sealer for Type I markings (thermoplastic) will be paid for under TxDOT Specification Item No. 662, "Work Zone Pavement Markings."

If the Engineer requires that markings be placed in inclement weather, repair or replacement of markings damaged by the inclement weather will be paid for in addition to the original plans quantity.



## ITEM NO. 872S – PREFABRICATED PAVEMENT MARKINGS

### 872S.1 – Description

Furnish and place retroreflectorized or non-reflectorized (contrast) prefabricated pavement markings.

### 872S.2 – Materials

Furnish prefabricated pavement marking materials in accordance with [DMS-8240](#), “Permanent Prefabricated Pavement Markings.”

Furnish prefabricated pavement marking materials used for contrast markings in accordance with [DMS-8240](#), “Permanent Prefabricated Pavement Markings,” with the exception that the color requirement for the black contrast portion does not have to meet the color requirements specified for white or yellow markings. Store all materials in a weatherproof enclosure and prevent damage during storage.

### 872S.3 – Construction

- A. **General.** Obtain approval for the sequence of work and estimated daily production. Remove all waste generated from the jobsite before the end of each working day.

Establish guides to mark the lateral location of pavement markings as shown on the plans or as directed and have guide locations verified. Use guide material that will not leave a permanent mark on the roadway.

Place pavement markings in alignment with the guides without deviating from the alignment more than 1 in. per 200 ft. of roadway or more than 2 in. maximum and with no abrupt deviations.

- B. **Placement Limitations.** Do not place Type B pavement-marking materials between September 30 and March 1 unless otherwise directed.

1. **Moisture.** Apply material to pavement that is completely dry. Pavement will be considered dry if, on a sunny day after 15 min., no condensation occurs on the underside of a 1 sq. ft. piece of clear plastic that has been placed on the pavement and weighted on the edges.
2. **Temperature.** Follow pavement and ambient air temperature requirements recommended by the material manufacturer. Do not place material when the pavement temperature is below 60°F or above 120°F if the material manufacturer does not establish temperature requirements.

- C. **Dimensions.** Place markings in accordance with the color, length, width, shape, and configuration shown on the plans. Locate alignment as shown on the plans or as directed.

- D. **Methods.** Place all materials in accordance with the material manufacturer’s instructions, as well as the surface condition, moisture and temperature requirements of this Item, unless otherwise directed.

- E. **Surface Preparation.** Prepare surface by any approved cleaning method that effectively removes contaminants, loose materials, and conditions deleterious to proper adhesion. Abrasive or water-blast cleaning is not required unless shown on the plans. Blast clean, when required, in accordance with TxDOT Specification Item No. 678, “Pavement Surface Preparation for Markings.” Prepare surfaces further after cleaning by sealing or priming as recommended by the pavement-marking material manufacturer or as directed. Use adhesive, when required, of the type and quality

recommended by the pavement-marking material manufacturer. Do not clean concrete pavement surfaces by grinding.

**F. Performance Requirements.**

1. **Adhesion.** Ensure markings do not lift, shift, smear, spread, flow, or tear by traffic action.
2. **Appearance.** Ensure markings present a neat, uniform appearance that is free of excessive adhesive, ragged edges, and irregular lines or contours.
3. **Visibility.** Ensure markings have uniform and distinctive retroreflectance when inspected in accordance with [Tex-828-B](#).

**G. Performance Period.** All markings must meet the requirements of this Item for at least 30 calendar days after installation. Remove and replace all pavement markings that fail to meet requirements at the Contractor's expense unless otherwise directed. Replace failing markings within 30 days of notification. All replacement markings must also meet all requirements of this Item for a minimum of 30 calendar days after installation.

**872S.4 – Measurement**

This Item will be measured by the foot or by each word, shape, or symbol.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

**872S.5 – Payment**

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Prefabricated Pavement Markings" of the type and color specified and the shape, width, and size specified as applicable. This price is full compensation for cleaning the pavement by any means other than required abrasive or water-blast cleaning or milling; furnishing and placing materials; and equipment, labor, tools, and incidentals.

Abrasive or water-blast cleaning and milling, when shown on the plans, will be paid for under TxDOT Specification Item No. 678, "Pavement Surface Preparation for Markings."

## ITEM NO. 873S – RAISED PAVEMENT MARKERS

### 873S.1 – Description

Furnish and install raised pavement markers (RPMs).

### 873S.2 – Materials

A. **Markers.** Furnish RPMs in accordance with the following Department Material Specifications:

- Reflectorized Pavement Markers. DMS 4200, “Pavement Markers (Reflectorized),” types I A, I C, I R, II A A, and II C R.
- Traffic Buttons. DMS 4300, “Traffic Buttons,” types I A, I C, I R, II A A, II C R, W, Y and B. Round or oval unless otherwise specified on the plans.
- Plowable Reflectorized Pavement Markers. DMS 4210, “Snowplowable Pavement Markers,” types I A, I C, I R, II A A, and II C R.

The following are descriptions for each type of RPM:

- **Type I A.** The approach face must retro-reflect amber light. The body, other than the retro-reflective face, must be yellow.
- **Type I C.** The approach face must retro-reflect white light. The body, other than the retro-reflective face, must be white or silver-white.
- **Type I R.** The trailing face must retro-reflect red light. The body, other than the retro-reflective face, must be white or silver-white, except for I R plowable markers which may be black.
- **Type II A A.** The 2 retro-reflective faces (approach and trailing) must retro-reflect amber light. The body, other than the retro-reflective faces, must be yellow.
- **Type II C R.** Contain 2 retro-reflective faces with an approach face that must retro-reflect white light and a trailing face that must retro-reflect red light. The body, other than the retro-reflective faces, must be white or silver-white.
- **Type W.** Must have a white body and no reflective faces.
- **Type Y.** Must have a yellow body and no reflective faces.
- **Type B.** Must have a black body and no reflective faces.

B. **Adhesives.** Furnish adhesives that conform to the following requirements:

- [DMS-6100](#), “Epoxies and Adhesives,” Type II—Traffic Marker Adhesives.
- [DMS-6130](#), “Bituminous Adhesive for Pavement Markers.”
- The Contractor may propose alternate adhesive materials for consideration and approval.

C. **Sampling.** The Engineer will sample in accordance with [Tex-729-I](#).

### 873S.3 – Construction

Remove existing RPMs in accordance with TxDOT Specification Item No. 677, “Eliminating Existing Pavement Markings and Markers,” except for measurement and payment. Furnish RPMs for each class from the same manufacturer. Prepare all surfaces in accordance with TxDOT Specification Item No. 678, “Pavement Surface Preparation for Markings,” when shown on the plans. Ensure the bond surfaces are free of dirt, curing compound, grease, oil, moisture, loose or unsound pavement markings, and any other material that would adversely affect the adhesive bond.

Establish pavement marking guides to mark the lateral location of RPMs as shown on the plans and as directed. Do not make permanent marks on the roadway for the guides.

Place RPMs in proper alignment with the guides. Acceptable placement deviations are shown on the plans.

Remove RPMs placed out of alignment or sequence, as shown on the plans or stated in this specification, at Contractor's expense, in accordance with TxDOT Specification Item No. 677, "Eliminating Existing Pavement Markings and Markers" (except for measurement and payment).

Use the following adhesive materials for placement of reflectorized pavement markers, and traffic buttons unless otherwise shown on the plans:

- standard or flexible bituminous adhesive for applications on bituminous pavements, and
- epoxy adhesive or flexible bituminous adhesive for applications on hydraulic cement concrete pavements.

Use epoxy adhesive for plowable reflectorized pavement markers.

Apply enough adhesives to:

- ensure that 100% of the bonding area of RPMs is in contact with the adhesive, and
- ensure that RPMs, except for plowable markers, are seated on a continuous layer of adhesive and not in contact with the pavement surface.

Apply adhesives in accordance with manufacturer's recommendations unless otherwise required by this Article. Apply bituminous adhesive only when pavement temperature and RPM temperature are 40°F or higher. Do not heat bituminous adhesive above 400°F. Machine agitate bituminous adhesive continuously before application to ensure even heat distribution.

Machine-mix epoxy adhesive. Apply epoxy adhesive only when pavement temperature is 50°F or higher.

Furnish RPMs free of rust, scale, dirt, oil, grease, moisture, and contaminants that might adversely affect the adhesive bond.

Place RPMs immediately after the adhesive is applied and ensure proper bonding. Do not use adhesives or any other material that impairs the functional retro-reflectivity of the RPMs.

Provide a 30 day performance period that begins the day following written acceptance for each separate location. The date of written acceptance will be the last calendar day of each month for the RPMs installed that month for the completed separate project locations. This written acceptance does not constitute final acceptance.

Replace all missing, broken or non-reflective RPMs. Visual evaluations will be used for these determinations. Upon request, the Engineer will allow a Contractor representative to accompany the Engineer on these evaluations.

The Engineer may exclude RPMs from the replacement provisions of the performance, provided the Engineer determines the failure is a result of causes other than defective material or inadequate installation procedures. Examples of outside causes are extreme wear at intersections, damage by snow or ice removal, and pavement failure.

Replace all missing or non-reflective RPMs identified during the performance period within 30 days after notification. The end of the performance period does not relieve the Contractor from the performance deficiencies requiring corrective action identified during the performance period.

#### 873S.4 – Measurement

This Item will be measured by each RPM.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., “Plans Quantity Measurement.” Additional measurements or calculations will be made if adjustments are required.

#### 873S.5 – Payment

The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Reflectorized Pavement Marker,” “Traffic Button,” or “Plowable Reflectorized Pavement Marker” of the types specified. This price is full compensation for removing existing markers; furnishing and installing RPMs; and materials, equipment, labor, tools, and incidentals.

No additional payment will be made for replacement of RPMs failing to meet the performance requirements.

## ITEM NO. 874S – ELIMINATING EXISTING PAVEMENT MARKINGS AND MARKERS

### 874S.1 - Description

Eliminate existing pavement markings and raised pavement markers (RPMs).

### 874S.2 - Materials

Furnish surface treatment materials in accordance with the following Items:

- Standard Specification Item No. 301S, "Asphalts, Oils, and Emulsions"
- Standard Specification Item No. 302S, "Aggregates for Surface Treatments"
- Standard Specification Item No. 312S, "Seal Coat"

Use approved patching materials for repairing damaged surfaces.

Use a commercial abrasive blasting medium capable of producing the specified surface cleanliness. Use potable water when water is required.

### 874S.3 - Equipment

Furnish and maintain equipment in good working condition. Use moisture and oil traps in air compression equipment to remove all contaminants from the blasting air and prevent the deposition of moisture, oil, or other contaminants on the roadway surface.

### 874S.4 - Construction

Eliminate existing pavement markings and markers on both concrete and asphaltic surfaces in such a manner that color and texture contrast of the pavement surface will be held to a minimum. Remove all markings and markers with minimal damage to the roadway to the satisfaction of the Engineer. Repair damage to asphaltic surfaces, such as spalling, shelling, etc., greater than 1/4 in. deep resulting from the removal of pavement markings and markers. Dispose of markers in accordance with federal, state, and local regulations. Use any of the following methods unless otherwise shown on the plans:

- Surface Treatment Method.** Apply surface treatment material at rates shown on the plans, or as directed. Place a surface treatment a minimum of 2 ft. wide to cover the existing marking. Place a surface treatment, thin overlay, or microsurfacing a minimum of one lane in width in areas where directional changes of traffic are involved or other areas as directed.
- Burn Method.** Use an approved burning method. For thermoplastic pavement markings or prefabricated pavement markings, heat may be applied to remove the bulk of the marking material before blast cleaning. When using heat, avoid spalling pavement surfaces. Sweeping or light blast cleaning may be used to remove minor residue.
- Blasting Method.** Use a blasting method such as water blasting, abrasive blasting, water abrasive blasting, shot blasting, slurry blasting, water-injected abrasive blasting, or brush blasting as approved. Remove pavement markings on concrete surfaces by a blasting method.
- Mechanical Method.** Use any mechanical method except grinding. Flail milling is acceptable in the removal of markings on asphalt and concrete surfaces.

#### 874S.5 - Measurement

This Item will be measured by each word, symbol, or shape eliminated; by the foot of marking eliminated; or by any other unit shown on the plans.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

#### 874S.6 - Payment

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Eliminating Existing Pavement Markings and Markers" of the type and width as applicable. This price is full compensation for the elimination method used and materials, equipment, tools, labor, and incidentals. Removal of RPMs will not be paid for directly but will be subsidiary to the pertinent bid items.

## ITEM NO. 875S – PAVEMENT SURFACE PREPARATION FOR MARKINGS

### 875S.1 - Description

Prepare pavement surface areas before placement of pavement markings and raised pavement markers (RPMs). TxDOT Specification Item No. 677, "Eliminating Existing Pavement Markings and Markers," governs removal of existing markings.

### 875S.2 - Materials

Use a commercial abrasive blasting medium capable of producing the specified surface cleanliness. Use potable water, when water is required.

### 875S.3 - Equipment

Furnish and maintain equipment in good working condition. Use moisture and oil traps in air compression equipment to remove all contaminants from the blasting air and prevent the deposition of moisture, oil, or other contaminants on the roadway surface.

### 875S.4 - Construction

Prepare enough pavement surface for the pavement markings or RPMs shown on the plans. Remove all contamination and loose material. Avoid damaging the pavement surface. Remove loose and flaking material when existing pavement markings are present. Approved pavement surface preparation methods are sweeping, air blasting, flail milling, and blast cleaning unless otherwise specified on the plans.

Air blast concrete pavement surfaces, in addition to the above, after the removal of contamination or existing material and just before placing the stripe. Perform air blasting with a compressor capable of generating compressed air at a minimum of 150 cu. ft. per minute and 100 psi using 5/16 in. or larger hosing.

Contaminants up to 0.5 sq. in. may remain if they are not removed by the following test, performed just before application of markings:

- **Step 1.** Air blast the surface to be tested, to simulate blasting during application of markings.
- **Step 2.** Firmly press a 10-in. long, 2-in. wide strip of monofilament tape onto the surface, leaving approximately 2 in. free.
- **Step 3.** Grasp the free end and remove the tape with a sharp pull.

### 875S.5 - Measurement

This Item will be measured by the foot for each width specified; by each word, shape, or symbol; or by any other unit except lump sum.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

### 875S.6 - Payment

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Pavement Surface Preparation for



Markings" of the type and width as applicable. This price is full compensation for the cleaning method used, materials, equipment, labor, tools, and incidentals.



## ITEM NO. 876S – DELINEATOR AND OBJECT MARKER ASSEMBLIES

### 876S.1 - Description

- **Installation.** Install delineator or object maker assembly.
- **Removal.** Remove delineator or object marker assembly.

### 876S.2 - Materials

Furnish only new materials in accordance with details shown on the plans unless otherwise directed. The Engineer will sample in accordance with [Tex-725-I](#) or [Tex-737-I](#).

#### A. Delineator and Object Marker Assemblies. Fabricate in accordance with the following:

- DMS 8600, "Delineators, Object Markers, and Barrier Reflectors."
- DMS 4400, "Flexible Delineator and Object Marker Posts (Embedded and Surface-Mount Types)."

#### B. Wing Channel Post. Furnish material of the size shown on the plans. Supply a notarized original of the Form D-9-USA-1 (Department Form 1818) with supporting mill test report certifying that the base metal is in accordance with the following:

- ASTM A1011, SS Grade 50.
- ASTM A499.

Galvanize material in accordance with TxDOT Specification Item No. 445, "Galvanizing."

### 876S.3 - Construction

#### A. **Installation.** Locate delineators and object markers as shown on the plans or as directed.

Locate barrier reflectors as shown on the plans or as directed and install in accordance with manufacturers recommendations.

Install winged channel post and flexible delineator posts to allow the reflector units and reflectorized panels to be installed at the specified height and orientation. Align post as shown or as directed.

Drive post plumb using a driving cap to prevent visible cross-section dimension distortion. Drill or drive a pilot hole when post cannot be driven without visibly distorting the cross-section dimension. Backfill pilot holes thoroughly by tamping in 6-in. lifts to grade.

Install surface-mount and other types of delineators and object markers in accordance with details shown on the plans.

Repair damaged galvanizing in accordance with Section 445.3.5., "Repairs." Install reflector units on wing channel posts after the posts have been erected.

#### B. **Removal.** Remove post assemblies without damaging materials and salvage when indicated on the plans. Remove post to a minimum of 6 in. below finish grade. Stockpile salvaged materials at the location shown on the plans or as directed. Accept ownership of unsalvageable materials and dispose of in accordance with federal, state, and local requirements.

#### 876S.4 - Measurement

Installation will be measured by each delineator or object marker assembly installed. When removal is specified on the plans to be a pay item, it will be measured by each delineator or object marker assembly removed.

This is a plans quantity measurement item. The quantity to be paid for is shown in the proposal unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

#### 876S.5 - Payment

The work performed and materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for at the unit price bid for "Install Delineator Assemblies" or "Install Object Marker Assemblies" of the types and colors specified and for "Remove Delineator or Object Marker Assemblies."

- A. **Installation.** This price is full compensation for furnishing and fabricating when required, and installing and mounting the delineator or object marker assemblies including posts, adhesive or pads for surface mount assemblies, back plates, reflector units, fastening plates, brackets, bolts, nuts, and washers; and materials, equipment, labor, tools, and incidentals.
- B. **Removal.** Unless otherwise shown on the plans, removal will not be paid for directly but is subsidiary to bid items of the Contract.

When removal is shown on the plans as a bid item, this price is full compensation for removal and disposal of delineator and object marker assemblies and for materials, equipment, labor, tools, and incidentals.

SERIES 1300 – PARD

ITEM NO. 1301S – GRANITE GRAVEL HIKE AND BIKE TRAIL

1301.01 - Description

This standard specification item shall govern furnishing and placing red granite gravel surfacing for hike and bike trails. The granite gravel surface shall be constructed in a single layer on an approved and properly prepared base course, conforming to typical sections and to the lines and grades indicated on the drawings or established by the engineer or designated representative.

1301S.2 - Submittals

The submittal requirements of this specification item may include:

- A. Sample of decomposed red granite gravel surface material along with source identification and gradation and plasticity test results for approval, quality assurance and color;
- B. Sample of red road base material or approved equivalent along with source identification and gradation and plasticity test results for approval, quality assurance and color;
- C. Optimum moisture-density characteristics for decomposed red granite gravel and red road base sources;
- D. Proposed trail/path construction sequence and equipment; and
- E. Field density test results for in-place compacted red granite gravel and red road base.

1301S.3 - Materials

The surface and base layer materials shall be tested by the city's designated laboratory and approved by the engineer or designated representative prior to being hauled to the project.

The decomposed red granite gravel and red road base materials or approved equivalent shall be tested according to the following TxDOT standard test methods:

1. Preparation for Soil Constants and Sieve Analysis	Tex-101-E
2. Moisture Content	Tex-103-E
3. Liquid Limit	Tex-104-E
4. Plastic Limit	Tex-105-E
5. Plasticity Index	Tex-106-E
6. Sieve Analysis	Tex-110-E
7. Laboratory Compaction	Tex-113-E
8. Field Density	Tex-115-E

The surface layer material shall be from a source approved by the city and shall be composed of a mixture of Texas decomposed unwashed granite aggregate and red clay fines that meets the following requirements:

Sieve Designation	% Passing	
5/8 "	100	
#40	40 to 45	
# 200	15 to 25	
Plasticity Index		12 to 18

The red road base material or approved equivalent shall be from a source approved by the city and shall consist of a hematite, hydrated hematite or limonite "iron" ore, occurring with or without sand, as found at or near the ground surface, which, when loaded at from the material pit, shall not contain an excess of free clay. Material containing gravel or hard pieces of ore exceeding the maximum specified size in their largest dimension shall be broken up and uniformly mixed with the remainder of the material/.

When properly slaked and tested by TxDOT methods the red road base material or approved equivalent shall meet the following requirements.

Sieve Designation	% Passing	
1 <sup>3</sup> / <sub>4</sub> "	100	
7/8 "	65 to 90	
#40	15 to 50	
Liquid Limit		35 maximum
Plasticity Index		12 maximum

## 1301S.4 - Construction

### (1) General

Prior to commencement of this work, all required erosion controls and tree protection measures indicated on the Drawings shall be in place. All existing utilities shall be located and protected as specified in the Standard Contract Documents, Section 00700, "General Conditions" and/or as specified on the Drawings.

Areas within the construction limits shall be cleared of all obstructions, abandoned structures, and other items as defined above. All vegetation, except trees or shrubs indicated for preservation, shall also be removed. Trees and shrubs, which are scheduled for preservation, shall be carefully trimmed as directed by the engineer or designated representative and shall be protected from scarring, barking or other injuries during construction operations. All exposed cuts over 2 inches in diameter, exposed ends of pruned limbs or scarred bark shall be treated with an approved asphalt material within 24 hours of the pruning or injury.

Construction equipment shall not be operated, nor construction materials stockpiled under the canopies of trees, unless otherwise indicated on the Drawings and/or specified in the Contract Documents. Excavation or embankment materials shall not be placed within the drip line of trees until tree wells are constructed.

### (2) Subgrade Preparation

The subgrade shall be excavated and shaped in conformity with the typical sections shown on the drawings and to the lines and grades as established by the Engineer or designated representative. The subgrade shall be tested by "proof rolling" and shall conform to Standard Specification Item No. 236S "Proof Rolling", except that a 10-ton roller will be used prior to placement of the red road base material. Any unstable or spongy subgrade areas identified by proof rolling shall be corrected either by additional re-working, drying and compaction, or by removal and replacement of unsuitable materials.

If required the subgrade shall be wetted, reshaped and rolled to the extent directed in order to place the subgrade in an acceptable condition to receive the red road base material. The surface of the subgrade shall be finished true to line and grade as established by the Engineer or designated representative in conformity with the typical section shown on the drawings. Material excavated in the preparation of the subgrade shall be utilized in the construction of adjacent shoulders and slopes or otherwise disposed of as directed by the Engineer or designated representative. Additional material required for completion of the shoulders and slopes shall be secured from sources approved by the City of Pflugerville.

A 4-inch Schedule 40 PVC sleeve shall be installed every 100 feet along trail route. Sleeves are to be capped on each end if not used as part of the project.

### (3) Red Road Base

The Contractor shall not place red road base or approved equivalent until the subgrade has cured to the satisfaction of the Engineer or designated representative, regardless of whether or not the subgrade has been successfully proof rolled. As a minimum, this will be when the surface displays no damp spots and there is no evidence of "sponginess" in the subgrade.

The base material shall be delivered in approved vehicles of uniform capacity and it shall be the responsibility of the Contractor to deliver at each 100-foot station the required amount of specified material to yield the compacted thickness shown on the drawings. Material deposited upon the subgrade shall be spread and shaped the same day unless directed otherwise by the Engineer in writing. All areas and "nests" of segregated coarse or fine material shall be corrected or removed and replaced with well-graded material.

In the event inclement weather or other unforeseen circumstances render impractical the spreading of the base material during the first 24-hour period, it shall be scarified and spread as early as possible as directed by the Engineer or designated representative. If it becomes evident that insufficient material was placed, additional material as necessary shall be delivered and the entire course scarified, mixed and compacted.

The base layer shall be sprinkled as required to bring the material to optimum moisture content, then compacted in accordance with Standard Specification Item No. 210S, "Flexible Base" to the extent necessary to provide not less than 90% of the optimum density. In no case shall the material be worked at more than 2 percent above or below optimum moisture as determined by TxDOT Test Method Tex-113-E. Field density determinations shall be made in accordance with TxDOT Test Method Tex-115-E. In addition to the requirements specified for density, the full depth of base material shall be compacted to the extent necessary to remain firm and stable under construction equipment.

After each section of flexible base material is completed, tests, as necessary, will be made by the Engineer or designated representative. As a minimum, three in-place density tests per section. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. All initial testing will be paid for by the city. All retesting shall be paid for by the Contractor. Throughout the entire operation, the surface of the material shall be maintained by blading and, upon completion, shall be smooth and shall conform to the typical section indicated on the Drawings and to the established lines and grades.

If the base material, due to any reason or cause, loses the required stability, density or finish before placement of the red granite gravel surface layer, it shall be recompacted and refinished at the Contractor's expense.

(4) Red Granite Gravel Surface

Construction methods for the succeeding red granite gravel layer shall be the same as prescribed for the red road base layer with the exception of the compaction requirements. The surface layer shall be sprinkled as required to bring the material to optimum moisture content, then compacted in accordance with Standard Specification Item No. 210S, "Flexible Base" to the extent necessary to provide not less than 92% of the optimum density. In no case shall the material be worked at more than 2% above or below optimum moisture.

When the thickness of a particular lift of the flexible base is in question, the Contractor shall check the surface of for conformity to the lines and grades by setting "blue tops" at intervals not exceeding 50 feet on the centerline, the edge of the trail/path, and at other points that may be indicated on the Drawings

If the base material and/or surface layer due to any reason or cause, loses the required stability, density or finish prior to acceptance of the project, the base layer and/or surface layer shall be recompacted and refinished at the Contractor's expense.

1301S.5 - Measurement

"Granite Gravel Hike and Bike Trail" will be measured by the cubic yard, complete in place, as indicated in the Contract Documents.

1301S.6 - Payment

This item will be paid for at the contract unit bid price for "Granite Gravel Hike and Bike Trail." The unit bid price shall include full compensation for all work specified herein, including the protection of existing trees, property and public right-of-way, traffic control measures, the furnishing, hauling, placing and compacting of all materials; for rolling, proof rolling, recompacting and refinishing; for all water required; for retesting as necessary; and for all equipment, tools, labor and incidentals necessary to complete the Work.

Payment will be made under the following:

<b>Pay Item No. 1301S-B:</b>	Granite ( -inches) Gravel Hike and Bike Trail	Per Square Yard.
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**END**