

CITY OF JEFFERSON

TECHNICAL STREET SPECIFICATIONS

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TECHNICAL STREET SPECIFICATIONS

TS-1. CLEARING, GRUBBING AND REMOVAL

TS-1.1 Clearing and Grubbing

TS-1.1.1 Scope: This work shall consist of clearing, grubbing, removing, and disposing of vegetation within the construction limits.

TS-1.1.2 Construction Requirements: The Engineer will establish the construction limits and will designate all trees, shrubs, vegetation within the construction limits shall be removed and properly disposed of.

Stumps and roots in cut area shall be grubbed to a depth of not less than twelve (12) inches below the finished earth grade. Grubbing of Osage orange or locust hedge shall include removal of roots. In embankment areas, undisturbed stumps and roots extending not more than six (6) inches above the ground line may remain, provided they are a minimum of three (3) feet below the finished earth grade or the slope of the embankment. Except in areas to be excavated, stump holes shall be backfilled with suitable material and compacted to the approximate density of the adjacent area. When burning is permissible under controlling air pollution regulations, all burning of products of clearing and grubbing shall be done under the care of a competent watchman at such times and in such manner that neither vegetation on adjacent property nor that designated to remain on the right-of-way will be jeopardized. The burial of stumps and debris will not be permitted on the right-of-way. Products of clearing grubbing may be removed from the right-of-way and disposed of out of sight from the roadway provided an acceptable written agreement with the property owner on whose property the products are placed is submitted by the contractor.

The contractor shall scalp all areas where excavation or embankment is to be made, except that mowed, burned over sod need not be removed where the embankment to be constructed is 4 feet or more in height. Scalping shall include the removal of material such as sod, grass, residue of agricultural crops, sawdust, and decayed vegetable matter from the surface of the ground without removing more earth than is necessary. The products of scalping shall be disposed of away from the site of the work unless permission is granted by the Engineer to allow such disposal on the right-of-way. All such disposal shall be at the contractor's sole expense.

TS-1.1.3 Measurement and Payment: No measurement will be made of clearing and grubbing.

Payment for clearing and grubbing will be at the lump sum price bid.

TS-1.2 REMOVALS

TS-1.2.1 Scope: This work shall consist of removing all drainage structures, pavements, surfacing, and base courses of all types, curb, curb and gutter, sidewalks and house walks, steps, retaining walls, foundation walls, catch basins, manholes, drainage and sewer pipes, water and gas main pipes, other objects or structures and other existing improvements which conflict with the work and are not designated to remain in place. No listing of items to be removed will be made.

TS-1.2.2 Construction Requirements: Old pavements, abandoned sewers or pipe lines, or other obstructions to the construction of the roadway or within the limits of the right-of-way and not designated or permitted to remain, shall be removed or disposed of by the Contractor away from the site of the work.

In removing pavement, curb, curb and gutter, gutters, sidewalk, and other similar improvements, and where a portion of such improvements are to be left in place, they shall be removed to an existing joint or to a joint sawed to a minimum depth of one inch with a true line and vertical face. Sufficient removal shall be made to provide for proper grade and connections in the new work regardless of any limits which may be indicated on the plans.

All sewers, drainage pipes and floor drains which have been or are to be abandoned shall be permanently sealed at the ends with bulkheads constructed of concrete or brick masonry, having a minimum thickness of 8 inches. The use of salvaged brick will be permitted for constructing bulkheads provided the brick are clean and sound. No direct payment will be made for blocking abandoned sewers, drainage pipes, or floor drains.

Broken concrete, paving material, bricks or rubble may be placed in roadway embankment provided they are well spread, completely surrounded by dirt and are not located within twelve inches of the finished subgrade, shoulder or ground surface.

TS-1.2.3 Measurement: The work provided herein will not be measured for payment, but will be considered a lump sum unit. This shall include the removal of all items, whether in view or hidden underneath the surface of the ground, regardless of whether shown on the plans or encountered during construction.

TS-1.2.4 Payment: The accepted removal of improvements will be paid for at the contract lump sum bid price.

TS-2 EARTHWORK:

TS-2.1 Scope: This work shall include all labor, material, equipment and services necessary to complete all earthwork as shown on the plans and specified herein including

roadway excavation, embankment, subgrade preparation and finish grading.

TS-2.2 Earthwork for Roadway:

TS-2.2.1 The term, "Roadway", as used in this Section, is defined as including roadways, roadway intersections, sidewalks, shoulders, cut and fill slopes, driveways, parking areas and all other areas of earthwork except excavation and backfill for pipe trenches and structures.

TS-2.2.2 Missouri Highway Specifications Section 203 shall govern all earthwork for roadway except that the provisions for measurement and payment therein shall not apply and except as modified in the form of additions, deletions and substitutions in this Article. Where any part of said Section of the Missouri Highway Specifications is so modified, the unaltered provisions shall remain in effect.

TS-2.2.3 Compaction shall conform to Missouri Highway Specifications Section 203.3. The first paragraph of Section 203.3.1 shall be changed to read as follows: Compaction to at least 90 percent of maximum density, as determined by standard Compaction Test, will be required in the following areas:

TS-2.2.4 Disposal: Unsuitable excavated material shall not be used in the embankments and shall not be disposed of on right-of-way. Disposal shall be the sole responsibility and at the sole expense of the contractor. Unsuitable and excess excavated material may be disposed of on private property adjacent to the right-of-way, provided written permission of the property owner is obtained and provided the surface is properly finished and drained. In such cases, seeding, sodding, and other pay quantities shall not be increased thereby.

TS-2.2.5 Ditch Cleanout: Special care shall be taken to clean out all debris and organic matter from existing roadway ditches to be filled. The ditches shall be carefully backfilled in accordance with the requirements herein, using trench rollers or hand-operated power compactors as may be needed to assure proper compaction throughout.

TS-2.2.6 Undergrading in Rock Cut: In rock cut areas excavation shall be carried to twelve (12) inches below subgrade to a minimum distance of two (2) feet behind back of curb. Backfilling of undergraded cut areas shall be with a drainable material with top surface choked with fines for proper subgrade preparation.

Whenever possible, this material shall be from project excavation. Where authorized an open-graded drainable crushed limestone shall be brought in. Undrained pockets shall not be left in the surface of the rock.

TS-2.2.7 Sub-grade Stabilization: Pockets of unsuitable earth may be encountered in cut areas

where it will be impracticable to replace with suitable materials from excavation on the work site. In such cases, where authorized by the Engineer, the contractor shall furnish and place crushed stone base as required to provide a stable sub-grade. Crushed stone base in accordance with requirements of Article TS-11. Where necessary, a portion of the stone base shall be mixed with existing earth to provide subgrade stability, and that portion of the stone base material shall be delivered to the project in as dry as possible condition.

- TS-2.2.8 Additional Base Thickness: Where, in the opinion of the Engineer, conditions are such that it is impracticable to obtain sub-grade satisfactory for the design pavement thickness, the contractor may be directed to finish the sub-grade at lower than specified elevation and increase the thickness of asphaltic concrete base.
- TS-2.2.9 The provisions of paragraphs TS-2.2.7 and 8 shall not be construed to relieve the contractor of his responsibility for any necessary aeration and compaction of suitable earth at sub-grade level.
- TS-2.2.10 Protection of Sub-Grade: The contractor shall protect the subgrade by not allowing delivery vehicles of excess weight thereon and by varying the path of delivery vehicles so as to not cause excessive rutting. Heaving or rutting damage to sub-grade caused by delivery vehicles during asphalt paving operations shall be immediately repaired and brought back to specified elevation prior to placing asphaltic concrete base or portland cement concrete pavement.
- TS-2.2.11 Topsoil: The top four (4) inches of backfill behind curbs shall be top soil, free from rocks, gravel, and any undesirable materials and shall be material suitable to establish a seed bed. This material may be either top soil available within the limits of the project or it may be top soil furnished by the contractor. No direct payment will be made for such topsoil, but shall be included in the lump sum price for grading and excavation.
- TS-2.2.12 Area Drainage: All earth areas within and adjacent to the grading limits as shown on the Plans shall be graded to drain as directed by the Engineer, at one (1) percent minimum slope wherever possible. Special care shall be taken to avoid leaving low areas or water pockets. No direct payment will be made for such grading except that measurement for payment of Proposal items will be made.
- TS-2.2.13 Sub-Grade Tolerance: Except as otherwise specified in paragraph TS-2.2.7, the sub-grade for all paving and surfacing shall be within the tolerance range of minus one-half (2) inch to plus one-quarter (3) inch with respect to specified elevation.
- TS-2.2.14 Borrow Material:

- (a) If borrow material is required, the contractor shall supply this material from a borrow area off the site. The borrow area shall be obtained by the contractor at his sole expense. Borrow materials shall be approved by the Engineer before they are transported to the site of the Project.
- (b) Materials shall be similar to soils found on the Project. Soils showing high swell potentials will not be approved.
- (c) The Engineer's Earthwork Calculations are shown on the plans for the convenience of the Bidder.

TS-2.2.15 Excess Material: All suitable excess material from excavation become the property of the City of Jefferson and will be stockpiled on site at the direction of the Engineer.

TS-2.3 Trenching, Embedment and Backfill for Pipe:

TS-2.3.1 Trench Excavation and Sheetting:

- (a) Excavate in open cut except where boring, jacking or tunneling is specified. Trench walls shall be vertical in streets or improved areas unless otherwise authorized by the Engineer. Provide bracing, sheeting and cribbing where necessary to prevent caving.
- (b) All sheeting shall be pulled immediately prior to backfilling around the sheeting. However, the Engineer may direct all or a portion of the sheeting to be left in place in order to protect the pipe against shock load of caving banks, or to protect adjacent street or property, or to prevent material that cannot be compacted to specified density from caving into the trench.
- (c) Where sheeting is left in place, do not brace against pipe, but support in a manner which will not apply concentrated loads or horizontal thrusts on the pipe. Cross braces above the pipe may be removed after backfill to top of pipe has been completed.
- (d) Trench walls may be sloped in unimproved areas if required to prevent caving and if adjacent property or trees to be left in place are not thereby subjected to additional cutting of roots.
- (e) See Pipe Embedment Details on Plans for minimum and maximum trench widths. If maximum is exceeded, and strength requirements control, Engineer may direct contractor to install special bedding or heavier class or

gage of pipe at contractor=s expense.

TS-2.3.2 Ground Water and Surface Water:

- (a) Pipe trenches shall be kept free from water during excavation, fine grading, pipe laying and jointing, and pipe embedment operations. Where the trench bottom is mucky or otherwise unstable because of the presence of ground water, and in all cases where the static ground water elevation is above the bottom of any trench bell hole excavation, such ground water shall be lowered by means of pumps or other acceptable means to the extent necessary to keep the trench free from water, pipe sub-grade stable and firm under foot, at all times when work within the trench is in progress.
- (b) The contractor may use additional granular fill material, in accordance with the requirements of subparagraph TS-2.3.3 (b), in connection with drainage control, at his own expense.
- (c) Each excavation shall be kept dry until the backfill is completed to the extent that no damage from hydrostatic pressures, flotation, or other causes will result.
- (d) Surface water shall be diverted, and otherwise prevented from entering excavations and trenches to the greatest extent practicable without damage to adjacent property from dikes, ditches, or impounded water.

TS-2.3.3 Pipe Foundation, Granular Fill and Trench Bottom Stabilization:

- (a) All pipe shall be bedded as shown in the APipe Embedment Details@ on the Plans.
- (b) Granular fill shall be clean river gravel or reasonably sound crushed limestone, free of cementitious, shaly, or flat and flaky particles in an amount which would cause the material to cake or pack or otherwise form an unyielding support for the pipe. Gradation shall be such that at least ninety-five (95) percent passes a three-quarter (3/4) inch square mesh sieve and not over five (5) percent passes a number four (4) square mesh sieve.
- (c) Stabilization: If the trench bottom at base of the required pipe embedment material is unstable, the contractor shall excavate to an additional depth and backfill with crushed stone as directed by the Engineer. The size of stone used shall be as required for effective stabilization. Where large stone is used, the upper portion shall be choked with smaller stone and no stone larger than one (1) inch size will be allowed within (3) inches of the pipe wall. Stabilization material ordered by the Engineer will be paid for in accordance with the stipulations of Articles TS-2.5 and TS-2.6. However, payment will

not be made for stabilization material or extra granular fill used for contractor=s convenience in controlling drainage or as may be required to stabilize trench bottoms made unstable through contractor=s disturbance thereof or excessive tramping thereon.

(d) Pipe shall not be placed over frozen trench sub-grade.

(e) Placement of Granular Fill:

1. Place granular fill in lifts not exceeding six (6) inches and bring up evenly on both sides of pipe. Do not dump over side of trench in any manner that will bring earth into the granular fill area or displace the pipe. Compact, vibrate, or slice with a shovel, in such manner that granular fill will take its final compaction and provide uniform and solid bearing under and around the pipe and its haunches.

2. Screed granular fill as shown on the Plans under elliptical or arch pipe.

3. For a length of two (2) pipe diameters (effective diameter equals average of span and rise for elliptical or arch pipe) on the upstream ends of culverts, omit granular fill. Use selected clay screeded and compacted to not less than ninety (90) percent of Standard Density.

TS-2.3.4 Bell Holes: Dig bell holes where pipe has bell joints. No part of any bell shall be in contact with the trench bottom or sides or granular fill when the pipe is jointed.

TS-2.3.5 Backfill to Top of Pipe:

(a) See APipe Embedment Details@ on Plans. This section covers the backfill from top of granular fill to top of pipe.

(b) Backfill as soon as possible to minimize the possibility of damage to joints an inconvenience to the public.

(c) Material to be selected earth or granular fill material, free from sod, sticks, roots, or rocks over one (1) inch size, to be unfrozen, and to be of proper moisture content for specified compaction. Suitable material from the project excavation shall be brought in from elsewhere on the work where required.

(d) Place alongside pipe in loose layers of six (6) inch maximum thickness, thoroughly compacting each layer. Take special care to place and compact material around the pipe so as to leave no voids and to provide uniform

lateral support for the pipe. Bring materials up uniformly on both sides of pipe, taking special care with corrugated metal pipe.

- (e) The material shall be compacted to the same density as required for backfill above top of pipe.

TS-2.3.6 Backfill Above Top of Pipe:

- (a) General: Backfill from top of pipe to original surface or to sub-grade where pavement is to be placed is covered by this section.

- (b) Materials:

1. Material for backfill above top of pipe shall be the same as for backfill below top of pipe as specified in subparagraph TS-2.3.5 (c), except that small sticks and roots less than one-half (2) inch in diameter, interspersed hard lumps and clods will be allowed insofar as they do not interfere with specified compaction. More suitable material shall be brought from elsewhere on the project if necessary and the unsuitable material disposed of. If the specified compaction cannot be obtained with earth excavated from the trench, the contractor shall use granular fill or similar approved material at his own expense.
2. Rock larger than one (1) inch shall not be placed within three (3) inches of pipe. Rock larger than eight (8) inches shall not be placed within two (2) feet of the top of pipe. No rock larger than two (2) inches may be placed in the upper six (6) inches under pavement sub-grade. No rock may be placed in the upper twelve (12) inches of trenches through grass parkways or earth areas.
3. Large stones may be placed in the remainder of the backfill only if well separated and so arranged that no interference with the specified backfill will result.

- (c) Methods:

1. Method of backfill used shall not impose excessive concentrated or unbalanced loads, shock, or impact on, or cause displacement of the pipe. The backfill shall be slowly rolled down a slope at the end of the trench and shall not be pushed over the side of the trench.
2. Consolidated material weighing more than one hundred (100) pounds shall not be permitted to fall more than three (3) feet into the trench unless cushioned by at least three (3) feet of backfill over top of pipe.

(d) Compaction:

1. Backfill under pavement shall be defined as being under all areas to be paved or surfaced for vehicular access, except those to be surfaced with crushed stone. The limiting line for such backfill shall extend from sub-grade at twelve (12) inches beyond edge of pavement or back of curb, downward on a slope not steeper than one (1) to one (1). In areas so defined, backfill shall be not less than ninety-five (95) percent of Standard Density.
2. Backfill in Other Areas: In areas not defined in Item 1 above, backfill shall be not less than ninety (90) percent of Standard Density.
3. The engineer may cause field density tests to be made whenever deemed necessary. The specified density will be the minimum allowed and the attainment thereof will be entirely the contractor's responsibility. Obvious voids will not be permitted.
4. Thickness of backfill layers will be determined by the coordination of test results with field performance and equipment used. The contractor will be expected to maintain established procedures except where unusual conditions arise.

TS-2.3.7 Installation of Pipe in Embankment:

- (a) If embankment is made prior to placing pipe excavate trench, place pipe and backfill, in accordance with the Specifications herein.
- (b) If embankment is made after placing pipe compact embankment to top of pipe on both sides of pipe for a distance of at least five (5) pipe diameters each side of Pipe.

TS-2.3.8 Protection of Pipe from Heavy Equipment: Provide temporary fill to at least two (2) feet over top of pipe extending at least five (5) pipe diameters each side, or greater protection, as required to protect pipe from heavy equipment. Damage to the pipe resulting from excessive equipment loads shall be satisfactorily repaired by the Contractor at his sole expense.

TS-2.3.9 Excavation Ahead for Location of Obstructions:

- (a) Except where otherwise directed, excavate at least one hundred fifty (150) feet ahead of pipe laying in order to uncover any possible obstructions in the way of laying the Pipe. If such obstructions are encountered notify the Engineer immediately so that a needed change may be considered and

effected.

- (b) Changes from Plans may be made only on the direction of the Engineer. Such changes may include changes in line, grade, pipe size or type, additional or less mitering, manholes, etc. Such changes may involve unanticipated moving of underground utility lines.
- (c) Refer to Article GP-7 regarding protection and moving of utilities and other obstructions.
- (d) The contractor will be paid for the actual amount of Proposal Items authorized (within the pay limits established) and performed by him. He will not be paid for unused materials left over or for delays arising from encountering obstructions.

TS-2.3.10 Maximum length of trenching allowed ahead of Pipe laying shall be one city block or four hundred (400) feet, whichever is shorter.

TS-2.4 Excavation and Backfill for Structures:

TS-2.4.1 The term Astructures@ as used in this Article, means inlets, manholes and all other structures, not including pipe.

TS-2.4.2 Missouri Highway Specifications Section 206 shall govern excavation and backfill for structures except that the provisions for measurement and payment therein shall not apply and except as modified in the form of additions, deletions and substitutions in this Article. Where any part of Missouri Highway Specifications Section 206 is so modified, the unaltered provisions shall remain in effect.

TS-2.4.3 Delete the following from Missouri Highway Specifications Section 206.

- (a) Subsections 206.2, 206.4.7, 206.4.8, 206.4.9, 206.4.10 and 206.4.11.
- (b) All sections on Measurement and/or Payment.

TS-2.4.4 Crushed stone, as specified in paragraph TS-2.3.3 (c), shall be installed where required by the stipulations of the Missouri Highway Specifications Article 206.3. This requirement shall apply to all structures as defined in paragraph TS-2.4.1. Stabilization material ordered by the Engineer will be paid for in accordance with the stipulations of Articles TS-2.5 and TS-2.6. However, payment will not be made for stabilization material used for contractor=s convenience in controlling drainage, in fine grading, or as may be required to stabilize structure bottoms made unstable through contractor=s disturbance thereof or excessive tramping thereon.

TS-2.4.5 Backfill for structures shall be in accordance with the applicable requirements of Section TS-2.3.6.

TS-2.5 Method of Measurement:

TS-2.5.1 Excavation and Compacted Embankment:

- (a) The excavation and compacted embankment item shall be bid on a lump sum basis. The work shall be performed in accordance with specifications and in conformance with the lines, grades, thicknesses and typical cross sections shown on the plans.
- (b) No measurement for payment will be made for any of the following:
 - 1. Excavation for structures, or pipes payment will be included in cost of bid item for each.
 - 2. No measurement of borrow excavation will be made. All costs of supplying borrow material to the Project site shall be included in the bid price for excavation and compacted embankment.
- (c) Computations: The Engineer=s earthwork computations are available for inspection. The volume of excavated and compacted embankment as shown thereon, and as listed in the plans, from existing cross sections by average end area method and will be the basis for final payment, except as follows:
 - 1. An authorized change in grade, slope, or typical section is made.

TS-2.6 Basis of Payment:

TS-2.6.1 Excavation and Compacted Embankment, will be paid for at the contract unit price bid based on a lump sum cost.

TS-2.6.2 Crushed stone for sub-grade and trench bottom stabilization, as well as open-graded drainable crushed stone for backfilling of undergraded rock cuts, measured as provided will be paid for at the contract unit price bid per ton.

TS-3 CLEANUP

The contractor shall remove from the owner=s property and from all public and private property, at his own expense, all temporary structures, rubbish, excess excavation and waste material resulting from his operations. All material found to be unsatisfactory for backfill shall be removed at the contractor=s expense.

All existing sod areas shall be hand raked to remove earth deposited on or in them during construction.

All ditches shall be graded and properly sloped. Excess excavated material shall be removed from ditches.

Shoulders where sodding, seeding or surfacing is not required shall be bladed and shaped.

The project area shall be kept at all times as neat and clean as possible. Debris from construction operations shall be removed from the site as soon as construction is completed in a given area. Dirt piles shall be removed and the area finish graded as soon as possible after construction of a given section of the project is completed. In no instance shall dirt piles or debris be allowed to remain on lawn areas long enough to damage growing sod.

TS-4 PIPE SEWER CONSTRUCTION

TS-4.1 General: This work shall include the construction of all pipe sewers whether storm sewers or sanitary sewers. The material required for each section of sewer shall be as shown on the plans. Trenching shall be in accordance with Part TS-2 of these specifications.

TS-4.2 Reinforced Concrete Pipe Storm Sewers:

TS-4.2.1 General: This section covers the materials and construction of reinforced concrete pipe storm sewers. Other types of pipe and all appurtenant structure are covered in other sections of these specifications.

TS-4.2.2 Material: All reinforced concrete pipe shall conform to the requirements of ASTM C-76-62T, Class III, Wall B. Pipe joints shall be tongue and groove or bell and spigot type.

Pipe for use on the project shall appear neat and well made. It shall be free of cracks, broken places, and obvious manufacturing defects.

All pipe shall be stamped on the inside with its class before delivery to the job site.

TS-4.2.3 Pipe Laying: Pipe shall be carefully handled by sling or other means to protect it from damage. Particular care shall be taken to avoid any free fall or shock to the pipe.

Pipe shall be carefully placed on the prepared bedding material and jointed as specified below. Pipe shall be laid true to both line and grade and shall produce a straight line between structures except where other than straight alignment is required or allowed by the plans.

Where curves are required they may be accomplished by the following methods:

- (a) If the curve is slight or if the radius of the curve is very long, curving may be accomplished by deflecting each pipe joint in the curved section equally to

form a smooth uniform curve. In no case shall any pipe joint be deflected to the extent that the maximum opening of the joint exceeds one half the joint depth (one half the depth of the socket).

- (b) Short radius bends shall be accomplished through the use of factory made mitered pipe sections. These sections shall be fabricated specifically for a given curve and, when properly assembled, shall produce a uniform curve (consisting of a series of short chords) of the specified radius. Pipe shall be placed in accordance with the manufacturer's recommendations and the details given on the plans.

All pipe laying shall begin at the lowest point on the sewer proceed to the higher parts.

TS-4.2.4 Jointing: Pipe jointing shall be as specified in Section 726.3 of Missouri Standard Specifications for Highway Construction, except as follows:

- (a) Cement or tar joints other than Adiape joints will not be permitted.
- (b) Pipe joint surfaces shall be clean prior to jointing.
- (c) Care shall be taken not to allow bedding Material or other deleterious matter to enter the joint during pipe laying or jointing.

TS-4.2.5 Backfill: Following jointing sufficient bedding material shall be placed and compacted along the sides of the pipe to hold it securely in place during the backfill operation. See plans for bedding details.

Next, the trench to 12 inches above the top of the pipe shall be backfilled with layers of carefully compacted select backfill material. This material shall be placed and compacted simultaneously on both sides of the pipe.

Backfill above this joint shall be as specified TS-2.

TS-4.2.6 Pipe Anchors: Wherever storm sewer does not outlet into a paved channel or other structure, pipe anchors will be required to connect all pipe joints in the 20 feet of storm sewer preceding the outlet. This 20 feet shall include the length of the end section.

TS-4.3 Corrugated Metal Pile and Pipe Arch Storm Sewers

TS-4.3.1 Scope: This specification covers corrugated metal pipe, pipe arch, and fittings which

shall be furnished and installed complete with connecting bands and other necessary appurtenances for sewers and culverts. Wherever applicable, the term pipe shall also include pipe arch.

TS-4.3.2 Uses: Where ACMP is called for or allowed on the plans corrugated steel pipe as specified herein may be used.

TS-4.3.3 Materials:

TS-4.3.3.1 Corrugated Metal Pipe and Pipe Arch shall be in accordance with AASHTO Designation M36 for riveted pipe and pipe arch. Helically constructed corrugated steel pipe which meets all other criteria of this section may be used provided the corrugations of the ends of the joints of pipe are made annular for tighter jointing.

Unless otherwise specified or shown on plans, gages shall be as follows:

Round Pipe

6" through 24" diameter - 16 ga.
30" through 36" diameter - 14 ga.
42" through 54" diameter - 12 ga.
60" through 72" diameter - 10 ga.

Pipe Arch

18" x 11" through 25" x 16" - 16 ga.
29" x 18" through 36" x 22" - 14 ga.
43" x 27" through 65" x 40" - 12 ga.
72" x 44" - 10 ga.
79" x 49" - 10 ga.

TS-4.3.4 Alignment and Grade: Corrugated metal pipe shall be aligned and graded in accordance with the requirements for reinforced concrete pipe.

Where plans show grade change between structures or slight alignment change to clear obstructions, deflect pipe and joints over a distance as required, after joints have been coupled and only to the extent that joints will not be over-stressed.

TS-4.3.5 Laying Pipe: Pipe shall be protected from lateral displacement by means of pipe embedment material installed as provided in the trench backfill specification. No pipe shall be laid in water and no pipe shall be laid in unsuitable weather or trench conditions.

When jointed in the trench, the pipe shall form a true and smooth line. Pipe shall not be trimmed except for closure, and pipe not making a good fit shall be removed.

Unless otherwise approved by the Engineer, the laying of pipe shall begin at the lowest point and the pipe shall be installed so that the outside laps of circumferential joints point upstream and with longitudinal laps on the sides.

TS-4.3.6 Coupling Pipe: Pipe ends shall be butted as closely as the corrugations will permit, then jointed with a firmly bolted coupling band. Draw coupling bands tight. Merely tightening bolts will not be adequate. Lubricate contact surfaces of coated pipe and bands with fuel oil or similar solvent. Tap the bands with heavy wooden or rubber mallet. Use chain clinching device or special clamping device if required for tight connection on larger pipe.

Field coat coupling bolts, nuts and rods with bituminous material after installation.

TS-4.3.7 Installing End Sections Prepare moist clayey soil bearing shaped to end section and place thereon. Join end section to pipe with coupling band. The toe plate shall be set in a trench and backfilled with compacted moist clayey soil or driven to the required elevation.

TS-4.4 Measurement and Payment

TS-4.4.1 CMP and RCP Pipe: Pipe will be measured per linear foot of completed pipe in place.

Payment will be made at the unit price bid per linear foot for the completed pipe in place. Payment shall include all costs of furnishing, and installing pipe including trenching, backfilling of pipe.

TS-4.4.2 CMP and RCP End Sections: End section will be measured as one unit each complete in place.

Payment will be made at the unit price bid for each complete end section in place. Payment shall include all costs for furnishing and installing end section including trenching, backfilling.

TS-4.5 Plastic Gravity Sewer Pipe

TS-4.5.1 General: This specification designates general requirements for polyvinyl chloride (PVC) Plastic Gravity Sewer Pipe with integral wall bell and spigot joints for the conveyance of domestic sewage.

TS-4.5.2 Materials: Pipe and fittings shall meet and/or exceed all of the requirements of ASTM Specifications D3034.

All pipe shall be suitable for use as a gravity sewer conduit. Provisions must be made for contraction and expansion at each joint with a rubber ring. The bell shall

consist of an integral wall section stiffened with two PVC retainer rings which securely lock the solid cross section rubber ring into position. Standard lengths shall be 20 feet and 12.5 feet ∇ 1 inch.

Rubber gaskets shall comply with the physical requirements of ASTM-D1869, C361, and C443. Lubricant shall have no deteriorating effects on the gasket or the pipe materials.

TS-4.5.3 Fittings: All fittings and accessories shall be as manufactured and furnished by the pipe supplier or approved equal and have bell and/or spigot configurations identical to that of the pipe.

TS-4.5.4 Physical and Chemical Requirements: The pipe shall be designed to pass all test at 73 degrees F (∇ 3 degrees F).

TS-4.5.5 Pipe Stiffness: Minimum A_{pipe} stiffness@ (F/y) at 5% deflection shall be 46 for sizes 6 inch through 12 inch when tested in accordance with ASTM Designation D2412.

Minimum A_{pipe} stiffness@ for 4 inch shall be 51. External Loading Properties of Plastic Pipe by Parallel-Plate Loading.

TS-4.5.6 Flattening: There shall be no evidence of splitting, cracking or breaking when the pipe is tested as follows:

Flatten specimen of pipe, six inches long between parallel plates in a suitable press until the distance between the plates is forty percent of the outside diameter of the pipe. The rate of loading shall be uniform and such that the compression is completed within two to five minutes.

TS-4.5.7 Drop Impact Test: Pipe (6" long section) shall be subjected to impact from a free falling tup (20 lb. Tup A) in accordance with ASTM method D2444. No shattering or splitting (denting is not a failure) shall be evident when the following energy is impacted:

Nominal size	4"	6"	8"	10"	12"
Ft. - Lbs.	150	210	210	220	220

TS-4.5.8 Acetone Immersion Test: After 20 minutes immersion in a sealed container of anhydrous (99.5% pure) acetone a 1" long sample ring shall show no visible spalling or cracking (swelling or softening is not a failure) when tested in accordance with ASTM 2152.

TS-4.5.9 Sizes, Dimensions, and Tolerances

Nom. <u>Size</u>	Outside Diameter		Min. Wall	
	<u>Average</u>	<u>Tolerance</u>	<u>Thickness</u>	<u>SDR</u>
4	4.215	∓0.009	0.125	33.5
6	6.275	∓0.011	0.180	35
8	8.400	∓0.012	0.240	35
10	10.500	∓0.020	0.300	35
12	12.500	∓0.024	0.360	35

TS-4.5.10 Alignment and Grade: Pipe which is a part of the gravity sewer line shall be aligned and constructed to grades as shown on the Plans.

TS-4.5.11 Connections to Manholes: Special manhole CPLGS fittings shall be used to connect PVC pipe into manhole walls.

TS-4.6 ABS Pipe:

TS-4.6.1 Scope: This Specification covers ABS composite pipe and fittings which shall be furnished and installed complete with all jointing materials and other necessary appurtenances for sewers.

TS-4.6.2 Materials: A B S Composite Pipe shall be made from virgin Acrylonitrile Butadiene-Styren material. This material shall be Type I, Grade I, Type I, Grade II, Type IV, Grade I, and shall conform to ASTM Specifications 1788-62-T. ABS Composite Pipe shall consist of two concentric thermo-plastic tubes intrically braced across the annulus with resultant angular space filled to provide continuous support between inner and outer tubes. The component between the ABS shall be of Portland Cement Pearl-lite concrete other inert biller exhibiting the same degree of performance which essentially fills the truss annulus to form a composite pipe to meet the requirements of this Specification.

Size, physical requirements, the dimensions, the method of test, the length, the testing procedures and marking procedures for this pipe shall conform with ASTM Specification D-2680-68T.

Couplings shall be of solid wall sleeve type for chemical weld to the truss pipe.

TS-4.6.3 Handling: Pipe, fittings and accessories shall be handled in a manner that will insure their installation in the work in a sound undamaged condition. Pipe shall not be dropped, bumped or drug along the ground. Pipe shall not be lifted by hooks.

TS-4.6.4 Cleaning: The interior of all pipe and fittings shall be thoroughly cleaned of all

foreign matter before being installed and shall be kept clean until the work has been accepted. All joint contact surfaces shall be kept clean until the jointing is completed.

Every precaution shall be taken to prevent foreign material from entering the pipe during installation. No debris, tools, clothing or other materials shall be placed in the pipe.

Whenever pipe laying is stopped, the upper end of the pipe shall be closed with an endboard closely fitting the end of the pipe and having a number of small holes drilled near the center, to prevent the trench from filling with water and to keep sand and earth out of the pipe.

TS-4.6.5 Laying Pipe: Pipe shall be protected from lateral displacement by means of Class B pipe embedment material installed as provided in the trench backfill specification. No pipe shall be laid in water and no pipe shall be laid in unsuitable weather or trench conditions.

When jointed in the trench, the pipe shall form a true and smooth line. Pipe shall not be trimmed except for closure, and pipe not making a good fit shall be removed.

Unless otherwise approved by the Engineer, the laying of pipe shall begin at the lowest point and the pipe shall be installed so that the outside laps of circumferential joints point upstream and with longitudinal laps on the sides.

TS-4.6.6 Coupling Pipe: The couplings shall be chemically welded to the pipe with one end, factory applied. The coupling and pipe end to be chemically welded in the trench shall be thoroughly cleaned after it is in the trench and primer and cement shall be applied to both the coupling and the end of the pipe. This shall be done in accordance with the manufacturer's specifications. The pipe shall be thoroughly shoved into the coupling and then turned within the coupling one quarter turn to insure complete contact between cement, pipe and coupling.

TS-4.6.7 Manhole Construction: Connection at manhole walls shall be made by AO@ ring type couplings set in the wall and having a manhole water stop assembly between the coupling and the manhole wall. Between the pipe and the coupling shall be an AO@ seal.

TS-4.6.8 Measurement and Payment:

TS-4.6.7.1 ABS And Plastic Gravity Sewer Pipe: Pipe will be measured per linear foot of completed pipe in place.

Payment will be made at the unit price bid per linear foot for the completed pipe in place. Payment shall include all costs of furnishing and installing pipe including

trenching and backfilling of pipe.

TS-5 DRAINAGE STRUCTURES

TS-5.1 Scope of Work: The work shall consist of furnishing all labor, materials, and equipment necessary to perform all operations in connection with the construction of junction boxes, inlets and catch basins required for the project in accordance with the specifications and drawings. Items not specifically mentioned, but necessary for completion of the work shall be considered as incidental to other items in the contract.

TS-5.2 Materials:

1. Concrete shall be Class AB@ Portland Cement Concrete in accordance with the requirements of Section TS-6 of these specifications.
2. Reinforcing steel shall consist of deformed bars of grade 40 steel conforming to the requirements of ASTM designation A615 or of wire fabric conforming to ASTM designation A185.
3. Expansion Joint Fillers shall be of a non-extruding type conforming to ASTM designation D1751 and cut to the dimensions shown on the plans.

TS-5.3 Earthwork: This section shall cover all necessary excavation and backfill required for construction of the various structures.

All applicable portions of Section TS-2 shall apply to this work. Particular care shall be taken to protect existing underground utilities and surface improvements. Excavations for structures in improved areas shall be held to the smallest practical dimensions. No increase in payment for street or lawn repair will be made to allow for areas disturbed by such excavations. Structures shall be founded on undisturbed subsoil, if subsoil is not firm, over-excavate and replace with granular fill as required.

Section TS-2.2 shall apply for subgrade stabilization under structures.

Backfill requirements for each drainage structure will be the same as that of the pipe to which it is connected. If more than one pipe is connected to the structure, the higher backfill requirement shall apply.

Backfill under curb transitions shall be to 95% of Standard Maximum Density.

All excavations shall be kept drained until the structure is constructed and backfilled.

TS-5.4 Construction Methods:

TS-5.4.1 Forms: Forms shall be of wood, plywood, or any other suitable material, designed,

constructed, braced and maintained so that the finished concrete will be true to line and elevation and will conform to the required dimensions. They shall be designed to withstand the pressure of the concrete, the effect of vibration as the concrete is placed and all other loads incidental to the construction operations without distortion or displacement. They shall be mortar tight. Oiling both inside and outside surfaces will be required to prevent warping, shrinkage, or swelling.

Forms shall be constructed and designed so that their removal can be effected without injury to the concrete and so that portions where surface finishing is required may be removed without disturbing forms that are to remain. Dirt, chips, sawdust, nails and other foreign matter shall be removed before any concrete is deposited therein.

Tie rods, belts and anchorages within the forms shall be constructed so as to permit their removal to a depth of at least 1 2 inches from the face without injury to the concrete. In case wire ties were used, upon removal of the forms, all projecting wire shall be cut back at least 2 inch from face of all surfaces that will be exposed to view after the completion of the work and flush with the face of all concrete surfaces that will not be exposed to view. All fittings for metal ties shall be of such design that, upon their removal, the cavities which are left will be of the smallest practical size.

TS-5.4.2 Inlet and Outlet Pipe: Pipe or tile placed in the concrete for inlet or outlet connections shall extend through the concrete walls beyond the outside surfaces of the walls a sufficient distance to allow for connections. The pipe or tile shall be placed through the forms and poured in place.

The ends of the pipe shall be flush with the inside wall of the structure.

TS-5.4.3 Reinforcement:

1. Placement. Reinforcing bars shall be accurately placed as shown on the plans and shall be firmly and securely held in position in accordance with Concrete Reinforcing Steel Institute Recommended Practice for Placing Reinforcing Bars®, and by using concrete or metal chairs, spacers, metal hangers, supporting wires and other approved devices of sufficient strength to resist crushing under full load. Metal chairs, which extend to the surface of the concrete (except where shown on the plans) and wooden supports, shall not be used.

Placing bars in layers of fresh concrete as the work progresses and adjusting bars during the placing of concrete will not be permitted. Before placing in the forms, all reinforcing steel shall be cleaned thoroughly of mortar, oil, dirt, loose mill scale, loose or thick rust, and coatings of any character that would destroy or reduce the bond. No concrete shall be deposited until the placing of the reinforcing steel has been inspected and approved.

2. Splicing. Splices of bars shall be made only where shown on the plans or as approved by the Engineer. Where bars are spliced, they shall be lapped at least 30 diameters, unless otherwise shown on the plans.

Splicing shall be accomplished by placing the bars in contact with each other and wiring them together.

Welding of reinforcing steel or cutting with a cutting torch will not be permitted unless specifically authorized by the Engineer.

3. Bending Reinforcement. Bends and hooks in bars shall be made in the manner prescribed in the Manual of Standard Practice of the American Concrete Institute.

Bars shall not be bent or straightened in a manner which will injure the material. Bars with kinks or unspecified bends shall not be used.

4. Welded Wire Fabric. Welded wire fabric shall be spliced not less than two meshes. It shall be lifted carefully into its specified position after the concrete is placed but still plastic.

TS-5.4.4 Concrete Placement: Concrete construction shall be in accordance with Section TS-7. Concrete shall be conveyed, deposited, and consolidated by any method which will preclude the segregation or loss of ingredients.

Chutes used in conveying concrete shall be sloped to permit concrete of the consistency required to flow without segregation. Where necessary to prevent segregation, chutes shall be provided with baffle boards or a reversed section at the outlet. Where a sequence for placing concrete is shown on the plans, no deviation will be permitted unless approved in writing by the Engineer.

Where concrete is to be deposited against hardened concrete at horizontal construction joints, placing operations shall begin by conveying a grout mixture through the placing system and equipment, and depositing the mixture on the joint. The grout mixture shall consist of a modification of the concrete specified to reduce the quantity of coarse aggregate in the mix larger than pea-gravel size to one-half the quantity specified.

To avoid segregation, concrete shall be deposited as near to its final position as is practicable. The use of vibrators for extensive shifting of the mass of concrete will not be permitted. Concrete that has partially hardened or is contaminated by foreign materials shall not be deposited in the structure.

Concrete shall be placed in horizontal layers insofar as practical. Placing shall start at the low point and proceed up grade unless otherwise permitted by the Engineer. Concrete shall be placed in a continuous operation between construction joints and shall be terminated with square ends and level tops unless otherwise shown on the plans.

Concrete shall not be permitted to fall more than six feet without the use of pipes or tremies. Pipes or tremies shall be at least six inches in diameter, or the equivalent cross sectional area for rectangular sections. Concrete shall not be placed in horizontal members or sections until the concrete in the supporting vertical members or sections has been consolidated and a 2-hour period has elapsed to permit shrinkage to occur.

Concrete shall be thoroughly vibrated in a manner that will encase the reinforcement and inserts, fill the forms, and produce a surface or even texture free of rock pockets and excessive voids.

Structural concrete, except slope paving steeper than one (1) inch per foot, such as spillway aprons and channel lining, and concrete placed under water, shall be consolidated by means of high frequency internal vibrators or a type, size and number approved by the Engineer. The location, manner and duration of the application of the vibrators shall be such as to secure maximum consolidation of the concrete without separation of the mortar and coarse aggregate, and without causing water or cement paste to flush to the surface. Internal vibrators shall not be held against the forms or reinforcing steel.

The number of vibrators employed shall be sufficient to consolidate the concrete within 15 minutes after it has been deposited in the forms. At least two vibrators in good operating condition shall be available at the site of the structure in which more than 25 cubic yards of concrete is to be placed.

TS-5.4.5 Joints: The work shall be so prosecuted that construction joints will occur at designated places shown on the plans unless otherwise authorized by the Engineer. The Contractor shall construct, in one continuous concrete placing operation, all work comprised between such joints. Joints shall be kept moist until adjacent concrete is placed.

All construction joints having a keyed, stepped, or roughened surface shall be cleaned prior to placement of the adjacent concrete as directed by the Engineer.

Expansion and contraction joints in concrete structures shall be formed where shown on the plans. No reinforcement shall be extended through the joints, except where specifically noted or detailed on the plans.

No direct payment will be made for furnishing and placing asphaltic paint, pre-molded asphaltic filler, or other types of joint separators. The cost therefore shall be included in the price bid for the item of work of which they are a part.

TS-5.4.6 Cold Weather Requirements: Whenever the temperature of the surrounding air is below 40E F, or when the possibility exists that the temperature will fall below 40E F, within the 24 hour period after concrete operations, concrete placed in the forms shall have a temperature of between 80E F and 100E F. All concrete shall be maintained at a temperature of not less than 50E F for at least 72 hours or for as much time as is necessary to insure proper curing of the concrete. The housing, covering, or other protection used in connection with curing shall remain in place and intact at least 24 hours after the artificial heating is discontinued. No dependence shall be placed on salt or other chemicals for the prevention of freezing. Contractor will be held responsible for any damage to concrete as a result of cold weather operations.

TS-5.4.7 Finish: Inlet tops shall have light broom finish. Curb transitions shall have broom finish. Contraction joints shall be cut where shown. Cut each 1 2 inches deep and finish with joint tool.

TS-5.4.8 Inverts: Inverts shall be carefully constructed to maintain the proper velocities through the structure, and in no case shall the invert sections through the structure be greater than that of the outgoing pipe. The shape of the invert shall conform exactly to the lower half of the pipe it connects. Use half circle template to check invert shape and size while building. Grade on the invert shall be such that no water pockets are formed. Side branches shall be connected with as large radius of curve as practicable.

Inverts shall be constructed of concrete conforming to the requirements of Section TS-6.

Concrete filling between the sewer invert and walls of structure shall be flush with the top edges of the invert and shall slope up from the invert at the rate of three (3) inches per foot. Inverts shall be troweled smooth and clean. Where water problems require, use quick setting cement to aid in construction of smooth inverts.

TS-5.4.9 Steps: When shown on the plans, shall be solidly grouted in place with full mortar encasement.

TS-5.5 Precast Concrete Inlets:

1. Precast concrete inlets shall be constructed in all respects in accordance with the Plans and Specifications except as provided in the following items of this

subparagraph.

2. All applicable requirements of ASTM C-478 shall apply to the manufacture of precast concrete inlets.
3. The manufacturer of precast concrete inlets shall submit detailed drawings and specifications for the construction of the basic precast units and appurtenances to the Engineer and Owner for prior approval. A shop drawing for each inlet showing dimensions, elevations and openings, shall be submitted to the Engineer and Owner for approval prior to manufacturing of the units.
4. Where dividing walls are used or where multiple precast units are used, the total net length of opening shall equal the length of inlet specified on the project plans. Intermediate wall openings shall be large enough so as not to cause hydraulic head loss. Location and number of manhole openings, as well as openings in walls shall be as required to promote easy access to all parts of the inlet, subject to the Engineer's approval.
5. The walls of the entire structure shall be set in place on concrete blocks prior to pouring concrete base slab. The base slab shall be reinforced in accordance with the project plans, and the bottom of the base slab shall be at least the distance below bottom of precast walls that is shown on the project plans. The entire base slab shall be poured monolithic and shall be brought up to a level of at least six (6) inches above bottom of precast walls.
6. Mastic pipe joint compound shall be used in horizontal joints and where walls of multiple sections join, in order to form a reasonable watertight structure.
7. Where top slabs of multiple sections join, the joint shall be sealed with General Electric single component silicone, gray color, strictly in accordance with the manufacturer's recommendations.
8. Top slabs cast separately from inlet walls shall be anchored against lateral movement with respect to walls by a steel dowel in each corner extending from the walls through holes in the slabs. The top slabs shall be set accurately to line, grade and slope and grouted securely in place.

TS-5.6 Precast Concrete Manholes:

TS-5.6.1 Materials: Precast Concrete Manhole Rings. ASTM Designation C-478, except as indicated below:

(1) Shell Thickness:

<u>Inside Diameter of Manhole</u>	<u>Shell Thickness</u>
4' - 0"	5"
5' - 0"	6"
6' - 0"	7"

- (2) Precast Flat Tops. Designed to withstand H-20 wheel load plus 30% impact, AASHTO AStandard Specification for Highway Bridges@.
- (3) Conical Tops. Eccentric cone preferred.
- (4) Manhole Steps. When shown on plans, shall be solidly cast in place or set with expanding grout.
- (5) Shipment to job not allowed until units have cured sufficiently to prevent damage in handling.
- (6) Approval. Submit all details to Engineer and Owner for approval prior to manufacturer.

TS-5.6.2 Setting Precast Rings: Rings may be set either on a previously poured, properly cured base slab or may be blocked in place with solid concrete blocks while the base slab is poured around the first ring.

Rings shall be set with the bells up. Butter both bell and spigot ends with pre-mixed sewer joint mastic compound, as approved by the Engineer, and set the next section in place. Wipe joint smooth on the inside and fill all joints inside and out. Watertight joints will be required.

Where precast manholes are constructed in existing or proposed streets, 3 courses of brick shall be placed between the precast cone and the casting.

TS-6 CONCRETE:

TS-6.1 General:

- TS-6.1.1 Description of Work Included: All concrete required on the project except precast material.
- TS-6.1.2 Quality Control:
- TS-6.1.2.1 Supervision:
1. Provide full time superintendent on the project who is qualified and experienced in concrete construction. Superintendent shall direct all work in connection with concrete construction.
 2. Finishers shall be journeymen concrete finishers experienced in concrete finish work.
- TS-6.1.2.2 Submittals: Contractor shall submit name and location of transit mix company for approval along with complete data on gradation and durability of aggregate, mix, additives and cement.
- TS-6.1.3 Product Handling:
- TS-6.1.3.1 Transit Mix: Concrete shall be handled and preserved in its batched proportion during transportation. Mixing time shall not exceed 45 minutes and excess water shall not be added. Concrete improperly cared for or mixed in the truck longer than 45 minutes shall be disposed of away from the project.
- TS-6.1.3.2 Defective Concrete: Damaged or defective concrete shall be repaired or removed and replaced immediately as directed by the Engineer.
- TS-6.2 Materials:
- TS-6.2.1 General:
1. All concrete used in the project shall be furnished by a reputable permanent concrete plant using transit mix trucks. The plant shall be located within a reasonable distance from the project so travel time is 30 minutes or less. Supplier shall have adequate bins that weigh material by approved scale system. The supplier shall have an adequate number of modern trucks to insure delivery of concrete as required for placing schedule. Supplier shall be subject to approval of the Engineer.
 2. The contractor shall use whatever means necessary to insure concrete delivered to the project is properly batched with approved kinds and quantities of materials.
 3. A copy of the delivery ticket for each load of concrete shall be provided the

inspector as each truck is unloaded. Delivery ticket shall include the following information:

- (1) Name of concrete company
- (2) Serial number of ticket
- (3) Date
- (4) Number of truck
- (5) Name and location of job
- (6) Identification of concrete mix delivered
- (7) Volume of concrete in truck
- (8) Time concrete was loaded
- (9) Amount of water added at plant

TS-6.2.2 Cement: All cement shall be Type I Portland Cement conforming to ASTM C-150.

All concrete for curb and gutter and concrete pavement shall contain not less than 6.5 sacks cement per cubic yard. All other concrete shall contain not less than 5.8 sacks cement per cubic yard.

TS-6.2.3 Fine Aggregate: Fine aggregate shall consist of natural sand conforming to ASTM C-33. Sand shall be well graded, washed, clean sand from the Missouri River Class I or equal and shall conform to the following sieve analysis:

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8 inch	100
No. 4	95-100
No. 20	40-75
No. 50	5-30
No. 100	0-10

The sand shall not have more than 35% retained between any two consecutive sieve sizes. Fineness modulus shall not be less than 2.5 nor more than 3.1.

The amount of deleterious substances in fine aggregate, each determined on independent samples complying with the grading requirements of Division 3, shall not exceed the following limits:

Table 1. Limits for Deleterious Substances in Fine Aggregate for Concrete:

<u>Item</u>	<u>Maximum percent by Weight of Total Sample</u>
Clay Lumps	0.25 Material
Finer than No. 200 Sieve	2.00 Coal &

Lignite	0.25 Sticks, Leaves &
Other Deleterious Material	0.25

Fine aggregate shall be free of injurious amounts of organic impurities. Except as herein provided, aggregates subjected to ASTM test No. C40-56T for organic impurities and producing a color darker than the standard shall be rejected.

Fine aggregate shall be free of material that could react harmfully with alkalis in the cement. If such materials are present in injurious amounts, the fine aggregate shall be rejected, or shall be used with cement containing less than 0.6 percent alkali calculated as sodium oxide or with the addition of a material that has been shown to inhibit undue expansion due to the alkali-aggregate reaction.

Except as provided above, fine aggregate subjected to five cycles of the soundness test (ASTM C88-59T), shall show a loss, weighted in accordance with the grading of a sample complying with the limitations set forth above, not greater than 10% when sodium sulfate is used or 15% when magnesium is used.

TS-6.2.4 Course Aggregate: Course aggregate shall be crushed limestone produced from the Callaway formation or equal having an estimated history of sound material and shall be approved by the Engineer. Furnish soundness test results for approval of source. Coarse aggregate source shall not contain chert deposits.

<u>Gradation</u>	<u>Percent Passing</u>
<u>Sieve Size</u>	
1 2 inch	100
1 inch	95-100
2 inch	25-60
No. 4	0-8
No. 10	0-3

Satisfactory experience record shown for durability, other wise pass soundness test ASTM C88-5 cycles using magnesium sulfate without splitting or losing more than 15% weight.

Contractor shall arrange and pay for testing if adequate history is not available.

TS-6.2.5 Water: Water for mixing and curing concrete shall be clean, and free from injurious amounts of sewage, oil, acid, alkali, salt or organic matter. Only potable water shall be used.

TS-6.2.6 Concrete Mix: All concrete for the project shall conform to the design mix listed in the table below. The concrete mix shall include air entrainment not to exceed 7

percent air:

Maximum aggregate size	1 inch
Maximum water	250 lb/cy
W/C weight ratio (max.)	0.450
Cement	-6.5 sacks per cubic yard for curb & gutter and pavement -5.8 sacks per cubic yard for all others

The contractor shall furnish laboratory design mix for the approved materials.

Water reducing and air entraining agents shall be subject to Engineer=s approval.

TS-6.3 Construction Requirements:

TS-6.3.1 Preparation:

TS-6.3.1.1 General:

1. Clean all forms and correct all find grade damage.
2. Wet down all subgrades.
3. Verify all needed equipment for placing concrete is on hand: Vibrators, crane or pump, tremies, flumes, finishing equipment.
4. All keyways are to be in place.
5. Dry up excavation if any water is present.
6. Have cold weather equipment on hand if applicable.
7. Notify Engineer at least 24 hours in advance of placing concrete.

TS-6.3.2 Placing Concrete:

TS-6.3.2.1 General:

1. All concrete shall be placed in a manner and with adequate equipment which shall be subject to the Engineer=s approval. Equipment for placing concrete shall include flumes, tremies, cranes or concrete pumps for placing concrete: hand tool and finishing equipment for manipulation as needed.
2. Concrete shall be placed in a logical sequence that will permit efficient operation, but shall provide structural continuity and strength required. Placing sequence shall be subject to general approval by the Engineer.

3. Flumes shall not be used at slopes flatter than 45 degrees. Concrete pumping equipment shall be designed for the purpose - shall be subject to approval by the Engineer.
4. Subgrade shall have been fine graded and moistened prior to placing concrete. Forms and keyways shall be carefully cleaned prior to placing concrete. Concrete shall be placed in locations not to exceed 12 feet apart. Placing shall be a continuous operation using a heavy duty vibrator.
5. Tremies required for depth greater than 6 foot.
6. In case of pending inclement weather, prepare temporary covers to protect freshly placed and finished surfaces from surface damage. Protect for 12 hours.
7. Embedded screeds may be used unless otherwise called for. Screeds shall be accurately set and held in place by solid steel rods with mechanical clamps for attaching screed. Wood screed supports shall not be used. Screeds must be removed and voids filled while concrete is plastic.
8. Reduce coarse aggregate in first lift above cold construction joint.
9. Keep working face of concrete Aalive@ and plastic.
10. Avoid other vibrating.
11. Do not transport concrete in form with vibrator.
12. Place concrete uniformly at spacing not to exceed 10 feet.

TS-6.3.2.2 Slump: Hold slump as low as possible to allow proper placement of concrete. Maximum slump for curb, curb and gutter, and concrete pavement shall be 3 inches. All other concrete shall have a 4 inch maximum slump.

TS-6.3.2.3 Cold Weather Requirements:

1. Do not place concrete on ice or frozen subgrade.
2. Do not place concrete at temperature below 20EF unless covered and heated.
3. When temperature is or is forecast below 40EF, the following are required:
 - a. Heat water - 150EF maximum

- b. Heat aggregate to frost free temperature.
- c. Temperature of concrete regulated to the following schedule:

<u>Air Temperature</u>	<u>Concrete Temperature</u>
30 to 40	70 to 80
20 to 30	80 to 100

- d. Cover, protect, and heat to 70E F air temperatures when heated concrete is required.
- e. Preserve and maintain moist curing conditions when heating.
- f. Admixtures for cold weather purposes are not approved.

TS-6.3.2.4 Hot Weather:

- 1. Concrete exposed to direct weather shall not be placed at temperatures above 100E F.
- 2. Cover, protect and cool work as required to maintain concrete below 100E F.

TS-6.3.3 Finishing Concrete:

TS-6.3.3.1 General:

- 1. All slabs, walks and decks shall be sloped uniformly to drain to finish grade, and must drain completely.
- 2. Finish shall be of specified texture and uniform in color and appearance. Approval of finish is required on first concrete placed.
- 3. All voids in slabs and horizontal surfaces are to be filled during finishing operation. Voids in forms surfaces are to be repaired immediately at the time forms are removed.
- 4. Avoid over-finishing, late finishing, re-watering, and other techniques that may cause Acrazing@.
- 5. Provide adequate manpower and equipment for finishing prior to placing concrete.

6. Initiate curing process as soon as surface strength will permit.

TS-6.3.3.2 Formed Surfaces Exposed to View:

1. Remove forms as soon as curing and strength development permits.
2. Remove the cones where applicable and fill with sand cement grout.
3. Break off all fins; grind as required for uniform appearance.
4. Grind all form offset where concrete will be visible after construction is complete.
5. Chisel all loose material in honeycomb areas until only solid concrete exists. Fill void with grout. Cure 5 days.

TS-6.3.3.3 Pavement: All concrete shall be finished monolithically. No topping or plastering.

Sidewalks and curb and gutter shall receive a light broom finish. See Section TS-8 for finish of Concrete street pavement.

TS-6.3.3.4 Construction Joints: All keyed and other construction joints shall be constructed as shown on the plans. Keyway required unless otherwise shown.

TS-6.4 Curing:

TS-6.4.1 General:

1. All concrete is to be cured a minimum of 5 days after placing and finishing or 5 days after repairing.
2. Protect all concrete surfaces from damage during and after curing period.

TS-6.4.2 Formed Surfaces:

1. Forms are adequate if left in place 5 days.
2. Cover top with 6 mil Polyethylene sheet.
3. If forms are removed to stone finish or repair concrete, cover with polyethylene sheets. Anchor in place.

TS-6.4.3 Walks, Curb and Gutter, and Pavement:

1. Spray liquid membrane (ASTM - AStandard Specifications for Liquid Membrane - Forming Compounds for Curing Concrete@, Designation C-309, current edition).
2. Follow manufacturer=s directions for sprayed liquid membrane.
3. Protect surface from damage.

TS-6.5 Defective Work:

TS-6.5.1 General:

1. Defective concrete work shall be removed and replaced immediately.
2. Work built outside tolerances shall be considered defective.
3. Concrete of inadequate strength or having surface conditions indicating poor durability such as crazing, severe Amap cracking@, crumbling, or other evidence shall be considered defective.
4. Engineer shall be notified immediately when such conditions become apparent.

TS-6.5.2 Repairing:

1. Repairing of minor faults such as small Ahoneycomb@ areas and voids may be patched. Repairs shall be made as described in TS-6.3.3.2 above.
2. Cure patched areas 5 days.

TS-6.6 Joints:

1. Joints shall be constructed as shown on the plans. Unless shown on the plans, joints shall not be constructed unless approved by the Engineer. Where water stop is specified in joint, water stop shall be securely fixed in place to prevent voids or Afoldover@ of water stop. Vibrate around water stop to insure watertight seal with no voids.
2. All construction joints shall be made with canted 2x4 at least 2 2 inches from wall face. All construction joint contact surfaces shall be finished with wood float finish.
3. All horizontal construction joints shall incorporate 2x4 in keyway. Finish

- surface of joints with wood float.
4. Contraction joints shall be sawed to a depth equal to one-quarter of the thickness of the concrete. Unless otherwise indicated on the plans, contraction joints shall be spaced at a maximum distance of 12 feet each way for concrete pavement. Contraction joints shall be at approximately 10 foot intervals. Joints in curb and gutter shall line up with sawed joints in concrete pavement.

TS-7 ASPHALTIC CONCRETE

TS-7.1 General: This work shall consist of the construction of asphaltic concrete base, and surface course as shown on the plans and specified herein.

TS-7.2 Standard Specification: All work of this section shall be in accordance with the referenced portions of Missouri Standard Specifications for Highway Construction@ 1986 Edition published by the Missouri State Highway and Transportation Commission, except as modified here.

TS-7.3 Asphaltic Concrete Base:

TS-7.3.1 Subgrade shall be prepared as specified in Section TS-2.

TS-7.3.2 Material: Materials shall conform to Standard Specifications Section 301.2.

TS-7.3.3 Mixture: The mix shall conform to the requirements of Section 301.3 Asphalt cement content shall be in the range of 3 to 6 percent.

	Marshall Properties
Stability	1200 Min.
Flow	8 to 6

TS-7.3.3.1 Section 301.3.2 shall be changed to read as follows: Prior to preparing any of the mixture on the project, the Contractor shall obtain, in the presence of the Engineer, representative samples of asphaltic cement and mineral aggregates for tests. The samples of material shall be of the size designated by the Engineer and shall be submitted to an approved laboratory for testing. The Contractor shall also submit for the Engineer=s approval, a job-mix formula for each mixture to be supplied for the project. No mixture will be accepted for use until the job-mix formula for the project is approved by the Engineer. The job-mix formula shall be within the master range specified for the particular type of asphaltic concrete, and shall include the type and sources of all materials, the gradations of the aggregates, the relative quantity of each ingredient, and shall state a definite percentage for each sieve fraction of aggregate and for asphaltic cement. No job-mix formula will be approved which does not

permit, within the limits of the master range, the full tolerances specified for asphalt cement and for material passing the No. 200 sieve. The job-mix formula approved for each mixture shall be in effect until modified in writing by the Engineer. When satisfactory results or other conditions make it necessary, or should a source of material be changed, a new job-mix formula may be required. The Engineer may make adjustments in the job-mix formula in order that the mixture meets established criteria of the Marshall mix design. The maximum time a job-mix will be used will be two (2) construction seasons.

TS-7.3.3.2 Omit Section 301.3.6, 301.3.7, 301.3.7.1, and 301.4.

TS-7.3.3.3 Commercial Mixture: A commercial mix may be used if approved by the Engineer. To request approval of a commercial mix, the Contractor shall submit to the Engineer the proposed mix proportions, sources of materials, Marshall properties, and a list of projects on which it has been used.

TS-7.3.4 Construction Requirements:

TS-7.3.4.1 Weather Limitations: Bituminous mixtures shall not be placed (1) when either the air temperature or the temperature of the surface on which the mixture is to be placed is below 40E F. (except that base courses 3 inches or more in thickness may be placed when the air temperature is 35E F.) (2) on any wet or frozen surface, or (3) when weather conditions prevent the proper handling or finishing of the mixture.

Mixture shall not be placed during inclement weather.

TS-7.3.4.2 Asphalt Plant: The asphalt plant or plants shall meet the requirements or Standard Specifications Section 301.6. Plant calibration shall be the sole responsibility of the Contractor.

TS-7.3.4.3 Preparation of the Mixture: Preparation of the mixture shall be in accordance with applicable portions of Standard Specifications Section 404.6.2.1 through 404.6.3. Transportation of the mixture shall conform to Standard Specifications Section 301.8. An adequate number of trucks to provide constant supply of mix to the laying machine shall be used. The location of the plant shall be close enough to the project that excessive cooling does not occur.

The provisions of Standard Specifications 301.9 and 404.6.3 shall be met.

TS-7.3.4.4 Spreading the Mixture: Asphaltic mixtures shall be spread in accordance with Standard Specifications Section 301.9 and 301.9.1.

Allowance shall be made for the slope of the outside edge so that the finished top dimensions match those shown on the plans. The curb and gutter shall be used as a

grade reference for the automatic screed control.

TS-7.3.4.5 Compaction: Rolling shall begin as soon as practicable after the spreading. The Contractor shall submit to the Engineer the rolling system he proposes to use or the compaction of the mixture. Rollers shall be in good condition, capable of operation without backlash. Steel wheel rollers shall be equipped with scrapers. All rollers shall have a functioning water system for moistening each roller or wheel. Base course shall be compacted to 95% of laboratory density. Surface course shall be compacted to 98% of laboratory density.

TS-7.4 Asphaltic Concrete: This work shall consist of asphaltic concrete surface course.

TS-7.4.1 Materials: Material shall conform to the applicable sections of Standard Specifications for Highway Construction, Sections 401, 403, and TS-7.3.3.1 for Grade AC@, Grade AD@ and Type AC@ except as modified hereto.

TS-7.4.2.1 Gradation

Gradation Passing	Max Limit	Desired Gradation	Max Limit	Desired Gradation
	<u>Grade C</u>	<u>Grade C</u>	<u>Grade D</u>	<u>Grade D</u>
:@ sieve	100	100	100	100
2"	80-100	88	95-100	100
No. 4	40-65	52	60-90	70
No. 10	30-55	40	35-65	45
No. 40	8-25	18	10-30	20
No. 200	4-12	8	4-12	8

TS-7.4.2.1 Gradation

NOTE: The gradations of the aggregates will be determined from samples taken from the hot bins.

AType C@

Pass 3/4-inch sieve	100	...
Pass 3/4-inch sieve, retained on 2 -inch sieve	0	3
Pass 2-inch sieve, retained 3/8-inch sieve	0	25
Pass 3/8-inch sieve, retained on No. 4 sieve	20	45
Pass No. 4 sieve, retained on No. 10 sieve	7	20

Pass No. 10 sieve, retained on No. 40 sieve	7	20
Pass No. 40 sieve, retained on No. 80 sieve	5	20
Pass No. 80 sieve, retained on No. 200 sieve	3	18
Pass No. 200 sieve	4	10
Asphalt Cement	3.5	7

TS-7.4.2.2 Aggregate for Asphaltic Concrete: Shall conform to the applicable sections of the Standard Specifications for Highway construction with the additional requirement that supplier shall crush and stockpile 50% of the needed approved aggregates prior to placement of any asphaltic base or pavement.

TS-7.4.3 Construction Requirements: Construction requirements shall be specified in TS-7.3.4 as amended herein.

TS-7.4.3.1 Weather Limitations: Weather limitations shall be as specified in TS-7.3.4.1 except that no asphaltic concrete shall be placed when the temperature of the air or the surface on which the asphalt will be placed is less than 40E F.

TS-7.4.3.2 Spreading: Spreading of the mixture shall be in accordance with Sections TS-7.3.4.4 except that automatic screed control shall not be used on the surface source unless directed by the Engineer.

TS-7.4.3.3 Commercial Mixture: A commercial mixture may be approved for this work in accordance with TS-7.3.3.2.

TS-7.5 Tack Coat: A Tack Coat will be required over all existing pavement to be overlaid and between each lift of the new asphaltic concrete pavement unless the preceding lift has been protected from all dirt and traffic since its placement.

Tack Coat will be placed after cleaning and preparing of the surface is complete. Application rate will generally be 0.10 to 0.15 gallon per square yard as directed by the Engineer. Tack coat material shall be RC-70, SS-1 or SS-111 unless otherwise approved by the Engineer.

There will be no direct payment for tack coat. This work will be considered subsidiary to the asphaltic concrete pavement or base.

TS-7.6 Measurement and Payment: Measurement will be made for the various type of pavement as per the itemized bid form.

Where existing pavement is being overlaid, payment will be for Base Leveling Course per ton and for Surface Course per square yard as shown on plans.

Where all new pavement is to be constructed, payment will be made per square yard of full-depth base and surface course per typical section.

Payment will include all costs of cleaning existing pavement or previously laid lifts and all costs of tack coat.

TS-8 PORTLAND CEMENT CONCRETE PAVEMENT:

TS-8.1 Portland Cement Concrete: The work shall conform to the referenced portions of Missouri Standard Specifications as modified herein.

TS-8.1.1 Materials: Materials shall conform to Section 501.2 of the Standard Specifications as modified herein.

Tinting material as specified in Section 1056 will not be used. 501.2.2 Mix Design.

Delete Section 501.2.2.1 and Section 501.2.2.2.

501.2.2.3 Use Class A sand only. Mix shall contain not less than 6.5 sacks of cement per cubic yard.

501.2.4 Consistency. Delete slump table and paragraph 501.2.4.1.

Hold slump as low as possible to allow proper placement of concrete. Maximum slump for pavement, curb, or curb and gutter shall be 3".

All concrete shall be air entrained in accordance with Section 501.7 including paragraphs 501.7.1 through 501.7.3. Air content shall be between 4% and 7%.

All concrete for curb and gutter and concrete pavement shall contain not less than 6.5 sacks cement per cubic yard.

Actual mix design shall be prepared and submitted by the Contractor to the Engineer for his approval.

Submittal shall include source and properties of all aggregate, source of cement, proportions used, slump, air content and results of breaks of 5 test cylinders. Cylinders shall be broken as follows:

2 at 7 days
3 at 28 days

Prior to starting project, contractor shall obtain in the presence of the Engineer, representative samples of cement, fine and course aggregates for test. The samples of material shall be of the size designated by the Engineer and shall be submitted to an approved laboratory for testing. The Contractor shall submit for the Engineer=s

approval each Job-Mix formula. The maximum time a Job-Mix will be used will be 2 construction seasons.

Minimum compressive strength, based on ASTM designation C-39, C-31, and C-192, 2800 psi at 7 days and 4000 psi at 28 days laboratory cured, 13% less for job cured cylinders.

Concrete may be either central mixed and delivered in approved trucks or may be truck mixed.

Total elapsed time from time of combination of water and cement until all of that batch is placed shall not exceed one hour.

The use of calcium chloride will not be permitted. Other admixtures may be used only if approved by the Engineer.

TS-8.2 Portland Cement Concrete Pavement: This work shall conform to AStandard Specifications@ Section 502 and substitute the following:

TS-8.2.1 Materials: Delete the last sentence of Section 502.2 and substitute the following:

Contractor will conform to the requirements of the preceding section of these specifications.

Delete Sections 502.3.1, 502.3.2, and 502.3.2.1.

Delete Sections 502.3.4, 502.3.5, 502.3.6, and 502.3.7.

Delete Section 502.3.9 through 502.3.13.2.

Section 502.3.16 shall be changed to read as follows:

Auxiliary Equipment shall be available at all times as follows:

- a) Two or more 10-foot straight edges of an approved type. Blades shall be replaced when edges become wavy or warped.
- b) Immediately following the machine floating and while the concrete is still plastic, the contractor shall test the pavement surface for trueness by means of a 10-foot straightedge in contact with the concrete surface parallel to the pavement centerline, and drawing the straightedge lightly across the surface. Advance along the pavement shall be in successive stages of the more than one-half the length of the straightedge. All variations shall be eliminated by filling depressions with freshly mixed concrete or striking off projections, and the areas so corrected shall be consolidated and refinished by means of a long-handled float.

- c) Sufficient burlap, waterproof paper, or plastic film for the protection of the pavement in case of rain or breakdown of curing equipment.
- d) Joint Seal shall conform to Section 1057 of the 1986 Missouri Standard Specifications for Highway Construction.

Hand placement and finishing as specified in Section 502.10.9 will be permitted.

TS-8.2.2 Construction Requirements:

Delivery tickets shall be provided the inspector in accordance with Section TS-6.2.1 of this specification.

Delete Section 502.5.3.

Section 502.6 - Conditioning of Subgrade. References to other sections shall be references to those Sections as amended by these Specifications.

Delete Section 502.7 and paragraph 502.7.1.

Delete Section 502.9 and paragraphs 502.9.1 and 502.9.2. Delete Section 502.10.7 - Station Numbers.

Section 502.10.9 Hand Finishing will be permitted on the project.

502.16 Slip Form Construction. This type of construction will be allowed on this project. The provisions of Section 502.16 and the succeeding paragraphs as amended herein shall apply. References to other sections of the Missouri Highway Specifications shall refer to those sections as modified by these specifications.

502.16.1 Subgrade and Base. Delete all references to aggregate base. Pavement shall be placed on earth subgrade and the paver and check template shall also operate on the subgrade.

Delete Section 502.17 and paragraphs 502.17.1 through 502.17.5.

Cores will not be drilled on this project unless required by the Engineer. This will only be done if doubt as to the actual thickness exists.

Normally edge thickness will be used as a rough check on constructed thickness. Pavement thickness will be considered to be design thickness.

TS-8.2.3 Measurement and Payment shall be in accordance with Sections 502.18 and 502.19 of the Standard Specifications as amended by the following: If cores are taken and the thickness found to be deficient the provisions of 502.19.1 through 502.19.3 shall apply with the exception of Type AA@ curb and gutter (see typical section for end

details and thickness) which shall be measured on the basis of linear feet constructed. Payment shall be continuous through residential drive approaches and shall include the hooking up of existing house drains that now extend to the street.

TS-9 LAWN REPAIR AND SEEDING:

TS-9.1 General: All areas disturbed by the construction shall be seeded or sodded except for paved areas. See plans for areas to be sodded.

TS-9.2 Bluegrass Sodding: Sod shall be planted in accordance with the following requirements.

Sod shall be of the best quality and when placed, shall be live fresh growing grass with sufficient soil adhering to the roots. Sod shall be procured from areas where the soil is fertile and contains a high percentage of loamy topsoil and from areas that are predominately bluegrass and that have been grazed or mowed sufficiently to form a dense turf. Source of soil shall be approved by the Engineer before cutting and harvesting.

The sod shall be transplanted within 24 hours from the time it is harvested unless it is stacked at its destination in a manner satisfactory to the Engineer. All sod in stacks shall be kept moist and protected from exposure to the sun and from freezing. In no event shall more than one week elapse between the time of cutting and planting of the sod.

Before placing or depositing sod on areas to be sodded, all shaping and dressing of the areas shall have been completed to the satisfaction of the Engineer. Top soil as specified in shaping and dressing, commercial fertilizer, grade 12-24-24, shall be applied uniformly at a rate of not less than 350 pounds per acre and harrowed lightly.

Sodding shall follow immediately. After planting, the sod shall be watered and mowed as required until completion and acceptance of the entire work. No sodding shall be done during the period from June 1 to September 1, unless the planting season is extended by the engineer.

TS-9.3 Seeding: After shaping, placing 4" of topsoil, and dressing of areas to be seeded have been approved by the Engineer, a commercial fertilizer, grade 12-24-24, shall be applied at a rate of not less than 350 pounds per acre. The area shall be prepared to receive the seed mixture by using a disc spiker or other suitable implement. Seed shall then be spread at the specified rate by drill, by hand seeder, by billion seeder, or by other approved seeders. Seeding shall not be done during windy weather, or when the ground is frozen, muddy, or otherwise in a non-tillable condition.

An established grass cover shall be provided on all areas requiring seeding. Irrigation, mulching, mowing, and any other operation necessary to provide an acceptable grass cover shall be provided by the contractor at no additional cost to the

Owner.

Seed shall be applied at the rate of 300 pounds per acre. The seed shall be composed of a mixture of 60% ADerby@ Rye grass, 20% creeping fescue, and 20% Bluegrass. Bluegrass may be either Ram I, Touchdown, or Glade.

Seeded areas shall be mulched with straw at a rate of 1.5 tons per acre.

The contractor may at his option and at no additional cost to the Owner, provide sod as specified herein in lieu of seeding in any or all areas required to be seeded.

Protection and Repair: The seeded area shall be free of traffic. If at any time before acceptance becomes gullied or otherwise damaged, or the seeding has been damaged or destroyed, the affected portion shall be repaired to reestablish the specified condition prior to the acceptance of the work.

TS-9.4 Submittals:

TS-9.4.1 The contractor shall furnish certifications in triplicate from the supplier or manufacturer of seeds, sods, fertilizers and all other materials furnished in accordance with the requirements of this Section. The certifications shall state that each material supplied is in accordance with these Specifications and with specifically named state laws and regulations. The certifications shall have attached inspection or test reports of governing state agencies applicable to the lot or lots of material supplied.

TS-9.5 Method of Measurement:

TS-9.5.1 Definition of Grading Limit: The term Agrading limit@ as used in this Article, shall mean any of the following:

- (a) The location of a line determined by the interspection of the cut or fill slopes shown on the Plans with the existing surface, plus allowance for rounding at such intersection as shown on the Plans. During the course of the work the Engineer may direct that the grading limit be elsewhere than as determined by the foregoing, and, in such case, the grading limit will be at the location as directed by the Engineer.
- (b) For structures placed in excavations and for pipes in trenches, five (5) feet outside a vertical plane through the outermost surfaces of the neat lines of such structures or of the pipes.

TS-9.5.2 Seeding: Measurement will be made of the area seeded (horizontal measurement) to the nearest 1/10 acre. Measurement will not be made beyond a line 5 feet outside the

grading limit.

TS-9.5.3 Sodding: Measurement will be made of the areas sodded (slope measurement) to the nearest square yard. Measurement will not be made beyond a line 2 feet outside the grading limit.

TS-9.6 Basis of Payment:

TS-9.6.1 Seeding Sodding: The amount of completed and accepted work, measured as provided shall be paid for at the contract unit price bid per acre for seeding and at the contract unit price bid per square yard for sodding.

TS-10 REINFORCED CONCRETE DOUBLE BOX CULVERTS AND RETAINING WALLS

TS-10.1 General:

These items shall be bid on the lump sum basis to include: the necessary excavation and the disposal of any excess excavation material from the channel to allow construction of the proposed structures and all materials and labor to complete the construction of a 11 x 9 Reinforced Concrete Double Box Culvert and all Retaining Walls according to the plans and specifications.

TS-10.2 Reinforced Steel for Concrete Structures:

All reinforcing steel to be used for this structure shall be deformed bars meeting the requirements of the following: Grade 60 ASTM a 615-70 Deformed Billett Steel Bars Concrete Reinforcement. Reinforcing steel shall be protected from damage at all times. When placed in the work, it shall be free from dirt, oil, paint, grease, loose mills scale, thick rust and other foreign substances. Reinforcement for the top slab shall be held securely in correct position by means of approved metal bar supports and ties. Bars in the top slab shall be tied at each lap or crossings or closer. Care shall be taken to maintain proper clearance between the forms and the reinforcement. The steel shall be tied in correct position and inspected before any concrete is placed. Such inspection will not relieve the contractor of his responsibility for constructing the unit in accordance with the plans.

TS-10.3 Forming:

Forms for concrete shall be built true to the lines and grades designated and be mortar-tight and of sound materials adequate to prevent distortion during the placing and curing of concrete. All concrete shall be formed unless otherwise specified. If during or after placing the concrete, the forms sag or bulge, the concrete affected shall be removed, the forms realigned and new concrete placed. Construction camber to take care of shrinkage or settlement impairing the strength of the structure by the reduction of depth will not be permitted.

The forms shall be designed for a fluid pressure of 150 pounds per cubic foot on horizontal surfaces and 30 pounds per square foot on vertical surfaces for impact and vibration.

- TS-10.3.1 Face Lumber of forms for exposed surfaces of concrete shall present a smooth dressed surface free of loose knots, knot holes, and other defects. The spacing of supports and the thickness of face lumber shall have a minimum nominal thickness of one inch for solid lumber or 5/8 inch for plywood. Form materials shall be placed with horizontal joints. Triangular molding, smooth on three sides and having 3/4 inch width on each of the two form sides, shall be used to bevel all exposed edges of the structure, except where special bevels are shown on the plans.
- TS-10.3.2 Forms Re-used shall be in good condition. Form lumber which is unsatisfactory in any respect shall not be used.
- TS-10.3.3 Design and Construction of Forms permit their removal without damage to the concrete. Cofferdam braces or struts which will extend through any exposed concrete section will not be permitted. Forms under copings and around offsets may be given a draft of not more than one inch per foot to permit removal without damage to the concrete. For narrow walls where access to the bottoms of the forms is not otherwise obtainable, an opening shall be provided so that chips, dirt, sawdust, or other extraneous material may be removed immediately prior to placing concrete.
- TS-10.3.4 Ties and spreaders and all metal appliances used inside of forms to hold them to correct alignment and location shall be so constructed that after removal of forms, the metal may be removed to a depth of at least one inch below the surface of the concrete. Metal tie rods used inside the forms where concrete will have an exposed surface shall be a type which will not produce a cavity at the surface of the concrete greater than 1-1/2 inches in diameter. Bolts and rods used as ties shall not be removed by pulling them through the concrete. Wire ties and pipe spreaders will not be permitted, and metal or wood spreaders which are separate from form ties shall be removed as concrete is being placed. A bolt-through method of supporting forms for massive substructure units may be used with the approval of the Engineer. No form ties shall be embedded in concrete above the roadway surface on bridges.
- TS-10.3.5 Cavities produced by the removal of metal tie rods shall be carefully filled with mortar composed of approximately one part cement to two parts sand. White cement shall be added to the mortar if necessary to obtain the required color. In order to reduce the shrinkage, no mortar shall be placed in the cavities until 45 minutes after the initial mixing. In lieu of the above, any approved non-shrinking, non-staining type of mortar may be used. After the cavities are filled, the surface shall be left smooth, even, and uniform in color and texture. Tie rod cavities in surfaces against which backfill is to be placed shall be filled with mortar or an approved plastic

compound meeting the requirements of Section 1057.3. Patching of tie rod cavities in the interior surfaces of box grinders will not be required.

TS-10.4 Portland Cement Concrete

This item shall conform to the Missouri Standard Specifications for Highway Construction, Class B concrete with a coarse aggregate classification of Gradation D. Osage River Gravel. Fine aggregate shall be Missouri River Sand, Class A.

It shall be a 5.81 bag mix with an air content of four (4) to seven (7) percent.

Finish for bottom slab shall be travel and finish for top slab shall be broom.

TS-10.5 Excavation

The contractor shall be responsible for excavation required to complete the proposed structures in place. The contractor shall establish a sound bedding before pouring the bottom slab and footings.

TS-10.6 Testing of Portland Cement Concrete

The contractor shall perform or have performed the following tests to insure the strength of the structure when completed. Such tests in no way relieve the contractor of his responsibility for the construction of this structure and its acceptance after final inspection. (Payment for this item will be included under the bid item for Double Box.)

TS-10.6.1 Slump Test: Slump Tests shall be taken during each pouring and shall not be less than 2 inches and not more than 4 inches.

TS-10.6.2 Compression Test: Cylinders 6 inches in diameter and 12 inches in height shall be used in determining the compressive strength. The contractor shall make 1 cylinder per 25 cubic yards poured.

TS-11 CRUSHED STONE DRIVEWAYS:

TS-11.1 Crushed stone driveways shall be constructed in accordance with the details on the Plans and with the requirements of Missouri Highway Specifications Section 304 for aggregate base course except that the provisions for measurement and payment therein shall not apply and except as modified in this section.

TS-11.2 Aggregate Type: Type I

TS-11.3 The required thickness may be compared in one layer. Required density of compaction shall be not less than ninety (90) percent.

- TS-11.4 Where practicable, utilize temporary surfacing material as subbase to improve stability of crushed stone drives and to reduce amount of added material required.
- TS-11.5 Crushed stone drives shall be carefully graded to drain.
- TS-11.6 Measurement of crushed stone drives shall be to the nearest 1 square yard.
- TS-11.7 Payment shall be at the unit price bid including all labor, equipment and materials to construct the driveway complete including subgrade preparation.

TS-12 RIP RAP:

- TS-12.1 General: Rip rap shall be furnished where provided on the Plans or where otherwise directed. Rip rap shall be durable limestone meeting the requirements of Missouri Highway Specifications Sections 611.31, 611.32 and 611.33 for Type 2 Rock Blanket. The minimum layer thickness shall be one and one-half (1 2) feet. The surface of rip rap shall be flush with the surrounding finished earth grade and grouted.
- TS-12.2 Inspection: The Contractor shall notify the Engineer of the source of rip rap prior to its delivery in time to permit its inspection.
- TS-12.3 Measurement and Payment: Rip Rap will be measured complete and in place to the nearest square yard of surface area (slope measurement). Payment at the unit price bid will be full compensation for all costs of excavation and furnishing and placing rip rap as shown on the plans and specified herein.

TS-13 ROCK EXCAVATION:

- TS-13.1 General: Should rock be encountered in two or more ledges, each ledge being more than six (6) inches thick and with interlying strata of earth clay, shale, or gravel not more than twelve (12) inches thick in each stratum, the entire volume between the top ledge and bottom of the bottom ledge will be classified as rock. (See Article TS-2 for detail specifications.)
- TS-13.2 Use of Explosives: When explosives are used in the prosecution of work, the Contractor shall use the utmost care to prevent injury to persons and property. All explosives shall be stored and used in a safe manner and in compliance with all existing statutes and ordinances and all places used for such storage shall be marked clearly ADANGEROUS EXPLOSIVES@. The Contractor shall warn all persons in the vicinity of the danger area when explosives are being used. The Contractor shall save the City and its agents, officers, and employees harmless from any claim growing out of the use of such explosives. Removal of any item or material of any

nature by blasting shall be done in such manner and at such time as to avoid damage affecting the integrity of the design and to avoid damage to any new or existing structure included in or adjacent to the work. Unless the plans, special provisions, or the Engineer restricts such operation, it shall be the Contractor's responsibility to determine a method of operation to insure the desired results and the integrity of the completed work. Blasting will not be permitted until a Contractor has obtained prior insurance and has obtained a permit from the City Fire Department.

TS-13.3 Measurement and Payment

Rock excavation shall be bid on unit price per cubic yard and final payment shall be based on field measurement. Rock is defined as being sandstone, limestone, chert, granite, sillstone, quartzite, slate, shale, occurring in its natural undisturbed state, hard and unweathered or similar material in masses more than 1 2 cubic yard in volume, in ledges six (6) inches or more in thickness.

TS-14 SANITARY SEWER ADJUSTMENTS:

TS-14.1 Adjusting and Rebuilding Manholes:

TS-14.1.1 General:

- (a) Each existing storm or sanitary sewer manhole encountered within the grading limits, whether or not shown on the Plans, and which is to be left in service shall be raised or lowered to the new grade and slope.
- (b) All construction work in connection therewith shall be in accordance with the applicable details on the manhole sheet of the drawings. Manhole steps shall be properly reset and spaced. All new construction with brick shall be given a three-fourths (3/4) inch mortar coat on the outside. All new construction with brick or precast concrete shall be given one heavy coat of coal tar paint.
- (c) In areas to be paved or surfaced the work shall be accomplished and protected in such a manner as to not create a traffic hazard and to provide for proper construction and compaction of the sub-grade and pavement adjacent to the manhole.
- (d) Precautions shall be taken to drop no debris into the bottoms of manholes. Any debris so dropped shall be immediately removed to prevent being washed down the sewer line.
- (e) The Contractor shall verify for himself the types of construction of the existing manholes.

TS-14.1.2 Lowering Manholes:

- (a) Wherever possible, the manhole shall be lowered without resetting or rebuilding the cone (this will be classified as AAdjust Manhole to Grade@), utilizing one or both of the following methods:
 - 1. Remove existing straight neck brick or precast concrete ring sections and lower existing cast iron ring and cover.
 - 2. Remove existing cast iron ring and furnish and set shallow type cast iron ring, Type 3, as shown on the Plans, (machined), or equivalent, designed to receive existing cover.
- (b) When the required lowering is greater than can be accomplished as specified in the above subparagraph, the work will be classified as ARebuild Manhole to Grade@, which shall be accomplished by one of the following methods:
 - 1. Precast concrete shall be removed and reset, removing one or more precast concrete rings below the cone, furnishing any necessary shallow depth straight concrete rings below the cone or concrete or cast iron adjusting rings above the cone. The existing cast iron ring and cover shall be reset, or, if necessary, a shallow type ring shall be furnished as specified in Item 2 of sub-paragraph S-14.1.2 (a).
 - 2. Brick cones shall be torn down and rebuilt with brick, using eccentric or concentric cone as required to meet clearance conditions. An eccentric cone is preferred. Taper on walls shall not be more than twelve (12) horizontal to forty (40) vertical. The existing cast iron ring and cover shall be reset, or, if necessary, a shallow type ring shall be furnished as specified in Item 2 of subparagraph S-14.1.2 (a).

TS-14.1.3 Raising Manholes:

- (a) Wherever possible, the manhole shall be raised without resetting or rebuilding the cone. This will be classified as Aadjust Manhole to Grade@. This shall be accomplished by adding adjusting rings of cast iron, precast concrete or brick; or an appropriate combination thereof, and resetting the existing cast iron ring and cover. The maximum allowable height of straightneck section, measured to top of cast iron ring, shall be twenty-one (21) inches unless otherwise directed by the Engineer.
- (b) When the required raising is greater than can be accomplished as specified in the above subparagraph, the work will be classified as ARebuild Manhole to Grade@, which shall be accomplished by one of the following methods:

1. Precast concrete cone shall be removed and reset, adding one or more precast concrete rings below the cone, furnishing any necessary concrete or cast iron adjusting rings above the cone. The existing cast iron ring and cover shall be reset.
2. Brick cones shall be torn down and rebuilt with brick, using eccentric or concentric cone as required to meet clearance conditions. An eccentric cone is preferred. Taper on walls shall not be more than twelve (12) horizontal to forty (40) vertical. The existing cast iron ring and cover shall be reset.

TS-14.1.4 The Contractor shall furnish all materials required for adjusting and rebuilding manholes. Suitable materials salvaged from existing manholes may be reused as needed. If directed to replace any cast iron item found to be unsuitable through no fault of the Contractor, payment for the materials only will be made in accordance with the provisions of Regulations of the Contract Article FC-21.

TS-15 UNDERDRAIN:

TS-15.1 General: The Contractor shall install underdrains where directed. None are shown on the Plans. He shall have an available source of underdrain materials so that they can be quickly obtained when it is determined where and if they are required. However, such materials shall not be ordered until directed by the Engineer. Underdrains shall be installed only at locations as directed by the Engineer.

TS-15.2 Materials:

1. Pipe for Underdrain: Missouri Highway Specifications@ Section 1022, with necessary fittings. Pipe, fittings and shall be fully bituminous coated after fabrication in compliance with the requirements of AASHO M 190. Diameter of perforations after coating shall be not less than one-fourth (3) inch.
2. Aggregate for Underdrain: Natural sand, meeting the requirements for Fine Aggregate, MCIB Section 4.

TS-15.3 Installation:

1. Installation of underdrains shall be in accordance with the details on the Plans, with Missouri Highway Specifications@ Sections 605.11, 605.12.1, 605.13.2, 605.13.3, and 605.13.4, and in accordance with the following items.
2. Underdrains will generally be discharged to the nearest storm sewer pipe or structure or to the nearest ditch. Outlet in storm sewer shall preferably be in

upper two thirds (2/3) of pipe height; in ditches, a minimum of six (6) inches above bottom of ditch.

3. Break into storm sewer or drainage structure and grout underdrain in pipe into as for branch connection as shown on the Plans. Use granular fill beneath underdrain pipe to bottom of storm sewer trench or structure excavation.
4. A section of non-perforated pipe, of length as specified by the Engineer, shall be installed at the outlet end.
5. Seal around underdrain with clay near outlet ends to confine water in the pipe.
6. Aggregate for underdrain shall be compacted to final settlement by ponding.

TS-15.4 Measurement and Payment: Underdrain pipe shall be measured per linear foot complete including trenching, installation, granular fill and backfill.

TS-16 PAVEMENT MARKING:

TS-16.1 Scope: Furnish and apply white and yellow thermoplastic reflectorized pavement marking materials as indicated on the plans.

Cold applied type shall be used for all markings and shall consist of a homogenous, extruded, prefabricated material of specified thickness and width, which shall contain reflective glass spheres uniformly distributed throughout the cross section, and shall be applied to the pavement surface by means of a pre-coated adhesive and pressure.

TS-16.2 Materials:

TS-16.2.1 General:

- a) Materials will be considered only from manufacturers of reflectorized plastic pavement markers and legends, who can submit evidence of successful product use over the past five (5) years, under climatic conditions similar to that of the work location.
- b) Each work and symbol marking shall be supplied with a diagram with each section numbered to correspond with the completed layout.
- c) The plastic marker shall mold itself to pavement contours, breaks and faults, merely by traffic action at normal pavement temperatures. The plastic marker shall have resealing characteristics such that it will fuse with itself and with previously applied markings of the same composition under normal

conditions of use.

TS-16.2.2 Composition Requirements:

- a) As supplied, the plastic without pre-coated adhesive shall not be less than 0.06" in thickness. The edges shall be clear cut and true.
- b) Plastic shall be supplied complete with a pre-coated adhesive and an easily removable backing shall protect the adhesive in storage and facilitate rapid application.
- c) The plastic and its adhesive shall be sufficiently free of tack so that it can be easily handled without the protective backing, and be re-positioned on the surface to which it is to be applied, before permanently fixing it in this position with a downward pressure.

TS-16.2.3 Physical Requirements:

- a) Bend Test: The plastic shall be of such a structure that at a temperature of 80E F., a piece of 3" x 6" (with backing) placed upon a 1" diameter mandrel, may be bent over the mandrel until the end faces are parallel and 1" apart. There shall be no fracture lines apparent in the uppermost surface by visual inspection.
- b) Reseal Test: The plastic shall reseal to itself when tested as specified. Cut 1" x 3" pieces of plastic. Overlap these pieces face to face for an area of 1 sq. in. on a flat steel plate, with the backing material remaining in place. Center a 1,000 gram weight over the 1 sq. in. overlap area, and place in an oven at 190E ∇ 10E F. for two (2) hours. After cooling to room temperature, the pieces shall not be separable with tearing.
- c) Glass Sphere Retention: The plastic shall have glass sphere retention qualities. A 2" x 6" specimen of plastic shall be cut at a right angle to the beveled edge and bent parallel to the beveled edge of a 2" mandrel. While the specimen is bent, a strip of 2" wide masking tape (such as Utilitape, manufactured by Permacel) shall be applied firmly along the length of the area of maximum bend and then removed. Should any glass spheres remain on the masking tape when the strip is removed, the sample shall be rejected.
- d) Skid Resistance: The surface friction of properties of the plastic shall not be less than 35 B.P.N., when tested according to ASTM E-303-66T.
- e) Lateral Shock Load Test: A 3" x 6" plastic panel shall be applied to a 3" x 6" piece of carborundum extra coarse emery cloth, or its equivalent, so that 3" x 3" overlap occurs. The application shall be such that a pressure of 50 p.s.i. is

placed on the panel for 30 seconds. The overlap ends shall each be clamped with one end in a fixed position; a sudden load of 50 lbs. shall be applied vertically to the other end. Upon immediate load release and examination, there shall be no noticeable slipping or fracture of the adhesive coating. This test shall be conducted at a temperature of between 70E F. and 80E F.

- f) Adhesive Shear Strength: Specimens shall be tested according to the method described in ASTM D-638-61T as modified to test the adhesive shear strength. The samples shall be prepared as follows: Plastic samples cut as described in paragraph 207-3.3(i), shall have applied to the adhesive face a 1" x 3" piece of carborundum, extra coarse emery cloth, or its equivalent, so that there is 1 sq. in. overlap at one end of the plastic specimens. A pressure of 50 p.s.i. shall be applied over this area of a period of 30 seconds. Load shall be applied by gripping each end of the test piece in a suitable tensile test machine such as a Dillon or Scott Tester. The average of the load required to break the adhesive bond shall not be less than 10 lbs. The speed of testing shall be 0.25" per minute. The test shall be conducted at a temperature of between 70E F. and 80E F.

TS-16.3 Submittals:

The Contractor shall furnish a manufacturer's certification, in triplicate, attesting that all materials supplied conform to the requirements of these Specifications. The certification shall include, or have attached, specific results of laboratory tests for the specified physical and chemical properties as determined from samples representative of the lot or lots of thermoplastic compound, glass spheres and reflectorized plastic marker material supplied.

TS-16.4 Measuring and Premarking:

The Contractor shall do all measuring and pre-marking required for application of the pavement markings.

TS-16.5.1 Application Requirements:

Cold applied thermoplastic materials shall be applied to clear, dry pavement surfaces, free of dirt and foreign matter, by removing the release paper and placing the plastic on the surface with continuous pressure for a period of about 30 seconds, then permitting traffic to pass over it. The pavement temperature shall be 60E F. or over, unless special instructions are supplied by the manufacturer for application at temperatures below 60E F.

TS-16.5.2 The manufacturer shall supply detailed information concerning any special application procedures. Any necessary activators for the adhesives or various special

coatings for different pavement surfaces shall be supplied.

TS-16.6 Method of Measurement:

Measurements of the marking are given on the plans for informational use only.

TS-16.7 Basis of Payment:

Payment for pavement markings will be made at the contract lump sum bid price and shall include all material, labor and incidental items necessary to complete the work as shown on the plans.

TS-17 OMITTED

TS-18 TRAFFIC SIGNALS:

TS-18.1 General: All traffic control signal equipment, materials and construction methods relating thereto shall conform to Section 902, Traffic Signals of Missouri Standard Specifications for Highway Construction, 1986, except as amended by the additions, deletions, and substitutions of this Article. Where any section of the Missouri Specifications is so modified, the unaltered provisions shall remain in effect. Whenever this Technical Specification shall conflict with the Plans, or the Missouri Standard Specifications, these Technical Specifications shall govern.

TS-18.2 Scope: The work of this section shall consist of furnishing and installing traffic control signal equipment and materials as shown on the plans, as set out in these Technical Specifications and as directed by the Owner's authorized representative(s) to result in a complete and finished job.

TS-18.3 Section 902.3, Materials, of the Missouri Standard Specifications for Highway Construction is modified by adding the following paragraphs:

A. Section 902.3.5.1, Multi-Conductor Cable, shall be amended by the addition of the following:

1) As an acceptable alternate the Contractor may use multiconductor cable meeting the requirements of International Municipal Signal Association, Inc. Specification No. 19-1 (1967) for Polyethylene-Insulated, Polyvinyl Chloride Jacketed Signal Cable.

B. Section 902.3.5.3, Induction Loop Detector Cable, shall be replaced by the following:

- 1) Induction loop detector cable shall be No. 14 AWG, THWN or THHN, soft drawn, stranded copper wire encased in a 1/4-inch OD vinyl tube with a minimum wall thickness of 1/32-inch.

TS-18.4 Section 902.4, AEquipment@, of the Missouri Standard Specifications for Highway Construction is modified by adding the following paragraphs:

A. Section 902.4.1, ASignal Heads@ shall be amended by adding the following:

- 1) The housing, signal hardware, visors, louvers, and lenses may also be polycarbonate.
- 2) Lamps for signal section optical units shall be furnished by the Contractor as follows:

Lamps for 12-inch lenses shall be 150 watts. All other lamps shall be clear 116 watts.

Signal lamps shall be minimum life rating of 8,000 hours, guaranteed by the manufacturer.

Horizontally mounted lamps shall be installed with the open segment of the filament up.

B. Section 902.4.4, APower Supply Assembly@, shall be amended by adding the following:

1. The circuit breaker cabinet as detailed on the Plans for the power supply assembly shall be installed on the existing wood poles as shown on the Plans.

TS-18.5 Section 902.5 AConstruction Requirements@, of the Missouri Standard Specifications for Highway Construction shall be amended by adding the following:

A. Section 902.5.1, APull Boxes and Junction Boxes@, shall be amended by the addition of the following:

1. Concrete pipe, meeting ASSHO Specification Designation M86 for non-reinforced or M170 Class III for reinforced of suitable length and diameter, and provide with cable hooks, may be substituted for other types of pull boxes with the approval of the Owner=s authorized representative(s).
2. Expansion Cast ABS (Acrylonitrile-Butadiene Styrene) thermoplastic

Manhole Rings and Lock Covers shall specifically not be allowed on this project.

3. Delete subsection 902.5.1.4.
 4. Junction boxes shall be installed at locations shown on the Plans. They shall be of the sizes and designs as shown on the Plans.
 5. The Contractor, at his option, may submit in writing to the Owner, pull box or junction box designs with materials, shapes, and dimensions deviating from those required by the plans and specifications for possible use on this project. The submittal and approval must be completed prior to including such deviating designs in the construction bid.
- B. Section 902.5.3, AConduit System@, shall be amended by the addition of the following:
1. Polyvinyl chloride pipe schedule 40, UL approved, may be used in lieu of rigid steel pipe.
- C. Section 902.5.7, AWiring@, shall be amended by adding the following:
1. The detector loop wire shall normally be No. 14 AWG, THWN, Stranded of a continuous length from the spliced connection to the pair of shielded conductors in the lead-in cable. The splices will be permitted in the length of loop wire beyond the lead-in cable spliced or controller terminal when the loop wire is connected directly to the controller terminals. The loop wire shall be protected by a flexible vinyl plastic tubing of 3/16 inch ID, a minimum of 1/32 inch wall, 1/4 inch OD. The tubing shall be capable of resisting deterioration from oils and solvents. The tubing shall also be highly abrasion resistant and have a smooth bore. The wire shall be inserted into the vinyl plastic and placed into the slot with the number of turns as shown on the plans, or as directed by the Engineer. The tubing shall be of continuous length from the point of splicing of the loop wire to the lead-in cable. No splices will be made in the tubing.
 2. At the time of placing the loop wire in the sawed slots, the ends of the tubing shall be sealed to prevent any entrance of moisture into the tubing.
 3. All lengths of loop wires and tubing that is not imbedded in the pavement shall be twisted with at least 5 turns per foot, including lengths in conduits and handholes.

4. The electrical splice between the loop lead-in to the controller and the loop wire shall also consist of providing a watertight protective covering for the spliced wires, the shielding on the loop lead-ins, and the end of the tubing containing the loop wires. The splice shall be made by the following method:
 - a. Remove all lead-in cable coverings leaving four (4) inches insulated wire exposed.
 - b. Remove the insulation from each conductor of a pair of lead-in cable conductors for one-half (2) inch and scrape both copper conductors with knife until bright.
 - c. Remove the plastic tubing from the loop wires for one and one-half (1 2) inches.
 - d. Remove the insulation from the loop wires for one half (2) inch and scrape both copper conductors with knife until bright.
 - e. The conductors shall be connected by twisting together, soldering and covered with a screw-on wire connector.
 - f. Center all conductors in a splicing mold. The mold shall be approved by the Engineer.
 - g. Position the spliced wires in the center of the mold and fill the mold with a sealant or epoxy-type resign. The sealant or epoxy-type resin used must be approved by the Engineer.
 - h. Cover the exposed shielding, ground wire and end of any unused loop lead-in where the sheathing was cut, by liquid silicone rubber. Apply Butyl Rubber Polymer Tape sealant between the wires and completely cover the silicone rubber.
5. External surge protection is required on each loop detector which will meet or exceed the following requirements:
 - a. Unit must be a three terminal device capable of protecting the detector against differential (between the loop loads) surges, and against common mode (between leads and ground) surges.
 - b. Unit must be of the inductive type with a maximum DC resistance of 150 milliohms.

- c. Unit inductance must be at least 4 millihenries.
 - d. Unit must withstand repeated 400 ampere surges.
 - e. Unit must be a two stage device capable of clamping a 250 ampere surge to 20 volts within 40 nanoseconds. Surge applied across the two detector leads.
 - f. Unit must clamp a 250 ampere common mode (between leads and ground) surge to 20 volts.
6. The controller cabinet must be furnished with a surge arrestor on the AC service which meets or exceeds the following requirements:
- a. Unit must be capable of withstanding repeated 20,000 ampere surges (minimum of 25).
 - b. Unit must have internal follow-current limiters (resistive elements).
 - c. Unit must contain 3 active clamping stages minimum.
 - d. Unit must self-extinguish within 8.3 milliseconds after trailing edge of surge.
 - e. Parallel impedance of 1 limiters must be less than .15 ohms.
- D Section 902.5.10, APainting@, shall be amended as follows:
- 1. All exterior metal parts of the signal heads, including mounting brackets and other hardware, except door fronts, inside and outside of visors, louvers, and backplates, shall be primed and painted with a standard Federal Yellow enamel. Door fronts, inside and outside of visors, louvers, and backplates shall be painted flat black and in their entirety, except backplates constructed from black thermoplastic material.
 - 2. Polycarbonate components, if used, shall be the same color as specified for painted metal parts.

1. During the course of signal installation and until the signals are placed in operation, signal faces shall be covered or turned away from approaching traffic. When ready for operation, they shall be securely fastened into position facing toward approaching traffic. After the signal installation is complete, the Contractor may put the signal in operation for test purposes only. However, the signal shall not be put into permanent operation until authorization is given by the Owner=s authorized representative(s).
 - a. When the Contractor is certain the traffic signal controller and control accessories are working properly, and all signal equipment is properly installed, he shall make an inspection appointment with the Owner=s authorized representative(s).
 - b. After a thorough inspection of the signal equipment and installation, the Owner=s authorized representative(s) may authorize the Contractor to put the signal into permanent operation. This authorization will be given if all signal equipment is working properly, or if public safety and convenience warrants the operation of the signal before all corrections have been made.
 - c. A written communication confirming the permanent signal operation authorization and the findings of the inspection shall be prepared by the Owner=s authorized representative(s). The findings of the inspection may include the acceptance and approval of the signal or a list of signal or a list of signal deficiencies to be corrected.
 - d. If the inspection finding contain a list of signal deficiencies, the Contractor shall correct them as soon as possible. If the signal must be put on flashing operation or completely shut down to make the necessary correction, the Contractor must receive authorization from the Owner=s authorized representative(s) before this action is taken.

When the Contractor is certain all corrections have ben made he shall again make an inspection appointment with the Owner=s authorized representative(s). After the final inspection of the signal, a written communication confirming the acceptance and approval of the signal shall be sent to the Contractor by the Owner=s authorized representative(s) at the end of the 15 consecutive days of operation of said equipment.

TS-18.7 Guarantee and Maintenance:

1. General:
 - a. The Contractor is required, until the end of the one year guarantee period covered by the Performance and Guarantee Bond to:

1. Guarantee all traffic control signals against defective equipment, materials, and workmanship.
 2. Maintain all traffic control signals in connection with specific items enumerated in paragraph TS-14.7.2.
 - b. This requirement applies to all traffic control signals under this contract.
 - c. The intent is that at the end of the one (1) year guarantee period the Owner will have properly operating and serviceable traffic control signals; that defective equipment, materials and workmanship will have been corrected; and that any necessary maintenance in connection with specific items enumerated in paragraph TS-14.7.2 whether or not due to defects in Contractor=s materials and workmanship, will have been accomplished. All materials and installation for such work will be a the Contractor=s expense.
2. Conditions Requiring Corrections: Any adverse conditions which affect the use, function, operation, quality or life of the traffic control signals shall be corrected, including the following:
- a. Traffic control signal equipment malfunctions; including, but not limited to the following: signal controller malfunctions; vehicular and pedestrian detector malfunction; electrical cable malfunctions; and failure of traffic signal units, poles and mast arms; which affect the function and safe operation of the traffic control signals.
 - b. Exclusions: The following conditions are excluded and are not considered the responsibility of the Contractor.
 1. Traffic signal lamp replacement due to lamp burn-out.
 2. Damage to traffic control signal equipment and materials resulting from acts of vandalism, traffic accidents, natural disasters, or street cuts or excavation within the right-of-way of others.
3. General Requirements for Corrective and Maintenance Work:
- a. All corrective and maintenance work shall be done promptly upon notification by the Owner in order to prevent unnecessary inconvenience to the traveling public and to minimize traffic safety hazards.

- b. All work shall be in accordance with these specifications and the highest standards and methods of the traffic control signal industry. The Contractor shall submit his proposed methods and designation of equipment and materials to the Owner, for approval in advance of such work.

TS-18.8 Submittals: The Contractor shall furnish, in triplicate, a list of equipment and materials to be installed, showing name of manufacturer, catalog or descriptive data, and shall furnish manufacturer=s certifications, in triplicate attesting that all materials supplied conform to the requirements of these Specifications.

TS-18.9 Field Layout: All work covered by this Section shall be done to the lines shown on the Plans or as directed by the Owner=s authorized representative(s). The Contractor shall be responsible for all field layout work subject the approval of the Owner=s authorized representative(s).

TS-18.10 Method of Measurement: Method of Measurement shall conform to Section 902.8, Method of Measurement, of the 1986 Missouri Standard Specifications for Highway Construction.

TS-18.11 Basis of Payment: Accepted traffic control signals, measured as provided, shall be paid for at the Contract unit price for each of the pay items included in the Proposal. No direct payment shall be made for any incidental items necessary to complete the work unless specifically provided as a pay item in the Contract.

TS-19 OMITTED

TS-20 FENCING

TS-20.1. Removal and Re-setting Fence: Wherever existing fences lie within the construction limits or wherever shown on the plans, the Contractor shall remove and store the fencing during the construction of that portion of the project that is in conflict with the fence.

The Contractor shall take care not to damage the fencing materials during this operation and shall be fully responsible for any damage to the fencing materials caused by his operations.

Any damaged materials shall be replaced by the Contractor and at his sole expense with new material equal to that from which the fence was constructed.

The fence shall be reconstructed in accordance with best accepted fencing practices. All posts shall be cleaned of existing concrete and re-set in concrete.

Prior to removing any fence the Contractor shall contact the property owners so that they may take necessary steps to confine any animals or children normally kept within the fence.

It may be necessary for the Contractor to erect temporary fencing during the period between the actual construction and the re-setting of the permanent fence. Wherever this is necessary so that the property owner can retain normal use of his yard, the Contractor shall provide and erect such temporary fencing at no cost to the Owner.

Removal and re-setting of fence will be paid for at the unit price bid per linear foot.

TS-20.2 Temporary Fencing Wherever permanent fencing that is used to contain small children or animals must be removed to accommodate construction, the Contractor shall erect temporary fencing suitable to perform the function of the permanent fence until the permanent fence can be restored.

The construction of the temporary fencing shall be coordinated with the property owner to cause as little inconvenience as possible. In no case shall such area be left unfenced over a weekend or for more than one weekday.

At the Contractor=s option, materials from the existing fence may be used for the temporary fencing. However, the Contractor will be fully responsible for restoring the permanent fence in condition at least equal to that prior to construction.

Temporary fencing will be subsidiary to the other items of construction.

TS-21 CERTIFICATES OF COMPLIANCE:

TS-21.1 General:

- a. The Contractor shall submit, in triplicate, certificates of compliance from manufacturers, producers fabricators and suppliers of items to be incorporated in the work attesting that all items and materials supplied in connection with the work conform to the requirements of the Specifications, as provided in the various sections of these Specifications.
- b. Whenever the items so certified deviate from the requirements of the Specifications, Plans and other Contract Documents, then the Contractor shall point out such deviation in the letter of transmittal. Unless this procedure is followed and such deviations are specifically approved by the Engineer in writing, then the Engineer=s approval of such certifications will not constitute approval of the deviations.
- c. Said certificates may be accepted by the Owner and Engineer as adequate

evidence of compliance with the Contract Documents. However, at its option, the Owner may test any or all of said items for compliance. If found to be in compliance with the Contract Documents, the cost of testing will be borne by the Owner. If found to be not in compliance, the Contractor shall pay for such testing.

TS-21.2 Requirements For Certifications, Shop Drawings and Testing:

- a. Specific requirements for certifications, shop drawings and testing are given in the following subparagraphs.
- b. Manufactured items, as follows, will require certificates of compliance, with shop drawings, catalog data or installation instructions where so indicated.
 1. Reinforced concrete pipe, fittings and specials. (Shop drawings required for all fittings and specials, including branch connections, and riser manholes.)
 2. Joint materials for reinforced concrete pipe.
 3. Corrugated metal pipe and underdrain pipe, fittings and specials (Shop drawings required for same items as in item 1 above).
 4. Ductile iron, cast iron, vitrified clay and copper pipe and fittings.
 5. Brick and mortar.
 6. Precast concrete manholes and inlets.
 7. Reinforcing steel and welded wire fabric.
 8. Metal work (Shop drawings required for fabricated items).
 9. Iron castings.
 10. Seed.
 11. Sod (considered as manufactured material for compliance purposes). Engineer shall be given the opportunity to inspect and field prior to delivery to project.
 12. Fertilizer.
 13. Gabion baskets.

- 14. Fibercloth.
- c. Rock and sand products will require certificates of compliance, as follows:
 - 1. Stone for gabion fill.
- d. Backfill: It is recognized that, due to mixing of types of materials found in City construction, it may sometimes be difficult to correlate actual performance with test results. The Engineer may make notations of waiver on certain field moisture-density test reports when, in his judgment, the Specification requirements have been met on the basis of visual inspection and the test reports do not truly indicate the field condition. However, the Contractor will be fully responsible for settlement of backfill as provided in Special Conditions Article SC-3.
- e. Concrete:
 - 1. The actual mix proportions shall be determined by the Contractor, based on satisfactory experience with the proposed materials and MCIB mix. Mix proportions, typical test reports and complete data on materials and plant, supporting their acceptability under the Specifications, shall be submitted to the Engineer in triplicate for concurrence before beginning concrete work.
 - 2. Acceptance of Concrete for strength shall be as stipulated in Article 5.02 of MCIB Section 5.
 - 3. Air content shall be measured in accordance with the requirements of ASTM C 173.
 - 4. Visual inspections and tests for performance of concrete may be made by the Engineer to satisfy himself that consistency, air content, minimum compressive strength, materials, gradation and cement content are in compliance with Specifications. Such inspections and tests will be in accordance with MCIB Bulletin No. 6, AConcrete Inspection@ and the applicable parts of MCIB Section 5, AConcrete Mix Design Tables@.
- f. Asphaltic Concrete Mix: The provisions of Item 1 of Subparagraph S-21.4 (e) shall apply to asphaltic concrete mix, except delete the reference to AMCIB@.

TS-21.3 Payment: No payment can be made to the Contractor unless the City is in receipt of Certificates of Compliance for all materials installed to date.

TS-22 SCHEDULE OF WORK

- TS-22.1 General: Scheduling shall provide for the least practical inconvenience to the traveling public and to residents along the project.
- TS-22.2 Submission and Concurrence: Before work is started, the Contractor shall prepare a detailed schedule of all construction operations that shall not only indicate the sequence of the work but also the time of starting and completion of each part. The schedule shall be submitted to the Engineer for his concurrence.
- TS-22.3 Winter Shut Down: If the project is shut down over a winter, the area shall be left in a safe, passable, and accessible condition for the winter. The Contractor shall maintain traffic and access over the winter shutdown as provided in paragraph S-23.2. The Contractor shall maintain the project over the winter shutdown period in such manner that there will be no undue hardship or inconveniences to the neighborhood residents or traveling public. Manholes and valve boxes projecting above the base shall be ramped with temporary bituminous cold-mix or asphaltic concrete in order to facilitate the City=s snow plowing. Access shall be provided to all houses.

TS-23 MAINTENANCE OF TRAFFIC AND ACCESS:

- TS-23.1 General: The Contractor shall conduct his work so as to interfere as little as possible with public travel, whether vehicular or pedestrian. Whenever it is necessary to cross, obstruct, or close roads, driveways and walks, whether public or private, the Contractor shall, at his own expense, provide and maintain suitable and safe bridges, detours, or other temporary expedients for the accommodation of public and private travel, and shall give reasonable notice to owners of private drives before interfering with them; provided, however, that such maintenance of traffic will not be required at any point where the Contractor has obtained permission from the owner and tenant of private property, or from the authority having jurisdiction over public property involved, to obstruct traffic at any designated point thereon and for the duration of whatever period of time as may be agreed upon.

The Contractor will be required to make provisions for or maintain local traffic. He will be expected to make reasonable effort to provide access to all drives whenever possible, and particularly when work is not in progress. He shall provide for emergency vehicle access to any point at all times.

The Contractor shall present a work schedule and a plan for handling traffic for review before commencing any work.

- TS-23.2 When Work Not In Progress: The work shall be cleaned up at the end of each working day, and temporary surfacing shall be placed such that access will be had to all driveways during the night, weekends, holidays, and other days when work is not

in progress and when the stage of the work does not directly interfere with the drive. The Engineer, at his discretion, may grant short-term exceptions to this requirement in connection with preparing sub-grade and paving.

TS-23.3 Contact Person: The Contractor shall designate a person (with phone number) who can be called by the City during the night, weekends, holidays, and other days when work is not in progress. The Contractor will be responsible, through this person, for making such temporary repairs during said periods as may be needed to meet the requirements of paragraph S-23.2.

TS-23.4 The provisions of MUTCD, Part VI, apply to this Contract.

TS-24 TEMPORARY SURFACING

Where required to provide access and when directed by the Engineer, the Contractor shall provide temporary surfacing either of Crushed Stone for Temporary Surfacing or of Asphaltic Concrete for Temporary Surfacing as directed by the Engineer. Such temporary pavements shall be maintained by the Contractor in a safe, reasonably smooth condition as long as they are in use. Crushed stone for temporary surfacing shall meet the requirements of paragraph 1007.2 of Missouri Highway Specifications for Type 2 Aggregate, Gradation A unless the Engineer agrees to a different gradation because of site conditions. Asphaltic concrete for temporary surfacing shall be Type 1 base as specified in Article 23.

Payment for temporary surfacing shall be at the unit price bid per ton of material. Measurement will be on the basis of delivery tickets.

TS-25 DUST CONTROL

Adequate precaution shall be taken to insure that excessive dust does not become airborne during construction. The Contractor shall comply with any regulations of the Missouri Air Conservation Commission or federal government which apply to this matter in the geographical area of the work. The determination as to whether excessive dust is becoming airborne shall be by the Engineer. When directed by the Engineer, the Contractor shall take appropriate dust control measures satisfactory to the Engineer. No separate payment will be made for performing dust control or for applying water for this purpose.

TS-26 PROPERTY CORNERS AND MONUMENTATION:

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

TS-27 CLEANUP:

TS-27.1 The Contractor shall not allow the site of the work to become littered with trash and waste material, but shall maintain the site in a neat and orderly condition during the progress of the work. The Contractor shall, as directed by the Engineer, remove from all public and private property, at his own expense, all temporary structures, rubbish and waste materials resulting from his operation.

TS-27.2 The Contractor shall open and clean all existing ditches and culverts within the right-of-way and easements, leaving them free from all excess mud or silt, drift, brush, or debris of any kind prior to final acceptance. The Contractor shall clean up all dirt from paved surfaces, not allowing same to pack on the roadway or create a traffic nuisance. No direct payment will be made for work within the scope of this Article.

TS-28 TRAFFIC SIGNS, STOP SIGNS, AND STREET SIGNS:

All existing traffic signs, stop signs and street signs in the way of the work shall be carefully removed by the Contractor in accordance with the requirements of MUTCD. The required function of stop signs shall be preserved by the contractor whenever a street is open to traffic. All signs shall be re-installed following the construction. No separate payment will be made for this work.

TS-29 DOWNSPOUT DRAINS:

TS-29.1 General: This work shall include connecting existing downspout drains through and into the proposed curb, curb and gutter, or storm sewer facility. The location of some downspout drains may be shown on the plans, but other drains may exist that are not shown. The contractors shall be responsible to connect all downspout drains regardless of whether they are shown on the plans.

TS-29.2 Construction Methods: The contractor shall exercise care in removing existing facilities so as to minimize damage to existing drains. Generally, new material of the same diameter as the existing drain shall be used.

As approved by the owner, the removed pipe may be cleaned and re-used.

TS-29.3 No Direct Payment: All work associated with connecting downspout drains through or into the proposed curb, curb and gutter, or storm sewer facility shall be subsidiary to the item to which it is connected. No direct payment will be made.

TS-30 SUBSIDIARY ITEMS:

There are small items of work specified herein or that are incidental to the other construction for which no bid items are given. These items and any item for which no bid item is given shall be considered subsidiary and their cost shall be included in the bid price of other related items of work.

