CITY OF Tulsa
A New Kind of Energy.

Design Engineering
MEMORANDUM

DATE: May 9, 2019

TO: Paul Zachary, Engineering Services Department Director

FROM: Henry Som de Cerff, Design Manager

SUBJECT: Standards and Specifications for Sanitary Sewer Pipe

The Specification Review Committee recommends and asks the Engineering Services Department Director to approve the following:

1. Modification to Section 203.1.6 to exclude ductile iron pipe from gravity sanitary sewer use except by Engineering Director approval only.

2. Modification to Section 205 to exclude concrete pipe from sanitary sewer use.

3. Modification to Section 208 to exclude SDR-35 PVC from use and make a maximum required standard dimension ratio (SDR) for PVC gravity sanitary sewer pipe of 26. SDR-26 pipe is no longer restricted from use under pavement or locations adjacent to arterial streets provided the installation meets the requirements of Standard Detail Numbers 351 and 713 and Standard Drawing Numbers 730, 731 and 733.

4. Modification to Section 302.3 for bedding and compaction requirements.

5. Modification to Section 310 for requirement of Marking Tape for PVC sewer pipe.

6. Modification to Section 313 requiring all gravity sewer pipe to be tested for leakage for acceptance.

7. Revisions to Standard Detail Numbers 351 and 713 and Standard Drawing Numbers 730, 731 and 733 corresponding to modifications above are enclosed.

Please call me at (918) 596-7355 if you have any questions.

Thank you.

APPROVED:

Paul Zachary, Director

06.26.19
Date

Cc: Engineering Services Department Specification Review Committee

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DIVISION II
MATERIAL SPECIFICATIONS
APPROVED FITTINGS MANUFACTURERS

Tapping Saddles and Valves
Mueller (DIP)
Clow (DIP)
American (DIP)
Tyler (DIP)
PowerSeal (DIP)
Smith-Blair (DIP)
Hanson Concrete (Conc)
Price Bros (Conc)
TD Williamson (Conc)
Baker Series 428 (Steel)
Rockwell 622 (Steel)
Dresser (DIP)
Ford (DIP)
JCM Industries

Restrained Joint Systems
American Flex-Ring (DIP)
EBAA Megalug (DIP,PVC)
Ford Meter Box Uni-Flange (DIP,PVC)
Star StarGrip (DIP,PVC)
Price Snap Ring & Harness Joint (Conc)
Hanson Snap Ring & Harness Joint (Conc)
Northwest weld (Steel)
Hanson weld (Steel)
USPipe TR Flex (DIP grav sanit, water)
Griffin SNAP-LOK (DIP grav sanit, water)
McWane THRUST-LOCK (DIP grav sanit, water)
Smith-Blair CAM-LOCK
Clow TUFGrip
Sigma Corporation ONE-LOK Series (DIP)

Resilient Wedged Gate Valves
American
Mueller (Aquagrip allowed)
M&H
Clow
Kennedy
US Pipe
AVK

Ball Valves
Pratt

Couplings for Out-of-Round CI Pipe
Viking-Johnson
Smith-Blair
Straub

Check Valves
M&H
American Flow Control
Mueller
US Pipe
Clow
Kennedy
Watts
ValMatic

4-Way Fire Hydrants
American Darling
Mueller (Aquagrip allowed)

3-Way Hydrants
American Darling B84B
Kennedy Guardian
Mueller Centurian (Aquagrip allowed)
Clow Medallion

Valve Boxes
(Includes Debris Cap)
Tyler 6850 Series 562-S
East Jordan 85502737 (562-S)
SIGMA VB 262-35
Star VB 562SHD

4" Reversible Rim & 23 ¼" Lids (Water)
Neenah 1797-4R-TUL-WAT
Deeter 1155-TUL-WAT
East Jordan 2132R-TUL-WAT
Sigma MH121WV-35

Uniflanges
EBAA Series 2100 Megaflange

1 ½" & 2" Meter Setters

Ford B-C10046-011 (1 ½"), B-C10046-013(2")
Mueller 1 ½"x15"B2423, 2"x15"B2423
AYMcDonald 20C615WFFF6654 (1 ½")
AYMcDonald 20C715WGFF7766x22.75 (2")

Air Relief Valves (Water)

APCO
Crispin
ValMatic
A.R.I

Air Relief Valves (Sanitary Sewer)

A.R.I

Butterfly Valves

Pratt
Mueller

Manhole Grade Adjustment Rings

East Jordan V-1901 series (CI only)
Deeter 1856 (CI only)

Chimney Adjustment Rings

GNC Concrete Products (Concrete)
Ladtech (HDPE)

Fittings

American
Griffin
McWane
Clow
Star
Sigma
US Pipe
Tyler
East Jordan
Pipeline Components (PCI)

4" Reversible Rim & 23 ¼" Lids (Stm)

(Only McGard system allowed for sealed lids)
Neenah 1797-4R-TUL-STM
Deeter 1155-TUL-STM
East Jordan 2132R-TUL-STM
Sigma MH121TW-35

4" Reversible Rim & 23 ¼" Lids (San)

(Only McGard system allowed for sealed lids)
Neenah 1797-4R-TUL-SAN
Deeter 1155-TUL-SAN
East Jordan 2132R-TUL-SAN
Sigma MH121N-35

8" Non-Reversible Rim & 23 1/4" Lid (San)

(Only McGard system allowed for sealed lids)
Deeter 1265-TUL-SAN
Neenah 1797-TUL-SAN
East Jordan 2132-TUL-SAN
Sigma MH122N-35

4" Reversible Rim & 31 ½" Lid (San)

(Only McGard system allowed for sealed lids)
Deeter 1296-R-TUL-SAN
East Jordan 2230-R-TUL-SAN
Sigma MH123N-35

8" Non-Rev Rim & 23 ¼" Lid (Stm)

(Only McGard system allowed for sealed lids)
Deeter 1265-TUL-STM
Neenah 1797-TUL-STM
East Jordan 2132-TUL-STM
Sigma MH122T-35

4" Reversible Rim & 31 ½" Lid (Stm)

(Only McGard system allowed for sealed lids)
Deeter 1296-R-TUL-STM
East Jordan 2230-R-TUL-STM
Sigma MH123T-35

Cast Iron Curb Inlet – 6" Barrier

Deeter 2445
East Jordan 00760065
Neenah R-3076-6BOK

Lampholes (with closed pickhole)

East Jordan 3312800lid/3342800frame
Deeter 1828
Deeter 1828-B (Bolted Ring & Cover)

Vane Grates–"Drain to River" with "COT"

Neenah 3076-3000
East Jordan 00760033

Type "D" 27 7/8" Circular Grate
Deeter 1950
East Jordan 00210032

Bicycle Safe 17 ¾"x29 ¾" Grate
Neenah 3076-0015
EJ 44230231grate/FA1833032G0frame

Bolted Bicycle Safe Trench Grate
Neenah 3076-0019
East Jordan 00697033

Solid Knobby Frame/ 27 7/8" Circular Lid
Deeter 1159 Frame /1159 Lid
Neenah 1682-0001 Frame/R1682 Solid Lid
East Jordan 00210002

Vertical Standard Stormwater Grate
Neenah R5050

Cast Iron Curb Inlet – 8" Barrier
Neenah R-3076-8BOK
East Jordan 00760067

Cast Iron Curb Inlet – 6" Mountable
Neenah R-3076-6M
East Jordan 00760063

Single Inlet Frame
Neenah 3076-0001
East Jordan 00760011

Center Inlet Frame
Neenah 3078-0001
East Jordan 00760017

Left Inlet Frame
Neenah 3077-0001
East Jordan 00760013

Right Inlet Frame
Neenah 3077-0002
East Jordan 00760015

Water Meter Cans, Rims, Lids (non lockable)
East Jordan 18 x 18 assembly 32534019 (3/4" x 5/8")
East Jordan 18 x 24 assembly 32535019 (1")
East Jordan 36 x 36 Assembly 00842804 (1 ½")
East Jordan 36 x 36 Assembly NCR06-569B (2")
Sigma 18 x 18 MB-161TT-35 (3/4" x 5/8")
Sigma 18 x 24 MB-163TT-35 (1")
Sigma 36 x 36 MB-147TT-35 (1-1/2")
Sigma 36 x 36 MB-147T2-35 (2")

PART 201 - CONCRETE

201.1 CEMENT

201.1.1 All cement used in the work shall be a well-known brand of true Portland Cement and shall conform to the Standard Specifications for Portland Cement, ANSI/A.S.T.M. Designation C150. Unless otherwise permitted, the Contractor shall use only one brand of cement in the work and under no condition shall he use more than one brand of cement in the same structure. Cement, which for any reason has become partially set or contains lumps or cakes will be rejected and shall be removed from the site.

201.1.2 The acceptance or rejection of cement shall rest with the Engineer. All rejected cement shall be plainly marked for identification, shall be immediately removed from the work, and shall not be offered for inspection again. Cement kept in storage for several months may be subject to repeated tests, as directed by the Engineer.

201.1.3 The cement shall be delivered in strong cloth or paper bags. No cement shall be used or inspected unless delivered in the original package with the brand and name of the manufacturer plainly marked thereon. Each bag of cement shall contain approximately ninety-four pounds of cement, net weight, and four bags shall be the equivalent of one barrel. Packages received in broken or damaged condition will be rejected or accepted only as fractional packages.

201.1.4 The Contractor shall provide, at the site of the work, a suitable weather tight building, or buildings, having a tight floor properly blocked or raised from the ground, for the storage of cement. The building shall be large enough to permit keeping on hand a supply of cement in quantity sufficient to prevent delays or interruptions to the work, which might be due to the lack of cement. The cement shall be stored in such manner to permit easy access for the proper inspection and identification of each shipment. Cement in bags shall not be piled to a height in excess of seven feet. Suitable accurate scales shall be provided by the Contractor for weighing the cement. After it has been delivered to the job, the Contractor will not be permitted to remove or dispose of the cement in any way without the consent of the Engineer.

201.1.5 At the beginning of operations and at all other times while cement is required, the Contractor shall have, at the site of the work, an ample supply of acceptable cement and shall carefully guard against possible shortage on account of rejection, irregular deliveries, or any other cause.

201.2 WATER

201.2.1 All water used in mixing mortar or concrete shall be free from acid, alkali, oil, salt, vegetable, or other matter in sufficient quantity to be injurious to the finished product, and shall be from an approved source.

201.3 AGGREGATE

201.3.1 Fine aggregate for concrete shall be clean, hard, durable, uncoated grains of Arkansas River sand or other sand acceptable to the Engineer. It shall be free from injurious amounts of dust, clay balls, soft or flaky particles, shale, alkali, organic matter, loam, or other deleterious substances. It shall not contain more than three per cent, by weight, of material, which can be removed by standard decantation tests. If the color of the supernatant liquid is darker than that of the reference standard color solution when subjected to the Standard Test For Organic Impurities in Sands for Concrete ANSI/ASTM C40, the fine aggregate shall be rejected unless it passes the Standard Test for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar ANSI/ASTM C87.

201.3.2 Fine aggregate shall be graded approximately within the limits shown in the following table. If not enough fines are available in the natural sands, limestone dust, or other approved fines shall be added:

Per Cent Passing Standard Square Mesh Screens

No. 4	No. 20	No. 50	No. 100
95-100	45-80	10-30	5-10

201.3.3 Coarse aggregate shall consist of the best available crushed limestone or other approved material. River gravel or other material with smooth surfaces shall not be used without specific written approval of the Engineer. Coarse aggregate shall be clean, tough, sound, durable rock and shall not contain harmful quantities of foreign materials and must be satisfactory to the Engineer.

201.3.4 Coarse aggregate shall be graded approximately within the limits shown in the following table:

Percent Passing Standard Square Mesh Screens

Aggregate								
Max Size	2 ½"	2"	1 ½"	1"	¾"	½"	3/8"	No. 4
2"	100	95-100	60-95	50-83	40-70	20-40		0-5
1 ½"		100	95-100		40-70		10-30	0-5
¾"				100	95-100		40-75	0-5

201.3.5 Coarse aggregate shall conform to Standard Specifications for Concrete Aggregates, ANSI/ASTM C33, except as to graduation. The maximum size aggregate to be used in structures six inches thick and under shall be three-quarters inch; in structures from six inches to ten inches thick, the maximum size of aggregate shall be one and one-half inches. If required, the Contractor shall furnish test certificates showing the aggregates meet the above requirements.

201.3.6 In case the concrete resulting from the mixture of the aggregates is not of a workable character or does not make the proper finished surface, the Engineer may require a different grading in order to secure the desired results, or they may allow the use of inert admixtures to correct deficiencies, upon proper showing that such use will not materially lower the strength or increase the permeability of the concrete.

201.4 STEEL REINFORCEMENT

201.4.1 All reinforcing steel shall be deformed bars and shall conform to the requirements of the Standard Specifications for Deformed and Plain Billet Steel Bars for Concrete Reinforcement, ANSI/ASTM A615, for grade 40 or grade 60. All steel shall be manufactured in the United States.

201.4.2 The Engineer reserves the right to require a test of three specimens of each size of bar from each carload received. These tests shall be made by a laboratory or testing firm approved by the Engineer and the cost of such testing shall be included in the price bid for steel reinforcement.

201.5 STRENGTH AND PROPORTION

201.5.1 The concrete shall have a compressive strength of not less than 3500 PSI, unless otherwise specified in the plans, as determined from test cylinders at twenty-eight days, made, cured, and broken, as hereinafter specified.

201.5.2 The concrete shall be mixed in the approximate proportion of 1:2-1/2:4-1/4 and shall contain not less than 6 sacks of cement per cubic yard of finished concrete. With the approval of the Engineer, admixtures may be added in order to increase workability.

201.6 TESTING OF CONCRETE

201.6.1 During the progress of the work, a reasonable number of compression tests shall be made when and if required by the Engineer. Each test shall consist of not less than three test cylinders. At least one test shall be made for each one hundred cubic yards of concrete placed. The test cylinders shall be made and stored in accordance with the Standard Method of Making and Curing Concrete Test Specimens in the Field, ANSI/ASTM C31, and shall be tested in accordance with the requirements relating to making compression tests on concrete test specimens as given in the Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens, ANSI/ASTM C39.

201.6.2 All test specimens shall be kept as near to the point of sampling as possible and yet receive the same protection from the elements as is given to the portions of the structure being built. Specimens shall be protected from injury. They shall be sent to a testing laboratory approved by the Engineer not more than seven days prior to the time of the test, and while in the laboratory shall be kept in the ordinary air at a temperature of approximately 70 degrees Fahrenheit until tested.

201.6.3 The Contractor shall furnish the Engineer certified reports on these tests and shall pay all the expense of making the tests and of furnishing the concrete for preparing and testing the cylinders.

201.7 RESPONSIBILITY OF CONTRACTOR FOR STRENGTH

201.7.1 It is the intent of these specifications that the Contractor shall guarantee that concrete of the specified compressive strength is incorporated in the structures and that the responsibility for producing the required grades of concrete is assumed by the Contractor.

201.7.2 Should the average strengths shown by test cylinders fall below the strengths required, the Engineer will require any or all of the following changes: amount of cement, grading of aggregate, or ratio of the water to the cement used. If the tests disclose that the strength of the concrete is insufficient for the structure as built, the Engineer may condemn the part of any structure in which concrete of insufficient strength has been placed and the Contractor, at his cost, shall remove and replace such concrete with concrete meeting these specifications.

201.8 EXPERIMENTAL CONCRETE MIXES

201.8.1 The Contractor shall make experimental mixes prior to the placing of the concrete and at any time during the progress of the work when necessary to demonstrate that the concrete will meet these specifications. Materials for making experimental mixes shall be furnished by the Contractor and these materials shall be identical with those intended for use in the work. The cost of the materials, as well as the costs of crushing test specimens made from the experimental mix, shall be borne by the Contractor and shall be included in the price bid for concrete.

201.9 MIXING

201.9.1 The concrete shall be mixed in an approved batch machine or mixer. The ingredients shall be accurately measured by weight, unless measurement by volume is permitted by the Engineer, before being placed in the mixer. Measuring boxes or other approved measuring apparatus shall be such that the proportions can be accurately determined. The quantity of water to be added, which will vary with the degree of dryness of the material and with the weather conditions, shall be accurately measured for each batch of concrete. Means shall be provided by which a measured quantity of water can be introduced at any stage of the process. The mixing shall be done in a thorough and satisfactory manner and shall continue until every particle of aggregate is completely covered with mortar. The mixing time for each batch shall not be less than one minute after the materials are in the mixer. The entire contents of the drum shall be discharged before recharging. Retempering of concrete, which has partly hardened, will not be permitted.

201.10 CONSISTENCY

201.10.1 All reinforced concrete which is required to be spaded or puddled in forms or around reinforcing steel shall be of such consistency that: all aggregate will float uniformly throughout the mass without settling or segregation; when dropped directly from the discharge chute of the mixer, it will flatten out at the center of the pile but will stand up at the edges, the pile spreading from internal expansion and not by flowing; it will flow sluggishly when tamped or spaded; it can be readily puddled into corners and angles of forms and around reinforcing steel, it can be readily spaded to the bottom of the pour or to a depth of several feet any time within thirty minutes after placing.

201.10.2 A desirable consistency is one which results in a very slight accumulation of water at the top of a layer several feet in thickness, but not with segregation or accumulation of laitance.

201.10.3 If, through accident, intention, or error in mixing, any concrete shall, in the opinion of the Engineer, vary materially from the consistency specified, such concrete shall not be incorporated in the work but shall be discharged as waste material at a location approved by the Engineer.

201.11 PLACING CONCRETE

201.11.1 Before beginning a run of concrete, surfaces of the forms, reinforcing steel, and concrete previously placed, shall be thoroughly cleaned of hardened concrete and foreign materials. Forms shall be thoroughly wetted or oiled.

201.11.2 Concrete shall be placed in the forms immediately after mixing. It shall be deposited so that the aggregates are not separated. Dropping the concrete any considerable distance, generally in excess of five feet, depositing large quantities at any point and running or working it along the forms, or any other practice tending to cause segregation of the ingredients, will not be allowed. It shall be compacted by vibration or continuous tamping, spading, or slicing. Care shall be taken to fill every part of the forms, to work the coarser aggregate back from the face, and to force the concrete under and around the reinforcement without displacing it. All concrete shall be thoroughly vibrated, except where specifically excepted in the specifications. The concrete shall be deposited in continuous horizontal layers and, whenever practicable, concrete in structures shall be deposited continuously for each monolithic section of the work. Chutes and tremies used for conveying concrete shall be mortar-tight.

201.11.3 Work shall be arranged in order that each part of the work shall be poured as a unit, if this is possible. Where necessary to stop pouring concrete, the work shall be brought up in level courses and against a vertical stop board.

201.11.4 The placing of concrete under water, where permitted, must be done by special approved methods.

201.12 PLACING IN COLD WEATHER

201.12.1 No concrete shall be placed without the specific permission of the Engineer when the air temperature is at or below thirty-five degrees Fahrenheit.

201.12.2 If concreting in freezing weather is permitted by the Engineer, care shall be taken to prevent the use of any frozen material. In addition to adequate provision for protecting the concrete against chilling or freezing, the Contractor shall be required to heat the water and aggregate in order that when deposited in the forms, the concrete will have a temperature of not less than fifty degrees Fahrenheit, nor more than ninety degrees Fahrenheit. The concrete shall be adequately protected in order to maintain this temperature for a minimum of seventy-two hours after it has been placed and a temperature above thirty-two degrees Fahrenheit for a period of two additional days. The work shall be done entirely at the Contractor's risk.

201.12.3 No chemicals or other foreign matter shall be added to the concrete for the purpose of preventing freezing.

201.12.4 When early traffic placement on a repair is required, the following guidelines are provided as a minimum to assure required strength during cold weather. The Contractor is responsible for the protection and quality of concrete placed during all weather conditions. If circumstances occur which preclude following

these guidelines, lower early strength may result in delays in opening areas to traffic as desired.

201.12.5 Ice, snow, and frost must be removed from the cut prior to placement of concrete. Concrete should not be place on frozen subgrade. Removal of frozen subgrade will be paid as unclassified excavation.

201.12.6 Fresh concrete temperatures shall be a minimum of 50°F and a maximum of 90°F at time of placement. Hot mix water and preheated aggregate may be necessary to accomplish the minimum temperature during extremely cold weather. The minimum ambient temperature at time of placement should be at least 30°F.

201.12.7 Insulated blankets should be placed immediately when average daily temperatures are below 50°F or when minimum ambient temperatures are anticipated below 40°F during the curing period and left in place until opening to traffic. Insulated blankets shall be MA KA closed cell insulated blankets or approved equal. The insulated blankets shall have a minimum R-value of 2. Cost of insulated blankets shall be included in the price bid for the concrete where they are used.

201.12.8 Strict compliance with mix design slumps must be achieved to reach early strengths. "Drying out" of excessive slump mixes will not be allowed to reduce the slump.

201.12.9 All cold weather practices also apply to cementitious backfill material, except that blankets will not be required.

201.13 READY-MIXED CONCRETE

201.13.1 Ready-mixed concrete may be used on the work, with the approval of the Engineer, when the Contractor can demonstrate that the concrete can be furnished in accordance with the specifications hereinabove and that delivery can be made at such rate as will insure the continuity of any pour. Standard Specifications for Ready-Mix Concrete, ANSI/ASTM C94, when not in conflict with the specifications herein, shall control the furnishing of ready-mix concrete.

201.13.2 All mixer trucks shall be equipped with water meters. Additional water shall be added at the job site only with the specific approval of the Engineer.

201.14 CONSTRUCTION JOINTS

201.14.1 Construction joints shall be located as shown on the drawings and at other points as may be necessary during the construction, provided that the location and nature of additional joints shall be approved by the Engineer. In general, joints shall be located at points of minimum shear, shall be perpendicular to the principal lines of stress, and shall have suitable keys having areas of approximately one-third of the area of the joints.

201.14.2 In resuming work, the surface of the concrete previously placed shall be thoroughly cleaned of dirt, scum, laitance, or other soft material, and shall be roughened. The surface shall then be thoroughly washed with clean water and covered with at least one-half inch of cement mortar, after which concreting may proceed. Mortar shall be placed in a manner in order not to splatter forms and reinforcing steel.

201.15 FINISH OF CONCRETE SURFACES

201.15.1 All surfaces exposed to view shall be free from conspicuous lines, affects, or other irregularities caused by defects in the forms. If for any reason this requirement is not met, or if there are any conspicuous honeycombs, the Engineer may require the correction of the defects by rubbing with carborundum bricks and water until a satisfactory finish is obtained or removal at Contractors expense.

201.15.2 Immediately after removing the forms, all wires or other exposed metal shall be cut back of the concrete surface, and the depressions thus made and all honeycombs and other defects shall be pointed with mortar and then rubbed smooth. If the Engineer deems any honeycomb or other defect to require such treatment, the defective concrete shall be cut out to a depth sufficient to expose the reinforcement and to afford a key for the concrete replacing that cut out.

201.16 CURING CONCRETE

201.16.1 Exposed surfaces of concrete shall be protected by approved methods from premature drying for a period of at least seven days. Curing compounds, when approved by the Engineer, shall be applied according to the manufacturer's recommendations. The Engineer may require the frequent wetting of the concrete and/or forms and the use of means to protect it from the direct rays of the sun.

201.17 PLACING REINFORCEMENT

201.17.1 All reinforcement, when placed, shall be free from mill scale, loose or thick rust, dirt, paint, oil or grease, and shall present a clean surface. Bends and splices shall be accurately and neatly done and shall conform to American Concrete Institute Manual of Standard Practice for Detailing Reinforced Concrete Structures.

201.17.2 All reinforcing shall be placed in the exact position shown on the drawings and shall be held firmly in position by means of approved metal spacers and supports, by wiring to the forms, and by wiring the bars together at intersections with approved wire ties in order that the reinforcement will not be displaced during the depositing and compacting of the concrete. The placing and fastening of reinforcement in each section of the work shall be approved by the Engineer before any concrete is deposited in the section. Care shall be taken not to disturb the reinforcement after the concrete has taken its initial set.

201.18 FORMS

201.18.1 Forms shall be so designed and constructed that they may be removed without injuring the concrete. The material to be used in the form for exposed surfaces shall be sized and dressed lumber or metal in which all bolt and rivet heads are countersunk. In either case, a plain, smooth surface of the desired contour must be obtained. Undressed lumber may be used for backing or other unexposed surfaces, except inside faces of conduit.

201.18.2 The forms shall be built true to line and braced in a substantial and unyielding manner. They shall be mortar-tight, and if necessary to close cracks due to shrinkage, shall be thoroughly soaked in water or as shown in plans. Forms for re-entrant angles shall be filleted, and for corners shall be chamfered. Dimensions affecting the construction of subsequent portions of the work shall be carefully checked after the forms are erected and before any concrete is placed. The interior surfaces of the forms shall be adequately oiled with a non-staining mineral oil to insure the non-adhesion of mortar.

201.18.3 Form lumber, which is to be used a second time, shall be free from bulge or warp and shall be thoroughly cleaned. The forms shall be inspected immediately preceding the placing of concrete. Any bulging or warping shall be remedied, and all dirt, sawdust, shavings, or other debris within the forms shall be removed. No wood device of any kind used to separate forms will be permitted to remain in the finished work.

201.18.4 Temporary openings shall be placed at the bottom of the column and wall forms and at other points where necessary to facilitate cleaning and inspection immediately before depositing concrete.

201.19 REMOVAL OF FORMS

201.19.1 Forms shall be removed in such manner as to insure the complete safety of the structure. No forms shall be removed except with the express approval of the Engineer. In general, this approval will be based on the following:

201.19.2 Forms on ornamental work, railings, parapets, and vertical surfaces which do not carry loads and which will be exposed in the finished work shall be removed within twenty-four to forty-eight hours after placing, depending upon weather conditions.

201.19.3 Girder, beam, and joist sides only, column, pier, abutment, and wall forms may be removed within twenty-four to forty-eight hours after placing, depending upon weather conditions. No backfill shall be placed against walls, piers, or abutments, unless they are adequately supported or have reached the required strength.

201.19.4 Girder, beam, and joist soffit forms shall remain in place with adequate shoring underneath, and no construction load shall be supported upon, nor any shoring removed from any part of the structure under construction until that

portion of the structure has attained sufficient strength to support safely its weight and the loads placed thereon.

PART 202 - QUICK-SETTING FLOWABLE FILL

202.1 MATERIALS

202.1.1 Quick-setting flowable fill shall be a sand-cement slurry consisting of the following materials in a one cubic yard mixture:

Type I Cement	100 pounds
Sand	2,925 pounds
Water	585 pounds
Master Builders Pozzutec 20	80 ounces
(ASTM C494, Type C and E)	

202.1.2 NOTE: Can change somewhat due to type of sand used.

202.1.3 The combination of materials above shall be mixed in a ready-mix truck to produce the sand-cement slurry mixture.

202.1.4 Submittals shall be delivered to the City of Tulsa at a date set by the Engineer. Submittals shall include the items outlined in ODOT Specification 701.03.

202.2 CONSTRUCTION METHODS

202.2.1 For each cubic yard of quick-setting flowable fill material required, the amount of the mix components in the MATERIALS section shall be used to produce the sand-cement slurry mixture. The slurry mixture shall be mixed between 70 to 100 revolutions of the ready-mix truck.

202.2.2 To minimize segregation, all flowable fill material shall be re-mixed at the project site at mixing speed in the ready-mix truck for approximately two minutes immediately prior to discharge of the sand-cement slurry mixture. Re-mixing of the flowable fill slurry shall be done under the direction of the Engineer

202.3 TESTING

202.3.1 Special Provisions, “Flowable Fill Testing Procedures” identifies the Ohio Ready-Mixed Concrete Association (ORMCA) Standards FF1(94), and FF4(94) which shall be used in the performance of field testing.

202.3.2 The following are the testing requirements for the quick-setting flowable fill:

Flow	Minimum = 4 ½ inches
Compressive Strength (28 days)	Minimum = 25 pounds per square inch (psi)
	Maximum = 60 pounds per square inch (psi)

202.4 GENERAL

202.4.1 The time required before placing pavement over the cured quick-setting flowable fill is a minimum of six hours and/or whenever a minimum penetration value of 400 pounds per square inch (psi) is achieved. Penetrometer readings shall be taken with a Soiltest Mortar Penetrometer, Model CT-421A, or approved equal. The upper three inches of the area of the cured flowable fill mixture to be tested shall be removed prior to taking the penetrometer readings. The test value of record shall be the average of three tests.

PART 203 - DUCTILE IRON PIPE, DUCTILE AND CAST IRON FITTINGS, AND VALVES

203.1 PIPE AND FITTINGS

203.1.1 Where ductile iron pipe (DIP) three (3) inches in diameter and larger is specified or required, it shall conform to, and be tested in accordance with, the current American National Standard for Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids, ANSI/AWWA C151/A21.51.

203.1.2 Length of joints shall be either eighteen or twenty feet. The minimum standard thickness class of each size pipe shall be as follows:

Pipe Size	Thickness Class
4” thru 8”	51
10” and larger	50

203.1.3 For 16-inch and larger Water Ductile Iron Pipe, all bell and spigot joints shall be electrically bonded, using a #4 AWG bare copper wire of adequate length to braze, using a #15 cadweld cartridge, the copper wire to the bare metal at the bell and spigot. Cost shall be included in the unit price bid per lineal foot of Ductile Iron Pipe.

203.1.4 For 16-inch and larger Water Ductile Iron Pipe, junction box test stations shall be furnished and installed, EXCEPT, no magnesium anode banks shall be furnished or installed. Junction box test stations shall be installed in accordance with the stationing shown on the Schedule of Anode Spacing. Cost shall be included in the unit price bid per lineal foot of Ductile Iron Pipe.

203.1.5 Fittings for ductile iron pipe shall be cast or ductile iron. Cast iron and ductile iron fittings shall conform to the American National Standard for Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, ANSI/AWWA C110; or the American National Standard for Ductile-Iron Compact Fittings, 3-inch through 48-inch, ANSI/AWWA C153. The length of all solid sleeves (both AWWA C110 and C153) shall be the longest length listed in the AWWA C110 specification (12-inch length for 3-inch through 12-inch sleeves, 15-inch length for 14-inch through 24-inch sleeves, and 24-inch length for 30-inch through 48-inch sleeves).

203.1.6 DUCTILE IRON PIPE FOR GRAVITY SANITARY SEWER USE SHALL BE BY ENGINEERING DIRECTOR APPROVAL ONLY. Interior of all sanitary sewer ductile iron pipe shall be lined with 40 mils of ceramic epoxy ("Protecto 401", or equal).

203.1.6.1 Condition of Ductile Iron Prior to Surface Preparation.
All ductile pipe and fittings shall be delivered to the application facility without asphalt, cement lining, or any other lining on the interior surface. Because removal of old linings may not be possible, the intent of this specification is that the entire interior of the ductile iron pipe and fittings shall not have been lined with any substance prior to the application of the specified lining material and no coating shall have been applied to the first six inches of the exterior of the spigot ends.

203.1.6.2 Lining Material.

The Standard of Quality is Protecto 401 Ceramic Epoxy. The material shall be an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. Any request for substitution must be accompanied by a successful history of lining pipe and fittings for sewer service, a test report verifying the following properties, and a certification of the test results.

A. A permeability rating of 0.00 when tested according to Method A of ASTM E-96-66, Procedure A with a test duration of 30 days.

B. The following test must be run on coupons from factory lined ductile iron pipe:

1. ASTM B-117 Salt Spray (scribed panel) – Results to equal 9.0 undercutting after two years

2. ASTM G-95 Cathodic Disbondment 1.5 volts @ 77°F. Results to equal no more than 0.5mm undercutting after 30 days.
3. Immersion Testing rated using ASTM D-714-87.
    a. 20% Sulfuric Acid – No effect after two years.
    b. 140°F 25% Sodium Hydroxide – No effect after two years.
    c. 160°F Distilled Water – No effect after two years.
    d. 120°F Tap Water (scribed panel) 0.0 undercutting after two years with no effect.

C. An abrasion resistance of no more than 3 mils (.075mm) loss after one million cycles using European Standard EN 598: 1994 Section 7.8 Abrasion Resistance.

203.1.6.3 Application

A. Applicator

The lining shall be applied by a competent firm with a successful history of applying linings to the interior of ductile iron pipe and fittings.

B. Surface Preparation

Prior to abrasive blasting, the entire area to receive the protective compound shall be inspected for oil, grease, etc. Any areas with oil, grease, or any substance which can be removed by solvent, shall be solvent cleaned to remove those substances. After the surface has been made free of grease, oil or other substances, all areas to receive the protective compounds shall be abrasive blasted using sand or grit abrasive media. The entire surface to be lined shall be struck with the blast media so that all rust, loose oxides, etc., are removed from the surface. Only slight stains and tightly adhering oxide may be left on the surface. Any area where rust reappears before lining must be reblasted.

C. Lining

After the surface preparation and within 8 hours of surface preparation, the interior of the pipe shall receive 40 mils nominal dry film thickness of Protecto 401. No lining shall take place when the substrate or ambient temperature is below 40 degrees Fahrenheit. The surface also must be dry and dust free. If flange pipe or fittings are included in the project, the lining shall not be used on the face of the flange.

D. Coating of Bell Sockets and Spigot Ends

Due to the tolerances involved, the gasket area and spigot end up to 6 inches back from the end of the spigot end must be coated with 6 mils nominal, 10 mils maximum using Protecto Joint Compound. The Joint Compound shall be applied by brush to ensure coverage. Care should be taken that the Joint Compound is smooth without excess buildup in the gasket seat or on the spigot ends. Coating of the gasket seat and spigot ends shall be done after the application of the lining.

E. Number of Coats

The number of coats of lining material applied shall be as recommended by the lining manufacturer. However, in no case shall this material be applied above the dry thickness per coat recommended by the lining manufacturer in printed literature. The maximum or minimum time between coats shall be that time recommended by the lining material manufacturer. **To**

prevent delamination between coats, no material shall be used for lining which is not indefinitely recoatable with itself without roughening of the surface.

F. Touch-Up & Repair

Protecto Joint Compound shall be used for touch-up or repair in accordance with manufacturer's recommendations.

203.1.6.4 Inspection and certification

A. Inspection

1. All ductile iron pipe and fitting linings shall be checked for thickness using a magnetic film thickness gauge. The thickness testing shall be done using the method outlined in SSPC-PA-2 Film Thickness Rating.

2. The interior lining of all pipe barrels and fittings shall be tested for pinholes with a nondestructive 2,500 volt test. Any defect found shall be repaired prior to shipment.

3. Each pipe joint and fitting shall be marked with the date of application of the lining system along with its numerical sequence of application on that date and records maintained by the applicator of his work.

B. Certification

The pipe or fitting manufacturer must supply a certificate attesting to the fact that the applicator met the requirements of this specification, and that the material used was a specified.

203.1.6.5 Handling

Protecto 401 lined pipe and fittings must be handled only from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe and fittings for lifting, positioning, or laying.

203.2 JOINTS

203.2.1 Cast iron and ductile iron pipe and fittings shall be jointed with any of the end types as specified below, unless a particular end type is specified. Fittings shall have mechanical joints, unless otherwise specified. Flanged ends shall be used only where specifically noted on the Drawings except that the valve connection end of all tapping sleeves shall be flanged.

203.2.2 Mechanical joints and push-on joints shall conform to, and be tested in accordance with, the American National Standard for Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings, ANSI/AWWA C111/A21.11.

203.2.3 Flange joints shall conform to the American National Standard for Cast Iron Pipe Flanges and Flanged Fittings, ANSI B16.1.

203.2.4 Where ductile or cast iron pipe is to be tapped, a split case iron or a flexible stainless steel tapping sleeve may be used.

203.2.5 Split case iron tapping sleeves shall be of 150 psi working pressure. Sleeve body shall be cast iron conforming to ANSI/AWWA C110. Sleeve shall have mechanical joints conforming to AWWA C111 on the run and a flange branch conforming to ANSI B16.1, Class 125. End gaskets shall be natural rubber or neoprene material conforming to ANSI/AWWA C111.

203.2.6 Flexible stainless steel tapping sleeves shall be rated at 150 psi pressure, with flanges meeting AWWA C207. Assembly shall be NSF or UL rated. Bolts, nuts, and washers shall be stainless steel. Gaskets shall conform to ANSI/AWWA C111.

203.2.7 Openings of the sizes shown on the drawings shall be furnished with steel blind flanges of proper strength to withstand working pressure of the line where no other provision is made for closing the openings. Blind flanges shall be fabricated from material as specified under ANSI/AWWA C200. All bolts shall be carbon steel ANSI/ASTM A307, Grade A only, in accordance with ANSI/AWWA C207.

203.2.8 Where restrained joints are specified or required, they shall be of a mechanical type or push-on type assembly easily removed in field once assembled without special equipment. Assemblies shall be ANSI/AWWA rated. Set screw type retainer glands will not be permitted.

203.3 COATING, LINING AND POLYETHYLENE WRAP

203.3.1 Cast iron and ductile iron pipe and fittings shall be bituminous coated outside and cement-mortar lined inside with seal coat in accordance with American National Standard for Cement Mortar Lining for Ductile-Iron and Gray-Iron Pipe and Fittings for Water, ANSI/AWWA C104/A21.4.

203.3.2 All ductile iron and cast iron pipe and fittings shall be encased with polyethylene tube in accordance with AWWA C105, American National Standard for Polyethylene Encasement for Ductile Iron Piping for water and other liquids. Polyethylene film shall be manufactured of virgin polyethylene material conforming to ASTM D-1248, Type 1, Class A or C, Grade E. Thickness shall be not less than 8 mils (0.008 in.). Tensile strength shall be 1200 psi, minimum. Elongation shall be 300 percent, minimum. Tube length shall provide at least one (1) foot of overlap at each joint of pipe. Tape shall

be a 2" width, plastic backed adhesive tape, Polykan #900, Scotch #50, or equal. Tube width for each pipe diameter shall be as follows:

NOMINAL PIPE SIZES	PUSH-ON JOINT FLAT TUBE WIDTH	MECHANICAL JOINT FLAT TUBE WIDTH
4”	14”	16”
6”	17”	20”
8”	21”	24”
10”	25”	27”
12”	29”	30”
14”	33”	34”
16”	37”	37”
18”	41”	41”
20”	45”	45”
24”	53”	53”
30”	67”	67”
36”	81”	81”

203.4 GATE VALVES

203.4.1 Where gate valves are specified, they shall be resilient-wedged.

203.4.2 Resilient-wedged gate valves shall conform to and be tested in accordance with ANSI/AWWA C509. The valve shall be bubble tight from either direction at the rated design pressure of 200 psi. The valve shall have a single disc gate with synthetic rubber seat bonded or mechanically attached to the disc; non-rising stem with 2-inch AWWA operating nut; counter clockwise opening, “O” ring stem seals, and corrosion resistant interior coating acceptable for potable water use.

203.4.3 Where specified, flanges shall be ANSI B16.1, Class 125, cast iron. Mechanical Joint, push-on, and bell and spigot joints are allowed.

203.5 BALL VALVES

203.5.1 Ball valves shall conform to and be tested in accordance with the AWWA Standard for Ball Valves, ANSI/AWWA C507. Where ball valves are specified or required, they shall be: double-seated with natural or synthetic rubber located in the valve body. Ball seating surfaces shall be stainless steel; designed for 150 psi working pressure; flanged end; "O" ring rotor bearing seals; constructed of high-tensile strength cast iron; counter-clockwise opening; equipped with totally enclosed manual operators, and torque limiting control device. Valves shall be tested by, and shall withstand without leak, a hydrostatic pressure of: (1) 250 psi on the valve body with rotor in the open position; and (2) 150 psi on the side of the valve with the opposite side open to atmosphere. Six (6) copies of the test results and manufacturer's drawings shall be submitted for approval prior to delivery of the valve.

203.5.2 Valves shall be bubble tight at rated pressure with flow in either direction.

203.5.3 Where flanges are specified, they shall be ANSI B16.1, Class 125, cast iron flanges.

203.6 BUTTERFLY VALVES

203.6.1 Butterfly valves shall be of the tight-closing, rubber-seat type, shall have a rated pressure of 150 psig, and shall be bubble-tight at this pressure with flow in either direction. Valve opening shall be counter-clockwise. The valves shall conform to and be tested in accordance with the AWWA Standard for Rubber-Seated Butterfly Valves, ANSI/AWWA C504, Class 150B. The valve body shall be of the short-body flange type, constructed of cast iron conforming to either ASTM A126, Class B, or ANSI/ASTM A48, Class 40 or ductile iron ANSI/ASTM A536, Grade 65-45-12. Flanges shall be ANSI B 16.1, Class 125, cast iron flanges. Valve Discs shall be constructed of alloy cast iron conforming to ANSI/ASTM A436, Type 1, or cast iron conforming to ANSI/ASTM A48, Class 40, or ductile iron ANSI/ASTM A536, Grade 65-45-12. Valve shafts shall be constructed of 18-8, Type 304 or 316 stainless steel, ANSI/ASTM A296, Grade CF8, or monel. Valve seats shall be body mounted and shall be of natural or synthetic rubber compound with mating seat surfaces of 18-8, Type 304 or 316 stainless steel, or alloy cast iron conforming to ANSI/ASTM A436, Type 1, or bronze Grade A, D, or E. Valve bearings shall be corrosion resistant and self-lubricating.

203.6.2 Interior surfaces of the valve, except seating surfaces, shall be epoxy coated in accordance with AWWA Standard for Protective Interior Coatings for Valves and Hydrants, AWWA C550. Exterior surface of the valve shall be painted with two (2) coats of asphalt varnish conforming to Federal Specifications TT-V-51C. For non-buried service, exterior surface shall be coated with two (2) coats of epoxy, not zinc chromate.

203.6.3 Performance, hydrostatic and leakage tests shall be conducted in strict accordance with ANSI/AWWA C 504, except that the leakage tests as outlined in Section 5.3 are to be conducted on both faces of the disc.

203.6.4 Six (6) certified copies of the manufacturers detail drawings shall be submitted for approval prior to delivery of the valve.

203.6.5 Six (6) certified copies of the test results, signed by a registered professional engineer, are to be furnished to the Engineer.

203.7 MANUAL OPERATORS FOR BALL VALVES AND BUTTERFLY VALVES

203.7.1 Manual Operators for Ball and Butterfly valves shall be totally enclosed, permanently lubricated, counter-clockwise opening, and designed for buried or submerged service. Manual Operators shall be equipped with a 2" square AWWA operating nut with a removable handwheel complete with spinner and an open-closed indicator, suitable for one-man operation at 150 psi unbalanced across the valve. Manual Operators shall be either worm gear or

traveling-nut type, and shall conform to AWWA C507 for Ball Valves or AWWA C504 for Butterfly Valves.

203.7.2 Manual Operators for Ball and Butterfly Valves 16" and larger shall be equipped with a Torque Limiting Control Device. The device shall be mounted directly on the operating nut for valves in vaults and on top of the extension shaft for buried valves. The device shall be secured to the operating nut with two setscrews. The device shall declutch at 200 lb-ft of input torque in either direction of rotation. The device shall be designed for permanent buried or submerged service. Declutch and reset shall be automatic. Repeatability shall be within 5 percent of original rating for a minimum of 1000 cycles. Certified proof-of-design test reports shall be furnished for the device.

203.8 AIR RELIEF VALVES

203.8.1 Where air relief valves for water applications are specified or required, the valve shall be heavy-duty combination air release and vacuum type for 150 psi working pressure. Body, cover, and baffle shall be cast iron, or nylon. All internal parts to be either highest quality stainless steel, nylon or bronze. Interior and exterior surfaces of cast iron valve body and cover shall be coated with epoxy.

Air Relief Valve shall be guaranteed to operate under all surge conditions.

Acceptable Manufacturers for water ARV's: APCO, Crispin, ValMatic, ARI

203.8.2 Where air relief valves for sanitary sewer force mains, are specified or required, the valve shall be heavy-duty combination air and vacuum release type for 145 psi working pressure, tested to 230 psi, size shown on plans. Body, cover, and baffle shall be 316LC stainless steel or reinforced nylon. All internal parts shall be reinforced nylon, reinforced polypropylene or stainless steel. Valves shall have float system designed to insure separation of sewage and sealing mechanism. Valves to have back flushing attachments for routine cleaning maintenance.

203.9 CHECK VALVES

203.9.1 Where check valves are specified or required, they shall conform to, and be tested in accordance with the AWWA Standard for Swing-Check Valves for Ordinary Water Works Service, AWWA C508. They shall be horizontally mounted, single disc, swing type with a full diameter passage providing minimum pressure loss. Valves shall be of the non-slamming type designed for the future installation of outside lever and weight. Unless otherwise specified, all check valves installed in pump or lift stations shall be equipped with position indicator. Disk shall be coated rubber and body shall be epoxy coated. Ends shall fit the pipe or fitting to which attached (push-on, mechanical, bell and spigot, or flanged).

203.10 3-WAY FIRE HYDRANTS

203.10.1 Where fire hydrants are specified, they shall conform to, and be tested in accordance with the AWWA Standard for Dry-Barrel Fire Hydrants, ANSI/AWWA C502. All hydrants shall have: breakable connection features and a breakable coupling on the stem immediately above the bury line which has a lower breaking point than the rest of the unit; 5¼-inch compression main valve; 6-inch inlet connection; standard bell or mechanical joint hub; three-foot six-inch bury length, or as specified on drawings; two 2½-inch hose nozzles with National Standard threads; one 4-inch pumper nozzle with Tulsa Standard threads (refer to attached Standard Detail for Fire Hydrants); "O" ring seal; drain valve; left (counter-clockwise) opening; Federal yellow finish paint above ground line; and National Standard pentagon operating nut.

203.10.2 Where fire hydrant extensions are specified or required, they shall be of proper design to accommodate the make of fire hydrant installed.

203.11 FOUR-WAY FIRE HYDRANT

203.11.1 Where four-way fire hydrants are specified or required, they shall conform to, and be tested in accordance with the AWWA Standard for Dry-Barrel Fire Hydrants, ANSI/AWWA C502. All hydrants shall have: breakable connection features and a breakable coupling on the stem immediately above the bury line which has a lower breaking point than the rest of the unit; 8-inch inlet connection; bell, flange, or mechanical joint inlet; four-foot six-inch bury length; two 2½-inch hose nozzles with National Standard threads; two 4-inch pumper nozzles with Tulsa Standard threads; "O" ring seal; drain valve; left (counter-clockwise) opening; Federal yellow finish paint above ground line; and National Standard pentagon operating nut.

203.11.2 Where fire hydrant extensions are specified or required, they shall be of the proper design to accommodate the make of fire hydrant installed.

203.12 BLOW-OFF HYDRANT

203.12.1 Where blow off hydrants are specified or required, they shall be constructed in accordance with Construction Standard Blow-off Hydrant.

PART 204 - STEEL PIPE AND FITTINGS

204.1 GENERAL

204.1.1 Where steel pipe is specified or required, it shall conform to the AWWA Standard for Steel Water Pipe, 6-Inches and Larger, AWWA C200. No steel less than 35,000 psi specified minimum yield strength shall be permitted. All pipe shall be hydrostatically tested in accordance with AWWA C200. Mill Test Reports shall be furnished and the hydrostatic test pressure shown on shop fabrication drawings. AWWA Designation C200 shall govern the testing. Pipe length shall be not less than 35 feet per joint, except for specials, unless

otherwise noted. There shall be no more than one longitudinal or girth seam per section. Nominal pipe diameter and steel thickness shall be as specified on the drawings. The diameter shown is the required inside diameter after cement-mortar lining. All pipe shall be manufactured by an established manufacturer who has had at least five (5) years experience in successfully building this type of pipe. Openings for air valves, main connections, and blow-off connections shall be provided with suitable reinforcements around the opening, welded to the body of the pipe in accordance with AWWA Manual M11. Openings of the sizes shown on the drawings shall be furnished with steel blind flanges of proper strength to withstand the working pressure of the line where no other provision is made for closing the openings. Blind flanges shall be fabricated from material listed above as specified under AWWA C200. All bolts shall be carbon steel ANSI/ASTM A307, Grade A only, in accordance with ANSI/AWWA C207. For corrosion monitoring of steel pipe, junction box test stations shall be furnished and installed. Magnesium anode banks shall be furnished and installed if specified in the plans. Junction box test stations and anode banks shall be installed in accordance with the stationing as shown on the Schedule of Anode Spacing in the plans.

204.1.2 All steel pipe shall be manufactured with ends of true circular shape, free from indentations, projections, or roll marks for a distance of eight inches (8") from the end of the pipe. This shall be done by hydraulic expansion or some other method satisfactory to the Engineer. The outside circumference shall not vary by more that + or – 1 percent or as required for jointing of pipe as described in AWWA C200.

204.1.3 Where steel fittings or specials are specified or required, they shall conform to all of the steel pipe specification requirements and to the AWWA Standard for Dimensions for Steel Water Pipe Fittings AWWA C208. Where fittings and specials are fabricated from mill pipe, they shall be fabricated from pipe hydrostatically tested in accordance with AWWA C200 with mitered joints dye checked for welding flaws. Changes in line and grade shall be made by steel specials or in the joints. Joint deflection shall not exceed that as recommended by the manufacturer. Inside diameter of steel specials and fittings shall be the required inside diameter of cement-mortar lining.

204.1.4 Where field cutting of steel pipe is permitted, pipe shall be cut by sawing. The inside lining shall be removed for a minimum of six inches each side of the cut and the pipe surface shall be cleaned and brushed to bright metal. After welding, the inside lining shall be replaced in accordance with AWWA C602.

204.1.5 Steel Pipe shall be designed in accordance with AWWA M11 and AWWA C200 except as noted herein. Steel Pipe shall conform to ASTM A139 Grade B or C. The design criteria for steel pipe thickness shall be based on a minimum 150 psi working pressure plus a 100-psi allowance for water hammer except the minimum thickness of steel pipe shall be 0.25 inches. The minimum thickness standard in inches for each following size pipe shall be as follows:

Minimum Thickness - Inches for Grade of Steel

Nominal Pipe Diameter	A-139 Gr. B	A-139 Gr. C
6” - 36”	0.250	0.250
42”	0.281	0.250
48”	0.313	0.281
54”	0.375	0.313
60”	0.406	0.344
66”	0.438	0.375
72”	0.500	0.406

Maximum depth of cover shall be 12 feet. Depth of cover in excess of 12 feet shall require special design.

204.1.6 Hangar and support systems shall be designed in accordance with AWWA M11.

204.2 JOINTS

204.2.1 Steel Pipe and fittings shall have one of the following type joints: slip joint ends for field lap welding, single beveled ends for field butt welding, double beveled ends for field butt welding, "O" ring bell and spigot joints, or plain ends for mechanically coupled field joints. Flange ends shall be used only when noted on the drawings.

204.2.2 Welded joints shall conform to, and be tested in accordance with the AWWA Standard for Field Welding of Steel Water Pipe Joints, AWWA C206. Slip joints for field lap welding shall be sized to provide tolerances per C200.

204.2.3 Mechanically coupled joints shall consist of Dresser Couplings, Style 38, or equal, or as specified on the drawings. The harness lugs, tie bolts, and nuts shall conform to AWWA M11 Steel Pipe Design and Installation, Par. 19.8.

204.2.4 Bell and spigot joints with rubber gasket shall conform to the AWWA Standard for Steel Water Pipe 6-Inches and Larger, AWWA C200 and the AWWA Steel Pipe Manual, M-11. The gasket shall be a continuous "O" ring design of natural rubber or neoprene and shall be of suitable cross-section and size to assure a watertight joint. Acceptable bell and spigot joints for all steel pipe diameters and thicknesses shall be the "O" Ring-Bar Type, or the "O" Ring-Carnegie Section, or rolled groove type joint. Bell and spigot ends shall be properly sized by forcing over a sizing die or by expanding to stretch the steel beyond its elastic limit so that the difference in diameter between outside of spigot and inside of bell at normal engagement is not less than 0.03” and not more than 0.10" as measured on circumference with a diameter tape. Shop applied interior lining on the bell end of the pipe shall be held back a minimum distance of the spigot engagement + 1-1/8" for the Bar and Carnegie Type Joints. Hold back for the rolled groove joint shall be the spigot engagement + ½". Interior lining for the spigot shall be continuous to the end. Field replacement of the interior joint linings shall be in accordance with Section 201.4. of these specification for cement-mortar linings. All "O" Ring joints shall

be electrically bonded using a #4 bare copper wire, 6" length #15 cadweld cartridge brazed to bare metal at the bell and spigot or equal. Shop applied exterior coatings shall be held back in accordance with manufacturer's specifications. Field replacement of exterior coatings at the joints shall be in accordance with the AWWA C216, Heat Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Specials, Connections and Fitting, AWWA C209, Cold-Applied Tape Coatings for Special Sections, Connections, and Fittings, for Steel Water Pipelines, or AWWA C205, Cement-Mortar Protective Lining and Coating for Steel Water Pipe, 4" and Larger, Shop Applied.

204.2.5 Where steel pipe is to be tapped in the field, a split tapping saddle of 150 psi working pressure shall be used. The saddle body shall be heavy welded ANSI/ASTM A36, or ANSI/ASTM A285, Gr. C steel with flange conforming to ANSI/AWWA C207, Class D. The gasket shall be natural rubber or neoprene design in a continuous ring of suitable cross-section, and sized to assure a watertight joint. The interior and exterior surfaces of the saddle body shall be shop coated with a fusion-bonded epoxy. The exterior coating or wrap on steel pipe shall be removed to bare metal beneath the entire area to be covered by the sleeve.

204.2.6 Flanged joints shall conform to the AWWA Standard for Steel Pipe flanges, AWWA C207, Class D.

204.3 EXTERIOR COATING

204.3.1 The exterior coating on steel pipe and fittings shall be in accordance with Tape Coating Systems for the Exterior of Water Pipelines, AWWA C214 or cement-mortar coatings in accordance with AWWA C205, Cement-Mortar Protective Lining and Coating For Steel Water Pipe, 4" and Larger, Shop Applied. Where tape coatings are used, the total thickness shall be no less than 80 mils. Where cement-mortar coating is used, the thickness shall be not less than 3/4" and reinforced with spiral-wire, wire-fabric, or ribbon mesh reinforcement in accordance with AWWA C205, Sec. 2.1. All above ground piping shall be cleaned, primed, and painted with enamel, as shown in the plans. The total dry film thickness shall be 6 mils.

204.3.2 If field welding is used, the pipe joints shall be furnished with the outside coating held back, in accordance with standard joint detailed drawings. The coating and any touch up work shall be done under the direction of the coating manufacturer, and as approved by the Engineer.

204.4 INTERIOR LINING

204.4.1 The interior lining shall be installed in the field in accordance with AWWA C602, Cement-Mortar Lining of Water Pipelines, 4-Inch and Larger, In Place; or shop applied in accordance with AWWA C205, Cement Mortar Protective Lining and Coating for Steel Water Pipe, 4" and Larger, Shop Applied. The lining shall be 3/8" thick for diameters through 36", and 1/2" thick for 42" and larger, whether shop or in place lined. Tolerances shall be in accordance with

the applicable AWWA standards. Coal-tar enamel and coal tar epoxy interior linings will not be permitted.

204.4.2 Where in place cement-mortar lining is used, the contractor shall furnish all materials, labor and equipment, prepare the interior surface, and machine place the mortar lining in the pipe. The lining at valves, specials, and bends may be hand sprayed or troweled, or hand applied as required. The lining shall be maintained in a moist condition while curing. The contractor shall be responsible for any extended curing time until acceptance by the Engineer. No additional payment shall be made for any extended curing period.

204.4.3 Where in-place mortar lining is cracked or delaminated from steel cylinder pipe, contractor shall repair broken or delaminated areas with Hilti 2-part epoxy, or approved equal.

204.5 STRUTTING AND BRACING

204.5.1 Strutting and bracing shall be provided on all specials, fittings, and straight pipe, where shop lined or coated with cement mortar, so as to limit the maximum pipe deflection to two (2) percent of inside diameter and to maintain roundness of +/- one (1) percent during transportation, handling and joining the pipe. Coated pipe shall be handled with wide belt slings or padded forks. Chains, cables or other equipment likely to cause damage to the pipe or coating shall not be used. The strutting shall remain in place until all compacting and backfilling has been completed.

PART 205 - REINFORCED CONCRETE PIPE AND FITTINGS

205.1 REINFORCED CONCRETE PIPE AND FITTINGS FOR WATER LINES

205.1.1 Where reinforced concrete pipe (RCP) and fittings are specified or required per AWWA C301, for water lines, they shall be designed, manufactured, and tested in accordance with the AWWA Standard for Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids, AWWA C301, or Reinforced Concrete Pressure Pipe, Steel Cylinder Type, Pretensioned, for Water and other Liquids, AWWA C303. All pipe shall be manufactured by an established manufacturer who has had at least three years experience in successfully building this type of pipe. All specials and fittings shall be built to the details furnished by the manufacturer and approved by the Engineer. Each special and each length of straight pipe shall be plainly marked to indicate the head for which the pipe is designed and to indicate where the pipe will be used by reference to the layout drawings. All closure fittings shall be furnished with an 18-inch flanged access manway with an 18-inch steel blind flange. 6-inch screw type hand hole fittings will not be permitted.

205.1.2 All concrete or mortar substrates must be sweep-abrasive grit blasted to create adequate profile then made dust free. All surfaces to be lined must be

free of any oil, grease, or other deleterious materials. The surface must be dry to the touch (no standing water), but can have some surface discoloration due to moisture.

205.1.3 RCP and fittings for water lines shall be designed for the following conditions (minimum): Normal operating pressure equal to 150 psi plus 50% for surge pressure plus earth load resulting from actual backfill depth, but not less than 8 feet plus external live load equal to AASHTO HS 20 loading. The thickness of the mortar coating shall provide a minimum cover of 1 inch over the reinforcing steel.

205.1.4 Reinforced concrete pipe and fittings for water lines shall be jointed according to AWWA Standard for Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids, ANSI/AWWA C301, or Reinforced Concrete Pressure Pipe, Steel Cylinder Type, Pretensioned, for Water and Other Liquids, AWWA C 303.

205.1.5 Where concrete pressure pipe ANSI/AWWA C301, Steel Cylinder Prestressed Concrete or Pretensioned Concrete Pressure Pipe, AWWA C303 is to be tapped, the tapping saddle shall be fabricated in accordance with the American Water Works Association Manual M-9, and as recommended by manufacturers of Concrete Pressure Pipe. Saddle shall provide grout gaskets and grout opening to enable filling the wall space between saddle and pipe wall with grout, to assure complete protection of the steel pipe wall. The saddle shall also provide gland assembly, including gasket and flange, to insure a tight seal.

205.1.6 Openings of the sizes shown on the drawings shall be furnished with steel blind flanges of proper strength to withstand the working pressure of the line where no other provisions is made for closing the openings. Blind flanges shall be fabricated from material as specified under AWWA C200. All bolts shall be carbon steel ASTM A307, Grade A only, in accordance with ANSI/AWWA C207.

205.2 REINFORCED CONCRETE PIPE AND FITTINGS FOR STORMWATER

205.2.1 Where reinforced concrete pipe (RCP) and fittings are specified or required per ASTM C76, for storm sewers, except as herein modified, they shall be designed, manufactured, and tested in accordance with ASTM C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe. Pipe shall be a minimum Class III. Pipe length shall be no less than 6'-0" except for shorts and specials. Pipe sections connected to a manhole or structure shall be no more than 4' - 0" in length, as measured from the inside face of the structure to the point of flexure of the joint. Elliptical reinforcement is not allowed. At least three circumferential reinforcing bars shall be provided in each pipe bell equal in area to an equivalent length of outside cage in the pipe barrel. Concrete shall have a minimum 28-day compressive strength of 6,000 psi, and absorption not to exceed six percent.

205.2.2 Testing shall be observed and reported by an independent testing laboratory approved by the Engineer. One (1) Three-Edge Bearing Test in accordance with ASTM C497 shall be performed on a representative sample of each diameter and class of pipe to be furnished. One (1) absorption test in accordance with ASTM C497 shall be performed for each 300 tons of pipe manufactured, not less than one (1) test per day's production. Four (4) concrete cylinders or core samples shall be tested for compressive strength from each days production, two at 7 days and two at 28 days. An in-plant hydrostatic test in accordance with ASTM C36l shall be performed on each section of pipe and each pipe joint at an internal hydrostatic head of 25 feet. The joints shall be tested for a minimum period of one (1) hour under constant pressure as specified. Each pipe unit that satisfactorily passes all hydrostatic testing shall bear the seal of the testing laboratory. This seal does not constitute acceptance of the pipe installation, which will be subjected to further testing and inspection in the field.

205.2.3 In lieu of the in-plant hydrostatic testing of each joint, the Contractor may substitute the following procedure: (1) Perform one in-plant hydrostatic test per days production, in accordance with the previously specified criteria; and (2) Perform an air test on each joint in the field after assembly, in accordance with the City of Tulsa Water and Sewer Department Standard Air Test Procedure. The Contractor shall furnish all air test equipment. Testing and test conclusions shall be verified by the Engineer. The Engineer reserves the right to require additional in-plant hydrostatic testing.

205.2.4 Reinforced concrete pipe and fittings for storm sewer shall be jointed in accordance with ASTM C361, Standard Specification for Reinforced Concrete Low-Head Pressure Pipe. Joints shall be concrete bell and spigot, employing a rubber gasket and cement mortar formed by a diaper. Rubber gaskets shall be either a standard o-ring gasket or a Forsheda pre-lubricated gasket, or equal. For the o-ring gasket, the spigot end shall contain a groove to confine and compress the gasket on four surfaces when the joint is in final position. The Forsheda joint shall be designed and installed in accordance with the manufacturer's recommendations.

205.2.5 .

PART 206 - VITRIFIED CLAY PIPE AND FITTINGS

206.1 PIPE AND FITTINGS

206.1.1 Where vitrified clay pipe (VCP), fittings and in-line tees are specified or required, they shall conform to the Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated ANSI/ASTM C700. Testing shall be in accordance with methods of Testing Clay Pipe, ANSI/ASTM C301.

206.1.2 Where vitrified clay pipe is being installed, in-line tees for future connections to the sanitary sewer shall be manufactured specifically for vitrified clay pipe.

206.2 JOINTS

206.2.1 Vitrified clay pipe shall be jointed with material conforming to the Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings, ANSI/ASTM C425. All jointing materials shall be used in accordance with the manufacturer's instructions and subject to the approval of the Engineer.

206.2.2 Where it is necessary to connect vitrified clay pipe to ductile iron pipe a rigid type adapter shall be used. Only the following adapters will be permitted: Dickey DPB- VC x DI, Dresser Style 39, and Rockwell Omni. Flexible couplings will not be permitted.

PART 207 - POLYVINYL CHLORIDE (PVC) PIPE, WATER SERVICE

207.1 Where polyvinyl chloride (PVC) pipe four (4) inches in diameter through twelve (12) inches in diameter is specified or required, it shall conform to and be tested in accordance with AWWA C900, "AWWA STANDARD for POLYVINYL CHLORIDE (PVC) PRESSURE PIPE, 4 IN. THROUGH 12 IN., FOR WATER", as herein modified. PVC water pipe shall be approved by the Underwriters Laboratory Sanitation Foundation Testing Laboratory for potable water pipe. Polyvinyl chloride water pipe shall be restricted from use adjacent to arterial streets.

207.2 PVC pipe shall conform to pressure Class 200 (equivalent to Dimension Ratio 14) and shall have an outside diameter (OD) equal to the OD of equivalent size ductile iron pipe.

207.3 PVC pipe shall have integral wall-thickened bell ends and shall be jointed using one-piece elastomeric gaskets. Solvent cement jointing shall not be permitted.

207.4 Fittings for PVC pipe shall be polyethylene wrapped ductile or cast iron conforming to Part 203 of these specifications. The use of PVC fittings shall not be permitted.

207.5 Contractor shall submit certifications from the manufacturer that PVC pipe has been manufactured in accordance with AWWA C900, and that it meets the approval of the "NSF".

207.6 Where restrained joints are required, they shall be of a mechanical type assembly easily removed in field once assembled without special equipment. Assemblies shall be ANSI/AWWA approved. Setscrew type retainer glands will not be permitted.

PART 208 - POLYVINYL CHLORIDE (PVC) PIPE, SEWER SERVICE

208.1 Where polyvinyl chloride (PVC) pipe eight (8) inches in diameter through fifteen (15) inches in diameter, fittings and inline tees are specified or required for sewer service, it shall conform to and be tested in accordance with ASTM D3034 "Type PSM Polyvinyl Chloride Sewer Pipe and Fittings" for standard dimensional ratio (SDR) of26. Minimum pipe stiffness for all sizes shall be 115 psi.

208.2 Where polyvinyl chloride (PVC) pipe 18-inches in diameter through 48 inches in diameter is specified or required for sewer service it shall conform to and be tested in accordance with ASTM F679, Polyvinyl Chloride (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings Minimum pipe stiffness shall be 115 psi.

208.3 The PVC sewer pipe shall be supplied in 12.5 foot, or 20 foot laying lengths as specified.

208.4 Where it is necessary to connect PVC sewer pipe to ductile iron pipe and AWWA C110 long body solid sleeve shall be used with a special gasket for the PVC pipe. Flexible couplings will not be permitted.

208.5 Where PVC sewer pipe is being installed, the fittings for the service line, and the in-line tees and risers for future service connections, shall be of the same material as the mainline, and manufactured and specifically designed for connection to Schedule 40 PVC service lines.

208.6 The manufacturer shall maintain quality control through regularly scheduled testing in accordance with all referenced ASTM standards. Testing for flattening and the pipe stiffness shall be performed on one test specimen for each size and class of pipe produced for the project. Certifications shall be furnished that the material was manufactured, sampled, tested, and inspected in accordance with all applicable specifications. The certifications shall indicate the manufacturer's production code from which the plant location, machine, and date of manufacture can be identified.

PART 209 - CASTINGS

209.1 Gray iron castings shall conform to and be tested in accordance with the Standard Specification for Gray Iron Castings ASTM A48 and applicable sections of Drainage Structure Castings, AASHTO M 306, current edition. All castings, including manhole steps, lamphole covers, water meter lids, manhole frames and lids, adjustment rings and valve boxes shall be Class 35B iron.

209.1.1 Iron class shall be determined using only those guidelines outlined in ASTM A48. Tensile specimens shall be obtained using AASHTO M306 Para 9.1.4, Acceptance on the Basis of Test Bars Cut from Portions of Units Supplied to

Purchaser. Where samples are too thin and cannot be obtained under ASTM M306 Para 9.1.4, specimens shall be obtained under ASTM M306 Para 9.1.3 Acceptance on the Basis of Cast-on Test Bars. Elapsed time during tensile test shall follow ASTM A48 para 14. Tensile test specimens shall fit the holders of the testing machine in a way such that the load will be axial.

209.1.2 Additionally, castings that are rated for traffic loadings within dedicated public rights-of-way or other locations subject to vehicular traffic must pass an AASHTO proof load test that can maintain a 40,000 lb proof load for one (1) minute, applied on a 9”x9” contact area in the center of the casting. The load shall be applied at a constant rate requiring a minimum of 30 seconds to reach the 40,000 lb level. Following this test the casting shall be visually inspected for cracks or permanent deformation which will be cause for rejection. Following this, the casting shall be loaded to failure.

209.1.3 Cost for tensile and proof load testing shall be borne by manufacturer, and testing shall be performed at a testing facility acceptable to the Engineer. All tests shall be witnessed by the Engineer.

209.2 Casting dimensions shall vary by not more than ± 1/16 inch per foot.

209.3 All bearings surfaces shall be machined to prevent rocking and rattling.

209.4 Where sealed manholes are specified, only McGard locking system with 5/8” – 11 thread which is keyed to City of Tulsa standard lock is allowed.

209.5 Only those castings which have been approved by the Department will be permitted. Approval for each casting shall consist of approved shop drawings, plus laboratory test reports of the tensile test and load test.

209.6 City of Tulsa Engineering Services Department, on an annual basis, reserves the right to randomly select any castings for tensile and proof load testing from the foundry’s local representative’s yard. Such testing shall be at manufacturer’s expense.

PART 210 - CONDUIT

210.1 Where conduit (also known as tunnel liner or pipe sleeve), 6 inches or larger, is specified or required, it shall be steel pipe, and be in accordance with AWWA C200, 3/8” wall thickness.

Conduit shall be sized according to the following:

Carrier Pipe		Conduit, ID
Water	**Sanitary Sewer**	
6”	6”	18”
8”	8”	20”
	10”	22”
12”		24”

Carrier Pipe		Conduit, ID
Water	Sanitary Sewer	
	12”	26”
	15”	28”
16”		30”
	16”	32”
	18”	32”
24”	24”	42”
30”	30”	48”
36”	36”	54”
42”		60”
	42”	62”
	48”	68”

PART 211 - VAULT, PITS AND MANHOLES

211.1.1 Concrete masonry units shall conform to, and be tested in accordance with the specifications for Concrete Masonry, Hollow Load Bearing Concrete Masonry Units, ANSI/ASTM C90, or Concrete Building Brick C55, Grade A.

211.1.2 Precast manholes shall conform to, and be tested in accordance with, the specifications for Precast Reinforced Concrete Manhole Sections, ANSI/ASTM C478, flat slab top type.

211.1.3 Manhole adjusting ring shall be solid cast iron that fits in the standard City of Tulsa Sanitary Sewer manhole frame and the standard manhole lid fits in the adjusting ring.

211.1.4 Adjusting rings shall conform to and be tested in accordance with the Standard Specification for Gray Iron Castings ASTM A48 and Drainage Structure Castings, AASHTO Designation: M306-89. Castings shall be Class 35-B iron and unpainted.

211.1.5 The contact surface between manhole ring and manhole frame and the contact surface between manhole ring and manhole lid shall be machined smooth to prevent rocking and rattling.

211.1.6 The two (2) inch manhole adjusting ring where specified shall have a minimum weight of 70 pounds and the three (3) inch manhole adjusting ring where specified shall have a minimum weight of 100 pounds.

211.1.7 Markings on all gray iron castings shall conform to AASHTO Designation M306-89. (AASHTO M306-89 states: Each casting shall be identified by the foundry showing): Name of Foundry, Country of manufacturer, ASTM Designation Number, Class by a number followed by a letter indicating the minimum tensile strength and size of test bar. (i.e. Class 35-B), Heat Number and Date. No other wording or marking of any kind other than those stated above or shown on the plan will be permitted on castings.

211.1.8 All sanitary sewer manholes and structures 5-foot I.D. or larger shall have an interior epoxy coating

211.1.9 MANHOLE COATING - This section specifies the insitu-coating of new concrete sanitary sewer manholes to provide protection against corrosion to the manhole interior. This section includes requirements for product and contractor qualifications, work, materials, and equipment required for surface preparation, repairs, and application of a monolithic solvent-free epoxy coating to specified surfaces.

211.1.10 SUBMITTALS - The following items shall be submitted to Engineer for approval:

A. Technical data sheet and material safety data sheet (MSDS) on each product used, including ASTM test results indicating the product conforms to and is suitable for its intended use per these specifications.

B. Contractor Qualifications:

1. Manufacturer certification that Contractor has been trained and approved in the handling, mixing and application of the products to be used.

2. Certification that the plural component spray equipment to be used for applying the products has been manufactured or approved by the protective coating manufacturer and Contractor's personnel have been trained and certified for proper use of the equipment.

3. Three (3) recent references of Contractor projects of similar size and scope indicating successful application of a high-build solvent-free epoxy coating by plural component spray application in underground concrete structures.

4. Proof of any necessary federal, state or local permits or licenses necessary for the project.

5. Design details for any additional ancillary systems and equipment to be used in site and surface preparation, application and testing.

211.1.11 DELIVERY, STORAGE, HANDLING AND SITE CONDITIONS

A. Protective coating materials are to be stored and handled according to their material safety data sheets.

B. Contractor shall conform with all local, state and federal regulations including those set forth by OSHA, RCRA and the EPA and any other applicable authorities.

211.1.12 WARRANTY

Contractor shall warrant all work against defects in materials and workmanship for a period of one (1) year, unless otherwise noted, from the date of final acceptance of the project. Contractor shall, within a reasonable time after receipt of written notice thereof, repair defects in materials or workmanship which may develop during said one (1) year period, and any damage to other work caused by such defects or the repairing of same, at his own expense and without cost to the Authority.

211.1.13 EXISTING PRODUCTS

A. Standard Portland cement or new concrete (not quick setting high strength cement) must be well cured prior to application of the protective coating. Minimum of 28 days cure time.

211.1.14 MANUFACTURER

A. Raven Lining Systems, Inc., Tulsa, Oklahoma 800-324-2810 or 918-584-2810 or FAX 918-582-4311, or equal.

211.1.15 REPAIR MATERIALS

A. Repair materials shall be used to fill voids, structurally reinforce and/or rebuild surfaces, etc. as determined necessary by the Authority and protective coating Contractor. Repair materials must be compatible with the specified epoxy coating and shall be applied in accordance with the manufacturer's recommendations.

211.1.16 PROTECTIVE COATING MATERIAL

A. Raven Lining Systems' Raven 405 epoxy coating system, or equal.

Product type	Amine cured epoxy
Color	Light Blue
Solids Content (vol %)	100
Mix Ratio	3:1
Compressive Strength, psi	18,000
Tensile Strength, psi	7,600
Flexural Modulus, psi	600,000
Hardness, Type D	88
Bond Strength - Concrete	>Tensile Strength of Concrete
Chemical Resistance to:	

Sulfuric Acid, 10%	Immersion Service
Sodium Hydroxide, 20%	Immersion Service
Municipal Wastewater	Successful pass L.A.
County	Sanitation District Coating Evaluation

211.1.17 SURFACE PREPARATION

A. Contractor shall inspect all surfaces specified to receive a protective coating prior to surface preparation. Contractor shall notify Engineer of any noticeable disparity in the surfaces which may interfere with the proper preparation or application of the repair mortar and protective coating.

B. All contaminants including: oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed.

C. All concrete or mortar that is not sound or has been damaged by chemical exposure shall be removed to a sound concrete surface or replaced.

D. Surfaces to receive protective coating shall be cleaned and abraded to produce a sound surface with adequate profile and porosity to provide a strong bond between the protective coating and the substrate. Contractor shall utilize high pressure water cleaning equipment capable of 5,000 psi at 4 gpm.

E. Infiltration shall be stopped by using a material which is compatible with the specified repair mortar and is suitable for topcoating with the specified epoxy protective coating.

211.1.18 APPLICATION OF REPAIR MATERIALS

A. Repair materials shall meet the specifications herein. If using approved cementitious repair materials, such shall be trowelled to provide a smooth surface with an average profile equivalent to coarse sandpaper to optimally receive the protective coating. No bugholes or honeycomb surfaces should remain after the final trowel procedure of the repair mortar. The repair materials shall be permitted to cure according to manufacturer recommendations.

B. After leak repair is performed, all surfaces shall be inspected for remaining laitance prior to protective coating application. Any evidence of remaining contamination or laitance shall be removed. If repair materials are used, refer to these specifications for surface preparation. Areas to be coated must also be prepared in accordance with these specifications after

receiving a cementitious repair mortar and prior to application of the epoxy coating.

211.1.19 APPLICATION OF PROTECTIVE COATING

A. Application procedures shall conform to the recommendations of the protective coating manufacturer, including material handling, mixing, environmental controls during application, safety, and spray equipment.

B. The protective coating material must be spray applied with protective coating manufacturer approved heated plural component spray equipment by a Certified Contractor of the protective coating manufacturer.

C. Specified surfaces shall be coated by spray application of a moisture tolerant, solvent-free, 100% solids, epoxy protective coating as further described herein. Spray application shall be to a minimum wet film thickness of 80 mils.

D. If necessary, subsequent topcoating or additional coats of the protective coating should occur as soon as the basecoat becomes tack free, ideally within 12 hours but no later than the recoat window for the specified products. Additional surface preparation procedures will be required if this recoat window is exceeded.

211.1.20 TESTING AND INSPECTION

A. All manholes shall be vacuum tested after installation and prior to protective coating preparation and application.

B. During application a wet film thickness gage, such as those available through Paul N. Gardner Company, Inc. meeting ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used to ensure a monolithic coating and uniform thickness during application. A log shall be submitted to Authority by Contractor that includes wet film thickness testing and protective coating material usage per manhole structure. This log is to be kept and certified by Contractor that material usage and WFT indicates proper coverage at a minimum of 80 mils per these specifications.

C. After the protective coating has set hard to the touch it shall be inspected by Authority with high-voltage holiday detection equipment. Surface shall first be dried, an induced holiday shall then be made on to the coated concrete surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays at that particular area. The spark tester

shall be initially set at 8,000 volts (100 volts per 1 mil of film thickness applied) but may be adjusted as necessary to detect the induced holiday (refer to NACE RPO188-99). All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional protective coating material can be hand applied to the repair area. Large areas may require additional surface preparation and spray application to achieve minimum thickness. All touch-up/repair procedures shall follow the protective coating manufacturer's recommendations.

D. At the Engineer's option, select structures may be subjected to adhesion testing and destructive testing for measurement of film thickness at no additional cost. Measurement of adhesion of the protective coating to the substrate can be made in accordance with ASTM D4541. Measurement of film thickness can be made from the dollies pulled during adhesion testing. Any areas detected to have inadequate adhesion shall be evaluated by the Engineer. Further tests may be performed to determine the extent of potentially deficient bonded area and repairs shall be made by Contractor in strict accordance with manufacturer's recommendations.

E. A final visual inspection shall be made by the Authority and Contractor. Any deficiencies in the finished coating shall be marked and repaired by Contractor according to the procedures set forth herein.

PART 212 - SAND FOR CUSHION OR BACKFILL

212.1.1 Sand shall be graded from fine to coarse, free from objectionable material, and contain not more than ten percent (10%) clay or loam by weight. One hundred per cent shall pass a three-quarter inch screen, and ninety-five per cent shall pass a number four screen.

PART 213 - CRUSHED STONE FOR SURFACING, BASE COURSE, AND STABILIZATION

213.1 Crushed stone shall consist of clean, tough, durable fragments, free from an excess of soft or disintegrated particles. Sampling shall be in accordance with the Standard Method of Sampling Aggregates, ANSI/ASTM D 75.Sieve analysis shall be performed in accordance with the method of Sieve Analysis, ANSI/ASTM Cl36. Gradation to be used at each location will be specified by the Engineer. Crushed stone for aggregate base and surface course shall conform to the Oklahoma Department of Transportation Specifications for Highway Construction, and shall conform to the following gradations:

213.2 Percent Passing

Sieve Size	Type A	Type B
3"	-----	100
1-1/2"	100	40-100
3/4"	40-100	30-75
3/8"	30-75	25-60
No. 4	25-60	20-50
No. 10	20-43	15-35
No. 40	8-26	7-22

213.2.1 Crushed stone aggregate for stabilization and bedding shall conform to the following ASTM D448 and C33 gradations:

213.2.2 Percent Passing

	Size #1	Size #467	Size #57	Size #67	Size #7
Sieve Size	3 ½" to 1 ½"	1 ½" to No. 4	1" to No. 4	¾" to No. 4	½" to No. 4
4"	100	-	-	-	-
3 ½"	50-100	-	-	-	-
2 ½"	25-60	-	-	-	-
2"	-	10	-	-	-
1 ½"	0-15	95-100	100	-	-
1"	-	-	95-100	100	-
¾"	0-5	35-70	-	90-100	100
½"	-	-	25-60	-	90-100
3/8"	-	10-30	-	20-55	40-70
No. 4	-	0-5	0-10	0-10	0-15

PART 214 - RIP RAP

214.1 All rip-rap designs and installations shall comply with the more stringent requirements of the following:

A. The most current ODOT Standard Specifications which have also been adopted by the City of Tulsa.
B. The most current edition of the City of Tulsa Stormwater Management Criteria Manual.

214.2 ODOT Type IV Grouted Rip-Rap is not allowed within the City of Tulsa unless specifically approved by the City Engineer.

SECTION END

DIVISION III

CONSTRUCTION SPECIFICATIONS

PART 301 - RIGHT-OF-WAY CLEARING AND RESTORING

301.1 Work under this item shall include the removal and reconstruction or replacement of all obstructions affected by the construction of the project, including, but not limited to fences, retaining walls, patios, trash burners, signs, mail boxes, out-buildings, landscaping, etc. Any such obstructions that are not to be reconstructed are so designated on the drawings. Such shall be removed and disposed of by the contractor. All obstructions to be replaced or reconstructed shall be restored to substantially the same condition as existed prior to the construction except as otherwise noted. The Contractor shall remove and dispose of all debris, restore the grade of the surface of the earth as reasonably as may be done to the grade existing prior to construction, and upon completion of the work shall leave the site in as neat, clean and orderly condition as nearly as it was prior to construction as may be reasonably done. Contractor shall document by photographing all concrete and asphalt driveway crossings and marking the location by street address on each photo. Photographs shall be filed with Engineering Services Department prior to commencing work. All costs of photography shall be included in Bid Item 301a, Right-of-way clearing and restoring.

301.2 Passable surfaces across or along the construction vicinity shall be maintained at all times with gravel, steel mat or plate, or temporary bituminous surfacing material where a sidewalk, driveway, parking lot, street or alley previously existed. Pavement damaged by the Contractor's equipment shall be replaced to original condition. Gravel surfaces shall be replaced with the same.

301.3 If an obstruction is of public ownership, the Contractor shall notify the appropriate agency, and obtain any necessary permit or license forty-eight hours before beginning any operations affecting the obstruction. All work shall conform to the current standards and specifications of that agency and shall be approved by the agency before completion of the project. At the Contractor's request, the Engineer will furnish information as to what licenses or permits are required.

301.4 PAYMENT: Payment for this item shall be made at the unit price bid per linear foot. Total footage shall be the total length of pipe, not including bores, fittings, or specials, as included in other items. No additional payment shall be made for alterations of utility mains, service lines, or appurtenances, unless specifically provided for elsewhere in the Contract Documents.

PART 302 - EXCAVATION AND BACKFILL, UNCLASSIFIED

302.1 The work under this item shall include all earth, shale, gravel, loose rock, solid rock, debris, junk and/or other material excavated or otherwise removed in the preparation of the trench; all work in connection with the excavation, removal and subsequent handling and disposal of such material, regardless of its type, character, or condition; subgrade preparation, all sheeting, piling, shoring, bracing, and dewatering of trenches; protection of adjacent property; backfilling; sand cushion; grade base stabilization; all specified backfill consolidation; and other work necessary or required.

302.2 The trench shall be excavated so that the pipe can be laid to the alignment and grades shown on the drawings, or as directed by the Inspector. In dense or built-up areas or where unstable soils exist, the trench shall be excavated a maximum of one hundred (100) feet in advance of pipe laying. In open areas or where soil conditions permit, the trench excavation may be unlimited in advance of pipe laying, as approved by the Engineer. Opening of trenches in excess of the maximum requires specific approval of the Engineer. Trenches shall be dry when the trench bottom is prepared. The trench bottom shall be shaped so that even bearing is obtained for the barrel of the pipe with the bells unsupported. The standard trench width as shown on the attached Standard Detail, shall not be exceeded at any elevation below a point twelve inches above the top of the pipe. If for any reason this portion of the trench exceeds the permitted width and if the Inspector shall determine that cradling or encasement then is required, said concrete cradle or encasement shall be installed. Any part of the bottom of the trench excavated more than four inches below the specified grade shall be corrected with approved material thoroughly compacted as directed by the Inspector. In the event suitable material is not available, sand shall be used. When rock is encountered, and concrete cradle is required, it shall be excavated four inches below the bottom of the pipe and the trench refilled to grade with sand. When quicksand or other unstable earth is encountered, the Contractor shall excavate to sufficient depth to permit backfilling with Class “A” crushed stone in order to provide a stable base for the pipe. Trench safety shall be in accordance with applicable OSHA, State, and local regulations.

302.3 Bedding of pipe shall be as shown on the attached Standard Details. Unless otherwise shown, bedding shall be placed in the trench simultaneously on both sides of the pipe to a minimum elevation of four inches above the top of the pipe, being carefully worked and hand-tamped around the pipe in order to consolidate and assure excellent bedding. Backfill material shall not be placed in the trench covering the bedding cushion without prior approval of the Inspector. To prevent damage to the pipe, do not use compaction equipment within 18 vertical inches directly over the top of the pipe.

302.4 For large diameter (18" and above) flexible water pipe, bedding shall be in accordance with the Bedding Detail for Large Diameter Flexible Pipe. The pipe shall be bedded in soil-cement, installed over a 6-inch sand cushion. The

bedding shall be installed to the top of the pipe for the full width of the excavated trench. The soil-cement shall consist of a mixture of sand, portland cement, and water. Each cubic yard of soil cement shall contain 1-1/2 sacks of cement and approximately 70 gallons of water. Precautions shall be taken to prevent flotation. Movable trench supports shall not extend lower than the top of the pipe.

302.5 When the type of backfill material is not indicated on the Drawings or specified, the backfill may be made with the excavated material, provided that such material, in the opinion of the Inspector is suitable for backfilling. In the event that excavated material is not suitable, sand or other approved material shall be used. From six inches above the pipe to eighteen inches above the pipe, the trench shall be backfilled by hand or by mechanical methods approved by the Inspector. Special care shall be used in placing this portion of the backfill to avoid damaging or moving the pipe. The remainder of the trench may be backfilled by mechanical methods. Backfilling operation shall be completed within one hundred (100) feet or less of the finished line at all times, as directed by the Inspector.

302.6 Unless otherwise directed by the Engineer, all trenches excavated across any sidewalk, driveway, parking lot or other paved area, across any traveled portion of unpaved streets or alleys, across any proposed roadways or proposed roadway fills, and as shown on the drawings shall be bedded and backfilled with 1-1/2" Type A Aggregate Base (see 213.2), placed in 8-inch maximum lifts and compacted to 95% Standard Proctor Density, as measured by the Nuclear Density Method. Compaction shall be done by a vibratory hand tamper. Trenches excavated across existing street or alley paving shall be backfilled in accordance with the standard detail for Pavement Removal and Replacement. For excavations where there is more than 6 feet of cover over the top of the pipe and where the trench width is sufficient for use of heavy compaction equipment, an engineered fill using a suitable compactable material may be used in lieu of aggregate base, if approved in writing by the Director of Engineering Services Department. If the backfilling has been completed and the backfill material does not meet the requirements for compaction, all the material shall be removed and hauled from the job site and the trenches refilled with material as specified above. Failure of backfill shall be corrected immediately, as directed by the Engineer.

302.7 PAYMENTS: Payment for this item shall be made at the unit price bid per cubic yard. Volume will be computed as follows: standard trench width as listed in Standard Detail No. 315; length of line, as the actual horizontal measurement along the centerline of the ditch; depth of excavation as the actual depth of ditch from the original ground surface to the flow line of the pipe as shown in the construction notes. Average end-area method of computing volume will be used. No payment for excavation will be made for material excavated outside the neat lines of the standard trench width. No additional payment will be made for: sand cushion; backfilling; compaction of backfill; crushed stone used for backfill under

existing and/or proposed roadways, roadway fills, streets, alleys, driveways, sidewalks, parking lots or as shown on the Drawings; removing and replacing top soils and obstruction, tunneling of trees, storm sewers or other obstructions; blasting; bracing and shoring; dewatering; pumping and draining; grade base stabilization; removal of excess excavated material; or restoration of the site. It is mutually understood that subterranean water, quicksand, or other unstable earth may be encountered and the Contractor has taken such into consideration in making this bid. Where such is encountered, Contractor will be required to excavate to sufficient depth to permit backfilling with crushed stone in order to provide a stable base for the pipe. Extra payment will not be made because of such additional excavation or because it is necessary to excavate wider than the standard trench width; or for crushed stone.

PART 303 - MOBILIZATION/DEMOBILIZATION

303.1 Mobilization/Demobilization shall be bid as Each and THE AMOUNT BID SHALL NOT EXCEED TEN PERCENT (10%) OF THE SUM OF ALL BID ITEM EXTENSIONS EXCLUDING MOBILIZATION/DEMOBILIZATION. This work shall consist of the performance of construction preparatory operations, including the movement of personnel and equipment to the project site and for the establishment of the Contractor's offices, buildings, and other facilities necessary to begin work on a substantial phase of the Contract. The Engineer's field office and laboratory is a separate pay item and is not included in this work.

303.2 PAYMENT

303.2.1 Payment shall be full compensation for performing the work specified and the furnishing of all materials, labor, tools, equipment, and incidentals necessary to mobilize and subsequently demobilize the construction preparatory operations.

303.2.2 Payment for this item will be made in two installments unless the first estimate submitted is also the final estimate, in which case the total will be paid. The first payment of 50 percent of the lump sum Contract price will be included in the pay estimate which reflects fifty percent completion of the work.

An additional fifteen percent (15%) of the price bid for mobilization/demobilization may be included in the pay estimate which reflects fifty percent (50%) completion of the work.

303.2.3 The final twenty five percent (35 - 50%) of the price bid for mobilization/demobilization may be included on the final pay estimate. No additional payment will be made for demobilization.

PART 304 - CONTRACTOR CONSTRUCTION STAKING

304.1 This work shall consist of furnishing, placing, and maintaining construction layout stakes necessary for the proper prosecution and inspection of the work under the contract.

304.1.1 Contractor shall exercise care in the preservation of stakes and benchmarks and have them reset when they are damaged, lost, displaced, or removed. Contractor shall use licensed land surveyor in the State of Oklahoma and suitable equipment for the layout work required.

304.1.2 Contractor shall set all additional stakes needed, such as offset stakes, reference point stakes, slope stakes, pavement, curb line and grade stakes, stakes for bridges, sewers, roadway drainage, pipe underdrains, paved gutter, fence, culverts, or other structures – and any other horizontal or vertical controls necessary to secure a correct layout of the work. Stake centerline/control line of temporary features, such as shoo-fly detours. Contractor shall make stakes for line and grade adequate to maintain the specified tolerances for the operation being performed and satisfactory to Engineer. Mark the station number and the distance from the centerline of construction on all grade stakes.

304.1.3 Contractor shall furnish platforms and equipment necessary for proper and safe access for checking the staking, and when significant errors occur, resurvey to satisfaction of the Engineer.

304.1.4 Contractor shall notify Engineer immediately of plan errors. Special surveys necessary to determine corrective action shall be responsibility of Engineer.

304.2 PAYMENT

304.2.1 Payment shall be by Each for Contractor Construction Staking, and shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified, including profile measurements of connecting features.

304.2.2 Payment for this item of work shall be on the following schedule:

25 percent on the first payment estimate
25 percent when 10 percent of the contract work is complete
25 percent when 50 percent of the contract work is complete
20 percent when 75 percent of the contract work is complete
5 percent when all construction features have been verified as properly placed and completed

PART 305 - PIPE, VITRIFIED CLAY

305.1 The work under this item shall include furnishing, delivery, and placing and jointing of vitrified clay pipe (VCP) in the trench in specific conformity with the line and levels given.

305.2 The pipe shall be laid on a firm trench bottom, true to the lines and grades shown on the Drawings and/or as given in the field by the Inspector. Pipe shall be protected during handling against impact shocks and free fall. The laying of pipe in finished trenches shall be commenced at the lowest point, with the spigot ends pointing in the direction of flow. Pipe shall be laid continuously through new manholes if both inlet and outlet pipes are of the same size and in line. Upon completion of the manhole the invert shall be shaped. The ends of adjoining pipes shall butt against each other for their entire circumference in such a manner that there is no shoulder or unevenness of any kind. If Contractor uses batterboards instead of laser level, a top line shall be maintained over a span of three grade stakes when laying pipe. As each batterboard is erected, the top line shall be sighted to assure the accuracy of the grade stakes and the batterboards' settings. Any errors, discrepancies, or displacement of grade stakes shall be called to the attention of the Inspector for correction.

305.3 Prior to making pipe joints, all surfaces of the portion of the pipe to be jointed shall be cleaned and dried. Jointing shall be done in strict accordance with the manufacturer's recommended procedure. Trenches shall be kept water-free during jointing and for a sufficient period thereafter to allow the joint to become fully set and completely resistant to water penetration. There shall be no realignment of the pipe after the joint is completed unless the pipe is removed and a completely new joint constructed.

305.4 Double joints of eight inch pipe may be prepared and laid, provided the double joints are prepared by jointing the pipe in a vertical position using a straight edge inside the pipe to align the joint. Double joints shall not be placed in a horizontal position prior to laying unless suitably supported in racks. Double joints of pipe shall be supported at the middle joint, as well as the ends, when the pipes are lowered into the trench.

305.5 PAYMENT: Payment for this item shall be made at the unit price bid per linear foot of the pipe specified in the Proposal, and placed as shown on the Drawings. Total footage shall be the actual horizontal measurement along the centerline of the pipe. No additional payment shall be made for vertical pipe or fittings used with drop manholes.

PART 306 - PIPE, REINFORCED CONCRETE

306.1 The work under this item shall include furnishing, delivery, placing and jointing of reinforced concrete pipe (RCP) in the trench in specific conformity with the lines and levels given.

306.2 For water and storm sewer lines, the Reinforced Concrete Pressure Pipe, Steel Cylinder Type, AWWA C-300, shall govern the installation as applicable. The method of bedding shall be as shown on the attached Standard Bedding Detail. Bedding for pretensioned concrete pipe shall be in accordance with Standard Bedding Detail for Pretensioned Concrete Pressure Pipe. The Drawings show the plan and grade for the pipeline. The Contractor shall submit detailed drawings to the Engineer for approval, showing the proposed method of laying the pipe to these grades. All pipelines to be crossed shall be located by the Contractor before these drawings are prepared. The ends of the pipes to be jointed shall be cleaned immediately prior to jointing and the rubber gasket thoroughly lubricated with vegetable soap before it is placed in position on the spigot end. Extreme care shall be taken in moving the spigot end of the pipe into the bell end of previously laid pipe. If the gasket is damaged or moved out of place, the new pipe shall be removed and a new gasket applied before rejoining. Any soap remaining on the exposed concrete surfaces inside or outside the pipe shall be completely removed. Fittings or specials included as pipe shall be blocked in accordance with the attached Standard Detail.

306.3 For storm sewers, the methods of laying pipe, foundation, and grade specified under Pipe, Vitrified Clay, shall apply. All pipe shall be installed with the mark "C-76" visible on the top of the pipe. The ends of the pipes to be jointed shall be cleaned immediately prior to joining and the rubber gasket. Extreme care shall be taken in moving the spigot end of the pipe into the bell end of previously laid pipe. If the gasket is damaged or moved out of place, the new pipe shall be removed and a new gasket applied before rejoining.

306.4 For all lines, after the pipe has been jointed, a band at least five-and-one-half inches wide shall be placed around the outside of the pipe at the joint. This band shall serve as a form for placing 1:1 cement mortar grout in the external recess formed by the face of the groove and the shoulder of the tongue. If a reinforced paper joint band is used, it shall be drawn up tight around the pipe and the backfill tamped against it up to the spring line before pouring the grout. If a cloth band is used, it shall be wired around the outside of the pipe, and the grout poured before backfilling. On all pipes, the joint space remaining on the inside of the pipe shall be filled with a stiff mixture of 1:1 cement mortar which shall be troweled in place to produce a continuous, smooth, flush surface across the joint.

306.5 PAYMENT: Payment for this item shall be made at the unit price bid per lineal foot of pipe of the type specified in the Proposal, and placed as shown on the Drawings. Total footage shall be the actual horizontal measurement along the centerline of the pipe. No additional payment shall be made for vertical pipe or

fittings used with drop manholes, for fittings or specials included as pipe, or for concrete blocking or interior coatings.

PART 307 - PIPE, DUCTILE IRON

307.1 The work under this item shall include furnishing, delivery, placing, and jointing of Ductile Iron pipe in the trench in specific conformity with the lines and levels given. All Ductile Iron pipe shall be wrapped with a loose fitting, slip-on polyethylene film. The polyethylene film shall be slipped over the end of the pipe length that has been raised above the ground at the trench side. After the joint on the pipe is made up, the one-foot length shall be slipped over the joint to form an over-or-under lap of the adjacent polyethylene tube at this point. The loosely fitting film shall then be neatly folded over the top of the joint and held in place with tape. The loosely fitting tube extending along the pipe shall be drawn up snugly and folded along the top and held in place by using short pieces of plastic tape at intervals not to exceed four (4) feet. Fittings, valves and corporation stops shall be wrapped with a section of polyethylene material split to form a flat sheet, using plastic tape to hold the material around the appurtenance. For all pipe, the American National Standard for Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances, AWWA C-600 shall govern the installation as applicable. The method of bedding shall be as shown on the attached Standard Detail for Thrust Blocks and Trench Conditions, and Standard Detail for Pavement Removal and Replacements as applicable.

307.2 For water lines, all angled fittings or specials included as pipe shall be restrained, or blocked in accordance with the attached Standard Detail, the size to be determined by the Engineer.

307.3 Detectable Mylar marking tape for location of DIP water pipe shall be required. Detectable Mylar marking tape shall be 2-inches wide, blue in color with a continuous black lettered imprint stating, “Caution: Water Line Below”. Tape shall be equal to Lineguard Tape III as manufactured by Lineguard, Inc. of Wheaton, Illinois.

307.4 Detectable Mylar tape shall be buried above DIP water lines at a depth of 10-inches below the surface.

307.5 PAYMENT: Payment for this item shall be made at the unit price bid per linear foot of pipe of the type specified in the Proposal, and placed as shown on the Drawings. Total footage shall be the actual horizontal measurement along the centerline of the pipe. No additional payment shall be made for vertical pipe or fittings used with drop manholes, for fittings or specials included as pipe, interior coatings, or for concrete blocking.

Payment for any ductile iron pipe designated “restrained Joint” shall include cost of all components necessary to restrain joints of pipe.

PART 308 - PIPE, STEEL

308.1 The work under this item shall include furnishing, delivery, placing, and jointing of steel pipe in the trench in specific conformity with the lines and levels given. For all lines, American National Standard for Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances, AWWA C-200 shall govern the installation, as applicable. The method of bedding shall be as shown on the attached Standard Bedding Detail for Steel Pipe. The Drawings show the plan and grade for the pipeline. The Contractor shall submit detailed drawings to the Engineer for approval, showing his proposed method of laying the pipe to these grades. All pipelines to be crossed shall be located before these drawings are prepared. Fittings or specials included as pipe shall be blocked in accordance with the attached Standard Detail for Thrust Blocks and Trench Conditions.

308.2 If joints are field-welded, they shall develop the full strength of the pipe. The Contractor shall file with the Engineer a description of the method of welding which he proposes to use, the name of the individual or company who will do the welding, and a statement regarding the previous experience of such individual or company in this particular line of work. Testing shall be in accordance with Section 3.3 of AWWA C206. If requested, coupons shall be cut across the field welds and tested by a testing company approved by the Engineer and at the contractor’s expense. The line may be welded continuously with provisions for slack in the line, or in sections to be lowered in the trench and connected by a position weld.

308.3 If joints are to be mechanically coupled, sections up to 240 feet may be coupled and lowered carefully into the ditch. Electrical continuity shall be provided at all joints. Preparation for, protection of, and repair of pipe coating and lining, and coating of mechanical couplings shall conform to the applicable section of these specifications.

308.4 Field replacement of the cement-mortar interior lining shall be in accordance with the AWWA Standard for Cement-Mortar Lining of Water Pipelines, 4-Inch and Larger, In Place, AWWA C602.

308.5 PAYMENT: Payment for this item shall be made at the unit price bid per linear foot of pipe of the type specified in the Proposal, and placed as shown on the drawings. Total footage shall be the actual horizontal measurement along the centerline of the pipe. No additional payment shall be made for vertical pipe or fittings used with drop manholes, for fittings or specials included as pipe, or for concrete blocking.

Payment for any steel pipe designated “restrained joint” shall include cost of all components to restrain joints of pipe.

PART 309 - POLYVINYL CHLORIDE (PVC) PIPE, WATER SERVICE

309.1 When PVC pipe is delivered to the jobsite it shall not be exposed to sunlight for more than three (3) weeks. PVC pipe exposed to sunlight for more than three (3) weeks shall be covered with an opaque protective covering. The pipe shall be left stacked and no more pipe than can be installed in one day shall be strung along the jobsite.

309.2 When a length of PVC pipe is cut, the plain end shall be beveled to the same configuration as the factory beveled end. The end shall be beveled using a pipe beveling tool, portable sander, or abrasive disc. After beveling, stop marks shall be applied to the plain end at a distance from the end corresponding to the original stop marks.

309.3 Both Bell End and Plain End of PVC pipe shall be thoroughly cleaned before connecting pipes.

309.4 Elastomeric Gaskets shall be placed into bell with colored side of the gasket to the outside.

309.5 Before connecting PVC pipes, the plain end shall be lubricated with an approved lubricant. The bell end of PVC pipe shall not be lubricated.

309.6 When connecting, the plain end pipe shall be inserted into the bell end pipe and then pushed until stop marks on plain end are flush with end of bell.

309.7 PAYMENT: Payment for this item shall be made at the unit price bid per linear foot of pipe of the type specified in the Proposal, and placed as shown on the Drawings. Total footage shall be the actual horizontal measurement along the centerline of the pipe. No additional payment shall be made for vertical pipe or fittings or specials included as pipe, or for concrete blocking.

Payment for any PVC pipe designated “restrained joint” shall include cost of all components to restrain joints of pipe.

PART 310 - LOCATOR WIRE AND DETECTABLE MARKING TAPE

310.1 A Number 8 bare copper conductor wire or Number 12 copper-clad steel (CCS) wire, 21% conductivity, for the purpose of locating PVC water pipe shall be buried along the top of the pipe, and connected at each end to a fire hydrant by Cadweld Brazing just above the ground.

310.2 Detectable Mylar marking tape for location of PVC water pipe shall be required in areas as designated by the Engineer, more generally in commercial zones and open areas. Detectable Mylar marking tape shall be 2-inches wide, Blue in color with a continuous black lettered imprint stating "Caution: Water Line Below". Tape shall be equal to Lineguard Tape III as manufactured by Lineguard, Inc. of Wheaton, Illinois.

310.3 Detectable Mylar marking tape for location of PVC sewer pipe shall be required in areas as designated by the Engineer, more generally in commercial zones and open areas. Detectable Mylar marking tape shall be 3-inches wide, Green in color with a continuous black lettered imprint stating "Caution: Sewer Line Below". Tape shall be equal to Lineguard Tape III as manufactured by Lineguard, Inc. of Wheaton, Illinois.

310.4 Detectable Mylar Tape shall be buried above PVC water and sewer lines at a depth of 10-inches below the surface.

310.5 Non-detectable 4 mil plastic marking tape for location of PVC sewer pipe shall be required in all areas. Non-detectable plastic marking tape shall be 3-inches wide, Green in color with a continuous black lettered imprint stating "Caution: Sewer Line Below". Tape shall be buried 18 inches above sewer line.

310.6 Payment for tape and wire shall be included with unit price payment for PVC pipe.

PART 311 - TAPPING OF PVC PIPE FOR SERVICE CONNECTIONS

311.1 Standard water service connections shall be made by using bronze service clamps as per standard drawings. The couplings shall be provided with factory installed brass bushings which conform to ASTM B62 and AWWA C800 for standard corporation stop threads. Bushings must match the corporation stops. Direct tapping of PVC water pipe will not be allowed.

PART 312 - FITTINGS

312.1 The work under this item shall include all of the requirements specified under the item of pipe, in that "pipe" is understood to also mean "bends, tees, crosses, sleeves, outlet assemblies and other specified fittings." Unless otherwise specified, outlet assemblies shall consist of a flanged or mechanized (MJ) outlet constructed into the wall of steel or concrete pipe. If ductile iron pipe is used, the outlet shall consist of a tee with the outlet flanged. If a gate valve is shown on the Drawings to be attached to the outlet, the line side end shall be flanged and the opposite end shall be bell or mechanical joint according to the item for valves.

All bends, tees, crosses, outlet assemblies, and plugs shall be blocked with concrete as shown on the attached Standard Detail, except where the fittings have flanged, welded, or harnessed joints, the Inspector may, under certain conditions, delete the blocking. Concrete blocking shall be placed so that joints are accessible for repair.

312.2 PAYMENT: Payment for this item shall be made at the unit price bid per fitting, of the type specified in the Proposal, and placed as shown on the drawings. Only fittings specifically noted in the Proposal are included in this item. No additional payment shall be made for excavation, backfilling, or concrete blocking.

Payment for any fittings designated “restrained” shall include cost of all components to restrain joints of fittings.

PART 313 - POLYVINYL CHLORIDE (PVC) PIPE, SEWER SERVICE

313.1 The work under this item shall include furnishing, delivery, placing, and jointing PVC sewer pipe in the trench in specific conformity with the line and levels given. Installation shall be in accordance with ASTM D2321, Underground Installation of Flexible Thermoplastic Sewer Pipe, except as modified by these specifications.

313.2 Pipe shall be protected during unloading and installation against impact shocks and free fall. After unloading and before installation, pipe shall be stored on flat level ground with no rocks or other objects under the pipe. PVC pipe that appears to be faded as a result of ultraviolet aging shall not be allowed. PVC pipe exposed to sunlight for more than three (3) weeks shall be covered with an opaque protective covering. The pipe shall be left stacked and no more pipe than can be installed in one day shall be strung along the jobsite.

313.3 The pipe shall be laid on a firm trench bottom, true to the lines and grades shown on the drawings and/or as given in the field by the Inspector. Pipe shall be protected during handling against impact shocks and free fall. The laying of pipe in finished trenches shall be commenced at the lowest point, with the spigot ends pointing in the direction of flow. Pipe shall be laid continuously through new manholes if both inlet and outlet pipes are of the same size and in line. Upon completion of the manhole, the invert shall be shaped. The ends of adjoining pipes shall butt against each other for their entire circumference in such manner that there is no shoulder of unevenness of any kind. The pipe grade shall be obtained by using laser or batterboards and a "top line". A top line shall be maintained over a span of three grade stakes when laying pipe. As each batterboard is erected, the top and the batterboards settings. Any error, discrepancies, or displacement of grade stakes shall be called to the attention of the Inspector for correction.

313.4 Prior to making pipe joints, all surfaces of the portion of the pipe to be jointed shall be cleaned and dried. Jointing shall be done in strict accordance with the manufacturer's recommended procedure.

313.5 At connections to manholes or other concrete structures, where the pipe is to be grouted or cast into the wall, a tight fitting rubber water stop gasket shall be installed around the pipe. The outer sealing surface of the pipe shall be planed smooth. The pipe section with the gasket shall be grouted or cast into the manhole wall. Only pipe with a smooth outer wall or concentric ribs shall be used for cast or grouted in place connections. Where A-Lock type gaskets are used, only smooth outer wall pipe shall be used.

313.6 Approximately 30 days after backfilling the contractor shall measure vertical ring deflection for all pipe. The deflection testing shall be performed in the presence of the Engineer or his designated representative. Maximum ring deflection of the installed pipe shall be limited to 5 percent of the base inside diameter. All pipe which exceeds the allowable deflection shall be replaced or corrected by the contractor at no additional cost to City. The Contractor shall provide all mandrels and necessary equipment to perform the tests. Tests must be performed without mechanical pulling devices. Deflection shall be tested using a Go/No/Go Deflection Test Gauge conforming to the standard detail or as manufactured by Cherne Industries, Inc., or equal in accordance with the manufacturer's instructions.

313.7 Any flushing of PVC sewer lines will be performed by the City, but the Contractor will lend assistance as may be required. Any infiltration of flushing water or other leaks into the sewer shall not be acceptable, and the contractor shall immediately correct the cause of the leak in a manner acceptable to the Engineer.

313.8 All sewers shall be tested for excessive leakage above 10 gallons per day per inch of pipe diameter per mile per day for any section of installed system. Where low pressure air testing of PVC pipe is specified, it shall be air tested in accordance with the City of Tulsa standard air test procedure. The air testing for all new gravity pipe alignments will be performed by the City. All pipe which exceeds the allowable leakage rate shall be replaced or corrected by the contractor at no additional cost to City.

313.9 PAYMENT: Payment for this item shall be made at the unit price bid per linear foot of the pipe specified in the Proposal, and placed as shown on the Drawings. Total footage shall be the actual horizontal measurement along the centerline of the pipe. No additional payment shall be made for vertical pipe or fittings used with drop manholes.

PART 314 - MANHOLE

314.1 The work under this item shall include all excavation, furnishing all materials required, construction, pipe connection thereto, finishing and backfilling of new

standard or drop manholes. Construction of manholes shall progress as rapidly as installation of the line permits, and as directed by the Inspector. Brick manholes are not intended for new construction and shall be allowed only as approved by Engineer.

314.2 Excavation for manholes shall be made with vertical sides and minimum dimensions permitting construction of the manhole in accordance with the attached Standard Details. Manholes are to be built to an elevation not less than that of the existing ground surface, or as shown on the drawings.

314.3 New manholes shall be constructed around existing lines without disturbance to the line. When the manhole is completed, the existing pipe shall be removed from the invert of the manhole. Care shall be taken in removing the pipe to prevent any stoppage. Immediately upon completion of the manhole, all waste mortar and debris shall be removed from the bottom and invert. When the walls are completed, a standard manhole frame and cover shall be set in place. Above the base, manhole inverts shall be carefully constructed of solid concrete to maintain proper velocities. Changes in pipe grade, alignment or size shall be made by transition sections of the invert, determined by the lower half of the inlet and outlet pipes, but not greater than that of the outlet pipe. All inverts shall be plastered, troweled, and brushed to a smooth, clean surface. Inlet and outlet pipes shall not project beyond the interior wall of the manhole and shall be free from all sharp masonry.

314.4 During construction, each manhole step shall be set in place on the inside of the manhole, beginning eighteen inches above the bottom and placed not more than fifteen inches apart. No steps shall be placed closer than eighteen inches to the manhole top or farther than 27” to the manhole top. If concrete masonry units are used for the walls, special cut step blocks shall be installed to receive the steps. Steps shall be built firmly into the wall, allowing the steps to project five inches inside the manhole. If five-inch concrete masonry units are used, the ends of the steps projecting beyond the outside wall shall be cut off flush with the wall, and plastered over. The centerline of the steps shall be as shown on the attached Standard Detail for Manholes. Four-and-one-half-inch steps shall be used for brick manholes and twelve-inch steps for precast manholes.

314.5 The use of concrete masonry units shall not be allowed in connection with pipes larger than eight inches in diameter. If concrete masonry units five inches thick are used, the manhole shall not be located within any dedicated street or alley, or any other location subject to vehicular traffic; and shall not exceed twelve feet in depth. The foregoing restrictions as to location and depth shall not apply if eight-inch concrete masonry units, brick, or precast manholes are used.

314.6 For brick manholes, a single rowlock course shall be turned over each pipe. Every unit shall have a full mortar joint on the bottom and sides, which shall be formed in one operation by placing sufficient mortar on the bed and forcing the unit into it. Horizontal joints shall not exceed three-eights inch and vertical joints

on the inside of the manhole shall not exceed one-quarter inch in thickness. All joints on the inside are to be rubbed full and struck as the manholes are built up. Walls shall be constructed in horizontal courses with vertical joints staggered. When the manhole top is above the proposed graded elevation, the taper shall be drawn in the manhole top to twenty-four inches I.D. at a point one foot below said proposed elevation and the remainder constructed with brick as a twenty-four inch cylinder. The inside and outside walls of the manholes are to be plastered with one-quarter inch of mortar to give a smooth and regular finish.

314.6.1 Testing of Manholes shall be done in accordance with Part 109.2 of the City of Tulsa Specifications.

314.7 PRE-CAST MANHOLES

314.7.1 Pre-cast manholes with cast-in-place base slabs will be permitted for all standard and drop manhole installations. Cast-in-place base slab shall be placed on a minimum of 6-inches of compacted Class A crushed stone.

314.7.2 Pre-cast manholes with integral pre-cast floors will be permitted for standard and drop manhole installations. Pre-cast manholes of twelve feet (12') depth or greater shall have an extended base. Pre-cast floors shall be placed on a minimum of 18-inches of compacted Class A crushed stone.

314.7.3 A drop manhole is required when the difference in elevation between an inlet pipe's crown and the outlet pipe's crown is two feet (2') or greater. The drop leg of a manhole shall be constructed such that the crown of the drop pipe matches the crown of the outlet pipe at the manhole. The drop will not be required if the crown of the drop leg cannot be constructed to match the crown of the outlet pipe.

314.7.4 Pre-cast manholes shall conform to the specifications for Pre-Cast Reinforced Concrete Manhole Sections, ASTM C478. Joint construction shall be in accordance with the standard specification for Reinforced Concrete Pipe except that no exterior grout band is required. No more than eight (8) inches of concentric rings shall be used to bring the manhole to finished grade. Each concrete concentric ring shall have a bitumastic sealer joint, not exceeding three-eighths (3/8) inch in thickness. Inside joints shall be rubbed full and struck.

314.7.5 Cost of sealed manhole rims and lids shall be included in cost of manhole.

314.8 PAYMENT: Payment for this item shall be made at the unit price bid per manhole of the type specified in the Proposal, and placed as shown on the drawings. If the manhole depth, measured from the invert to the top of the cover, exceeds six feet, the additional depth shall be paid for at the unit price bid per vertical foot of manhole depth over six feet. No additional payment will be made for excavation, backfilling, pipe or concrete bottoms or interior coatings. Separate payment will be made for each drop manhole. No additional payment will be

made for multiple drops at a manhole. Separate payment will be made at the unit price bid per vertical foot of drop manhole depth over six feet.

PART 315 - CONNECTION

315.1 The work under this item shall include all excavation, furnishing all materials required, construction, finishing, and backfilling of connections to existing mains, valves, manholes, special connections, service line re-connections, plugs, or in-line tees for future connections, as indicated on the Drawings or as directed by the Inspector.

315.2 The drawing shows details of the various connections and they shall be made in accordance with the details or as directed by the Engineer. On water mains, Contractor shall make the pressure and wet connections to existing mains, as shown on the drawing, unless specifically noted otherwise.

315.3 Connections to existing manholes shall be made by cutting into the manhole at the specified grade and inserting the pipe. Pipe installation shall be done in accordance with Standard Detail No. 405 using A-LOK or Z-LOK rubber gasket, or the pipe may be grouted in place with hydrophilic waterstop formed around the pipe and the cold joint. Acceptable hydrophilic compound is ADEKA P-201, or approved equal. Joint shall be watertight. Contractor shall not break into any existing sewer unless the Inspector is present and the work done shall be under the direction of the Inspector. Inlet and outlet pipes at the invert shall not project beyond the interior walls of the manholes. The manhole base shall be cut and reconstructed in such a manner that a proper invert section is maintained. All waste mortar, debris, and sharp edges shall be removed from the joints, bottom, and invert. Contractor shall remove and replace the manhole steps in the proper location and in accordance with Part 314.4 and Note #9 of Standard Detail No. 357, if they are not properly located after the connection is made. Any and all diversion or pumping of water or sewerage in a wet connection is included in this Item.

315.4 Methods of construction shall be the same for house line reconnections as for main sewers. All reconnections shall be constructed in conformance with the Plumbing Code of the City of Tulsa, unless modified herein. New pipe used shall be of the same diameter as the existing line.

315.5 Plugs shall be constructed of manhole brick and mortar, extending at least one foot into the line plugged from the manhole. The plug shall be watertight and troweled to a smooth finish on the interior of the manhole.

315.6 In-line tee fittings shall be installed for future service connections, as shown on the plans, in accordance with the Standard Detail for in-line tees. The tee shall be capped with a screw plug of either bronze, brass or a detectable plastic, marked by a non-magnetic, mylar tape, and stapled to both sides of a nominal 2"

x 4" marker, 8' long, 4' buried, and 4' exposed, directly above fitting plug. The mylar tape shall be minimum 2-1/2" width, green in color, marked "Caution, Sanitary Sewer Below," as manufactured by Terra Tape or Line Guard.

315.7 After new water mains have been tested and chlorinated, the Contractor shall excavate around the new main for the service transfer. The existing mains and new mains shall remain in service during the transfer of services. The Contractor shall tap the new main and install a new corporation stop, service clamp, bend, copper tubing, and required fittings. The new service shall be connected to the existing meter after the service has been tested for leakage. The excavated area shall be backfilled and restored to original condition. Where galvanized service lines are encountered, they shall be replaced with copper. Where long services are replaced, they shall be bored under existing pavement. Open cutting will not be permitted unless approved by the Engineer. Copper tubing shall be Type K soft annealed conforming to ASTM B 88.

315.8 PAYMENT: Payment for this item shall be made at the unit price bid for each type of connection constructed, or in-line tee for future connection, as specified on the Proposal, or as directed by the Engineer. No additional payment will be made for excavation, backfilling, furnishing and placing of concrete, flowable fill, removing and replacing of manhole steps, if necessary, or for the diversion or pumping of water or sewerage necessary to make the connection. Payment for water service transfers shall be made at the unit price bid for pipe and fittings under the appropriate connection bid item and shall include all necessary excavation, backfill, right-of-way clearing and restoring, materials, and labor.

PART 316 - LAMPHOLE

316.1 The work under this Item shall include all excavation, furnishing all materials required, construction, pipe connection thereto, finishing and backfilling of new lampholes. Lampholes shall be located and constructed as shown on the Drawings, or as directed by the Inspector. When the concrete lamphole frame base is completed, a standard lamphole frame is to be set in place and closed with a lamphole cover.

316.2 PAYMENT: Payment for this item shall be made at the unit price bid per lamphole constructed as specified on the Proposal. No additional payment will be made for excavation, backfilling, or pipe.

PART 317 - VALVE

317.1 The work under this item shall include furnishing, delivery, and installation of valves at the locations shown on the Drawings, and in accordance with the attached Standard Details. The American National Standard for Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances, AWWA C-600 shall

govern the installation, as applicable. If the paint is damaged, the valve shall be cleaned by wire brushing and given two coats of black asphalt paint.

317.2 Gate valves shall be set with the stems plumb. Ball valves shall be set with the handwheels horizontal. Air relief valves shall be set so that the square operating nut on the two-inch valve can be operated from the top. Check valves shall be set horizontally. Construction standards for air relief and check valve vaults shall be the same as for manholes.

317.3 Fire hydrants shall be set so that the bottom of the steamer nozzle is not less than eighteen (18) inches nor more than twenty-one (21) inches above the finish grade of the ground. Breakable bolts damaged in the installation shall be replaced in kind. If the Mueller hydrant is used, the oil reservoirs shall be filled before the hydrant is set. Concrete blocking shall be placed so that the drain and joints are accessible. Restraining glands may be used in lieu of concrete blocking for fire hydrants. Fire hydrant and stem extensions shall be provided and installed as necessary, in accordance with the manufacturer's recommendations.

317.4 PAYMENT: Payment for this item shall be made at the unit price bid per valve, of the type specified on the Proposal, and placed as shown on the Drawings. If fire hydrant and stem extension are required, they shall be paid for at the unit price bid for each different length of extension used. The unit price bid for air relief and check valves shall include the valve vault. No additional payment shall be made for: excavation; backfilling; concrete blocking; the pipe length between the line and the fire hydrant, except where the pipe is shown on the Drawings in a separate profile; crushed rock for drains; air relief valve piping vaults; or restraining glands on fire hydrants in lieu of cement blocking.

Payment for any valve designated “restrained joint” shall include cost of restraining glands.

PART 318 - VALVE BOX

318.1 The work under this item shall include furnishing, transporting, and installation of valve boxes at the locations shown on the Drawings. The American National Standard for Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances, AWWA C-600, shall govern the installation, as applicable.

318.2 Valve box shall include SW services’ Debris Cap or equal.

318.3 PAYMENT: Payment for this item shall be made at the unit bid price per value box and debris cap and placed as shown on plans. Any valve box extension shall be paid under separate bid time. No additional payment shall be made.

PART 319 - ENCASEMENT, CONCRETE

319.1 The work under this item shall include the installation of concrete encasement as shown on the Drawings or as directed by the Inspector, in accordance with the attached Standard Detail. Care shall be taken to assure that placing of encasement does not deflect the pipe from the proper grade and alignment.

319.2 Sanitary sewers shall be encased when the depth of cut from the original ground elevation to the flow line of the pipe is four (4) feet or less. Concrete encasement necessitated by trench widths more than the maximum as shown on the attached Standard Detail for Thrust Blocks and Trench Conditions shall be placed as directed by the Inspector.

319.3 PAYMENT: Payment for this item shall be made at the unit price bid per cubic yard of concrete placed as encasement. All concrete encasement required because of excessive trench width shall be placed at the expense of the Contractor. No payment will be made for concrete used as fill or in excess of the theoretical quantity computation based on the attached Standard Detail for Thrust Blocks and Trench Conditions.

PART 320 - CRADLE, CONCRETE

320.1 The work under this item shall include the installation of concrete cradle as shown on the Drawings or as directed by the Inspector, in accordance with the attached Standard Detail for Thrust Blocks and Trench Conditions. Care shall be taken to assure that placing of cradle does not deflect the pipe from the proper grade and alignment.

320.2 PAYMENT: Payment for this item shall be made at the unit price bid per cubic yard of concrete placed as cradle. All concrete cradle required because of excessive trench width shall be placed at the expense of the Contractor. No payment will be made for concrete used as fill or in excess of the theoretical quantity computation based on the attached Standard Detail for Thrust Blocks and Trench Conditions.

PART 321 - PIERS, REINFORCED CONCRETE

321.1 The work under this item shall include all materials, forming, construction and finishing of reinforced concrete piers, and necessary pipe anchorage. Piers shall be located and constructed as shown on the Drawings. Forms shall be made to conform to the shape of the pier and securely braced. Reinforcing steel shall be bent as detailed and securely tied in place. Bearing area for the pipe shall be made to fit the outside diameter of the pipe and shall support the pipe at the proper grade. Steel strapping and bolts shall be installed and painted with one heavy coat of coal tar or asphalt paint after bolting in place. Any honeycomb or

other unevenness in the concrete shall be patched with cement mortar immediately after form removal.

321.2 PAYMENT: Payment for this item shall be made at the unit price bid per cubic yard of concrete placed as reinforced concrete piers in accordance with the attached Standard Details, at the location shown on the Drawings, or as directed by the Engineer. No additional payment will be made for excavation, forming, bracing, dewatering, backfilling, or pipe anchorage.

PART 322 - CONDUIT, BORED

322.1 The work under this item shall include the installation of railroad, street, or other crossings by boring utilizing steel conduit as shown on the Drawings. The conduit pipe shall be installed to the line and grades given.

322.2 PAYMENT: Payment for this item shall be made at the unit price bid per lineal foot of steel conduit, of the size specified in the Proposal, and placed as shown on the Drawings. All carrier pipe shall be paid for under other items. No additional payment shall be made for excavation, backfilling, boring, tunneling, dewatering, bulkheads, end seals, spacers, bore pits, or vent pipes where required.

PART 323 - STRUCTURE, SPECIAL

323.1 The work under this item shall include the furnishing of all materials and performing all work necessary to complete any special structures shown on the Drawings.

323.2 PAYMENT: Payment for this item shall be made at the unit price bid for each structure as specified in the Proposal, and constructed as shown on the Drawings. Pipe, fittings, valves and other appurtenances will be paid for under other items. No additional payment will be made for excavation, backfill, foundations, or any particular element of construction or interior coatings.

PART 324 - MATERIALS FURNISHED BY CONTRACTOR AND INSTALLED BY CITY

324.1 The work under this item shall include furnishing and hauling of materials to the site of work. All necessary clearing, excavation, other site preparation, backfill and restoration, shall be performed by the contractor so that the City may install the materials in place with a minimum amount of delay. The Contractor shall furnish assistance to the City in installing the materials so that they may be readily installed. The City's responsibility shall be only for the actual installation of the materials. All other work shall be performed by the Contractor.

324.2 PAYMENT: Payment for this item shall be made at the unit price bid per material item of the type specified in the Proposal and actually installed per Drawings. Only materials specifically noted in the Proposal are included in this item. All necessary clearing, excavation, other site preparation, backfill and restoration will be paid for under other bid items.

PART 325 - SODDING AND SEEDING

325.1 Where the installation of water, sanitary or storm sewer mains traverse developed areas, residential or commercial, the Contractor shall restore all damaged sod turf using same type and variety. The restoration of sod turf shall be by either Sod Replacement or Hydromulch Seeding, as directed by the Engineer. Replacement sod shall match existing sod in type and variety.

325.1.1 Only that turf in one residential block may be removed at any time. Where residential blocks are not involved, only that turf in approximately 500 linear feet of trench excavation may be removed at any time. The Contractor shall restore all turf damaged by the construction. Payment for turf restoration will be per square yard, based on the length of main installed through an area.

325.2 Sod Replacement: Remove the sod turf with approved cutting equipment. Store the turf in an area where construction operations will not damage it and apply sufficient water to preserve the root system. Replace the sod turf after the trench has been backfilled and compacted. As an alternate to this method, the Contractor may furnish and install new solid slab grass sod of the same type as that which was removed. The new sod shall be moist when excavated from the source and kept moist until planted. Sod shall consist of vegetative parts (rhizomes, stolons, and roots) with an appreciable quantity of adhering soil. Sod that becomes dry shall be discarded. Sodded areas shall be thoroughly watered after placement.

325.3 Hydromulch Seeding: Remove, store, and replace topsoil. Apply seed, fertilizer, and mulch together in homogeneously mixed slurry. Fertilizer shall be 10-20-10 and shall be applied at a rate of 10 lbs. per 1,000 sq. ft. Mulch shall be wood fiber and applied at a rate of 46 lbs. per 1,000 sq. ft. Grass seed shall be either hulled Bermuda applied at a rate of 2 lbs. per 1,000 sq. ft. or K-31 fescue applied at a rate of 8 lbs. per 1,000 sq. ft. as directed. Mulch shall be kept moist for a minimum of 10 days or until seeds have germinated and rooted. Watering shall be provided as required to maintain the grass.

325.4 The Contractor shall obtain a construction meter from the Connection Control Division and pay all required fees for any watering. The Contractor shall maintain all sodded or seeded areas until acceptance of the contract.

325.5 PAYMENT: Payment for Sod Replacement or Hydromulch Seeding will be made at the unit price bid per square yard and shall include all necessary top soil

replacement, fertilizing, watering, and maintenance. The square yard pay quantity will be measured parallel to the pipe through the area being restored.

PART 326 - STREET WASH DOWN

326.1 The Contractor shall, at the written direction of the engineer, wash down streets to control dust and clean the streets in the area of construction. Contractor shall obtain a construction meter from the Connection Control Division of the Water and Sewer Department and shall pay all required fees for obtaining and using the meter.

326.2 PAYMENT: Payment for street wash down shall be made at the unit price bid per linear foot of street. No payment will be made for street washing without prior written instructions from the Engineer.

PART 327 - TRAFFIC CONTROL DEVICES

327.1 The Contractor shall furnish and install traffic control devices when construction is performed upon or adjacent to any street, alley, sidewalk, residence, public ground, or other location that is subject to pedestrian or vehicular traffic. Traffic control devices shall include safety fencing, barricades, signs, barrels, warning lights, arrow panels, flagmen, high level devices, etc.

327.2 Traffic Control Devices shall conform to the latest edition of the Manual on Uniform Traffic Control Devices.

327.3 Safety fence shall be an open mesh type, high-density plastic material, 48-inches in height, and colored International Safety Orange. Fence shall be supported by fence posts spaced at no more than 10 feet.

327.4 PAYMENT: Payment for safety fence shall be at the unit price bid per linear foot based on the total footage used for the duration of the project. No additional payment will be made for moving the fence as the job site changes. Payment for Type I, II, and III Barricades with flashing light; warning signs with flashing lights, 16 sq. ft. and over, and below 16 sq. ft.; barrels with steady burn light; advance warning arrow panels; and high level warning devices shall be made at the unit price bid per sign day. One sign day is one traffic control device in place for one day. Flagmen shall be paid for at the unit price bid per man-day. One man-day is one man flagging for one full eight (8) hour period. No payment will be made for cones.

PART 328 - BORE

328.1 Waterline installed under existing concrete or asphalt driveways shall be bored. The diameter of the bore shall be a maximum of 2-inches larger than the outside

diameter of the pipe bell. If the carrier pipe is ductile iron it shall be polyethylene wrapped and taped at one (1) foot intervals through the entire length of the bore. If the Engineer determines that boring is not possible, the driveway shall be open cut and the pavement replaced as directed by the Engineer.

328.2 PAYMENT: Payment for crossings by boring shall be at the unit price bid per linear foot as measured from edge to edge of the driveway. All carrier pipe shall be paid for under other items. No additional payment shall be made for excavation, backfilling, boring, tunneling, dewatering or sand fill, or bore pits.

PART 329 - PAVEMENT, REMOVAL AND REPLACEMENT

329.1 Work under this item includes removal and replacement of concrete or asphalt for sidewalks, driveways, parking lots, curbs, streets, alleys, and the like. Pavement crossed at right angles shall be saw cut, removed, and replaced as shown on the standard drawings or as directed by the Engineer for the type of pavement indicated on the proposal. Pavement crossed diagonally shall be squared by saw cutting at right angles to the paved area. If a construction joint is within three (3) feet of a proposed saw line, the pavement shall be replaced to the joint as directed by the Engineer. New concrete pavement shall bridge the top of the trench by a minimum of one (1) foot on each side. All paving shall conform to the standards and specifications of the Tulsa Office of the City Engineer and ODOT. All street cuts shall be approved by the Office of the City Engineer and a Permit shall be obtained before work may begin.

329.2 All concrete pavement removal shall be a minimum of 3 feet by 3 feet. Concrete shall be High Early Strength Class P5 as per ODOT Section 701A with a minimum 28 day compressive strength of 5,000 psi.

329.3 Concrete shall meet the existing concrete depth with a minimum depth of 8" for streets, 6" for commercial Driveways, 6" for residential driveways, and 4" for sidewalks. Edges of cut shall be sawcut full depth**.** No traffic shall be allowed on the street replacement for 24 hours after placing of concrete. Twenty-four hours after placing of concrete, all butt joints must be sawed a minimum of 2", cleaned and sealed with joint sealer, ODOT Section 701A.08(e). If curb and gutter are removed, they shall be replaced to the standards and specifications of the typical existing curb and gutter. When one or more longitudinal construction joints are removed, the joints shall be re-established in accordance with the City of Tulsa standards for concrete pavement. When a pavement section is removed along an existing longitudinal construction joint, the pavement shall be dowelled to the adjacent pavement.

329.4 All asphalt shall be Type S4 as per ODOT Section 708. The asphalt shall be compacted to a 92% maximum density as determined by AASHTO T-209 method. Spreading and finishing of asphalt shall meet ODOT Section 411.04(I).

Edges of cut shall be saw cut full depth. Prior to placement of asphalt in cut, a tack coat shall be uniformly applied. Tack coat shall be an asphalt rubber, meeting the specifications of ASTM D1190. Optional tack coat meeting ODOT requirements. All surface edge joints of cut/overlay shall be sealed with an asphalt rubber meeting minimum specifications of ASTM D1190. Asphalt rubber shall be squeegeed into edge joints. Optional edge seal shall meet ODOT requirements. Emulsion shall be squeegeed into edge joint and blotted with dry concrete screenings. If curb and gutter are removed, they shall be replaced to the standards and specifications of the typical existing curb and gutter. Macadamized or oiled surfaces shall be replaced with asphalt.

329.5 Materials for asphalt shall meet the following ODOT requirements:

329.6 PAYMENT: Payment for removal and replacement of concrete or asphalt pavement shall be at the unit price bid per square yard. The pay quantity of square yards will be computed using the standard pay width for the type of pavement replaced and the length of the pavement cut along the centerline of the pipe. The pay quantity will include pavement replaced due to the proximity of a construction joint if the specified criteria is meet. For diagonal crossings, the pay quantity will include the areas replaced due to squaring. Payment for saw cut shall be at the unit price bid per linear foot. Payment for curb and gutter shall be at the unit price bid per linear foot. Payment for dowells shall be at the unit price bid per each. No payment will be made for disposal of broken pavement, temporary surfaces, excavation, preparation of subgrade, forms, or reinforcing. No payment will be made for removal or replacement of gravel. No payment will be made for the replacement of pavement damaged by the Contractor's equipment movement. No payment will be made for joint sealer, tack coats, or edge sealing.

PART 330 - EROSION CONTROL MEASURES

330.1 The contractor is responsible to insure that measures are taken to minimize erosion and sedimentation problems. Measures include straw bale dikes, silt fence, silt dikes and inlet protection including but not limited to the following:

a) Place straw bale dikes in bar ditches at 500 ft. intervals on relatively flat grades and 200 ft. intervals on grades over 5%.

b) Place sediment sumps upstream of straw bales. Remove sediment on a regular basis.

c) Keep excavation and silt off of streets.

d) In areas where water line are being constructed adjacent to improved streets, measures shall be taken which will minimize siltation and excavation accumulating in existing storm sewers. Straw bales should be placed around

inlets. Precautions should be taken during heavy rains to assure that a flooding condition is not created.

e) Straw mulch can be used as an effective means of erosion control.

f) Erosion control measures shall be placed at the toe of slope of all cut and fill areas.

330.2 Straw bales shall be standard rectangular size, approximately 18" x 20" x 36", and shall be securely bound with wire. Bales shall be firmly anchored with wood or metal stakes approximately 3 feet long. A sediment sump shall be placed immediately upstream of each bale. Contractor shall clean and maintain sediment sumps throughout the maintenance period.

330.3 The contractor shall furnish and install straw mulch as directed. Mulch shall be applied at a rate of 1½ tons per acre. Mulch shall be securely anchored in place.

330.4 Payment for straw bales or other erosion control measures will be at the unit price bid and shall include the cost of sediment sumps and anchoring. Payment for straw mulch will be at the unit price bid per square yard and shall include the cost of anchoring.

PART 331 - WATER TABLE CRADLE

331.1 The work under this item shall include furnishing and installing Water Table Cradle as shown on the drawings or as directed by the Engineer and in accordance with the Standard Detail for Water Table Cradle.

331.2 The trench excavation shall be completely dewatered to provide a dry and stable trench bottom. The trench shall be excavated to a minimum of 18" below the bottom of the pipe. If additional base stabilization is required crushed stone, 3 1/2" to 1 1/2" (Gradation No. 1), shall be installed on the trench bottom, prior to the installation of water table cradle. Minimum trench widths for flexible pipe installations shall be as shown in the Standard Detail No. 367.

331.3 Geotextile filter fabric shall be installed on the trench bottom and walls. Crushed stone shall be installed in the trench directly on the filter fabric to a height of 12 inches above the top of the pipe. The crushed stone bedding material shall be carefully worked and compacted around the pipe. The filter fabric shall be placed over the top of the crushed stone with a minimum 24" lap. All fabric joints shall be lapped a minimum of 18". Water Table Cradle shall be installed for the full excavated width of the trench.

331.4 Crushed stone for Water Table Cradle shall be Gradation No. 57, 1" to No. 4. The Geotextile Filter Fabric shall be a nonwoven, needlepunch constructed fabric composed of petrochemical based polymers that are chemically and biologically

inert. The fabric unit weight shall be not les than 13 ounces per square yard with a Mullen Burst Strength (ASTM D-3786) of not less than 600 psi.

331.5 PAYMENT

331.5.1 Payment for Water Table Cradle will be made at the unit price bid per linear foot for the specified diameter of pipe. The unit price shall include the cost of all labor, equipment, and materials required. No additional payment will be made for dewatering or crushed stone required for additional base stabilization.

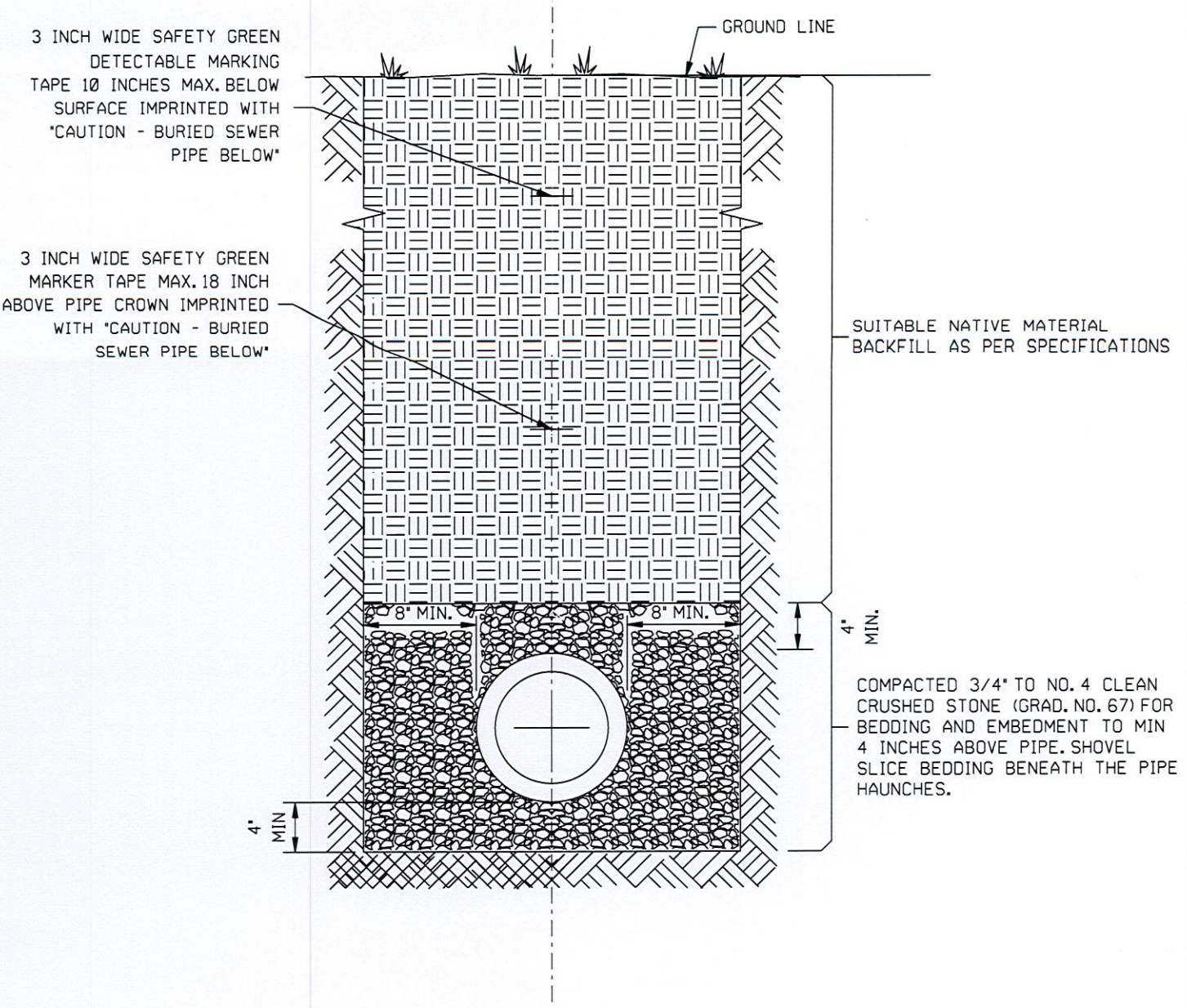
PART 332 - CONDUIT, OPEN CUT

332.1 The work under this item shall include the installation of railroad, street, or other crossings by open cut utilizing conduit as shown on the Drawings. The conduit pipe shall be installed to the line and grades given, and shall be installed in accordance with standard bedding detail for semi-rigid pipe.

332.2 The carrier pipe shall be installed with spacers, and end seals or bulkheads as shown in Standard No. 307.

332.3 PAYMENT: Payment for this item shall be made at the unit price bid per lineal foot of conduit, of the size specified in the Proposal, and placed as shown on the Drawings. All carrier pipe shall be paid for under other items. No additional payment shall be made for excavation, dewatering, backfill, spacers, bulkheads, end seals, or vent pipes where required.

SECTION END



TRENCH CROSS-SECTION
FOR DEPTHS UP TO 16' - 0"

NOTE:

1. ENGINEER OF RECORD SHALL SUBMIT LIVE AND EARTH LOADING CALCULATIONS FOR DEFLECTION AND PROJECT SPECIFIC EMBEDMENT DESIGN FOR DEPTHS GREATER THAN 16 FEET.

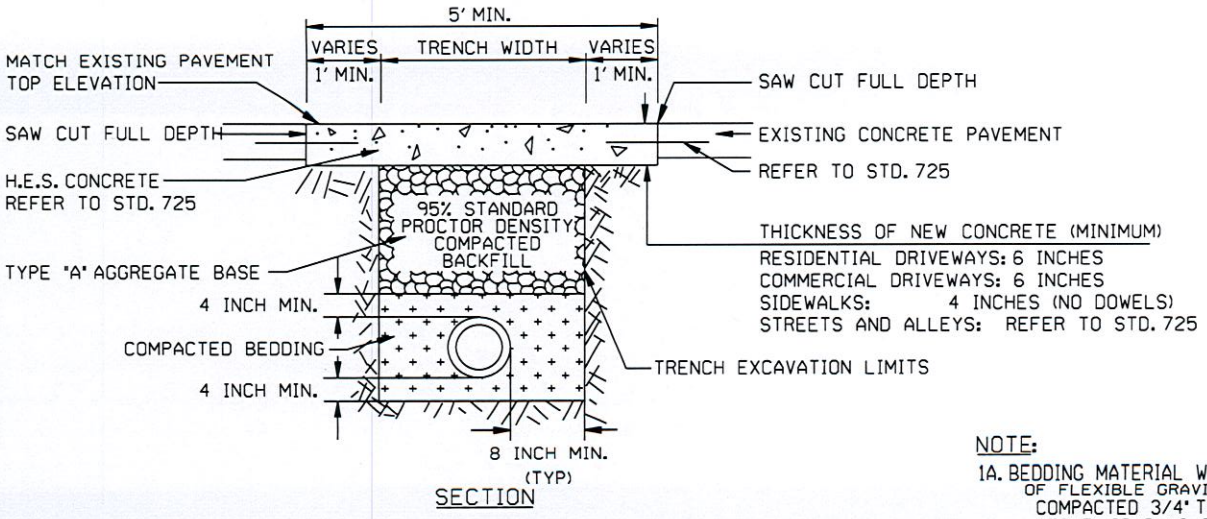
2. WHEN WATER TABLE CRADLE IS REQUIRED TO PREVENT SOIL MIGRATION AND/OR STABILIZE PIPE FOUNDATION SEE STANDARD DETAIL 367.

3. REFER TO STANDARD DETAIL 315 FOR STANDARD TRENCH WIDTH.

4. FOR PAVED AREAS, SEE STANDARD DETAIL 713.

BEDDING DETAIL POLYVINYL CHLORIDE FLEXIBLE SANITARY SEWER PIPE	
CITY OF TULSA, OKLAHOMA ENGINEERING SERVICES DEPARTMENT	
DRAWN BY: S.B.W. CHECKED BY: DATE: APRIL 2019	APPROVED
NOT TO SCALE	STANDARD NO. 351

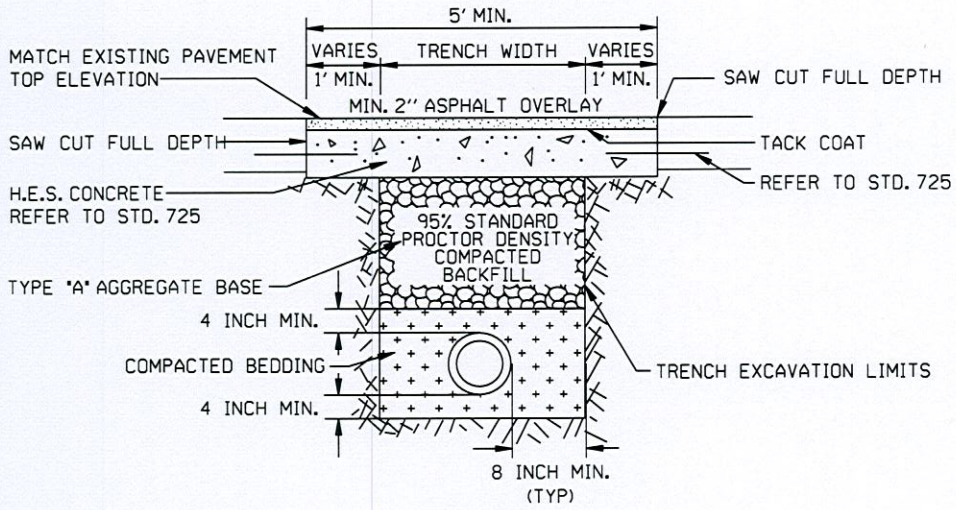
PATH NAME: /E1/PARTS/STD/DGN_STDS/351-BEDDINGPVC.DGN RMO 04/04/2019



SECTION

TYPICAL CONCRETE STREET OR DRIVEWAY (REPLACE FULL PANELS)

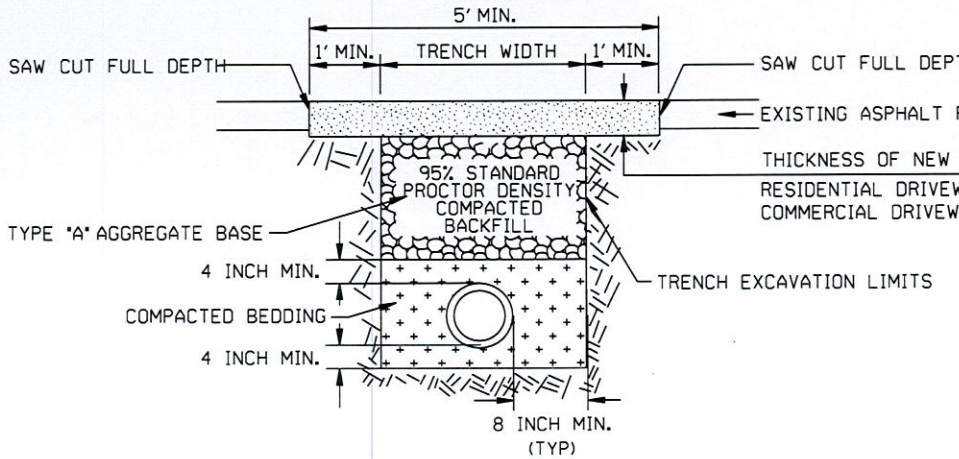
STD. PAY WIDTH = STD. TRENCH WIDTH + 2 FT.



SECTION

TYPICAL CONCRETE WITH 2" ASPHALT OVERLAY

FOR ASPHALT OR CONCRETE/ASPHALT STREETS
STD. PAY WIDTH = STD. TRENCH + 2 FT.



SECTION

TYPICAL ASPHALT DRIVEWAY OR PARKING LOT

STD. PAY WIDTH = STD. TRENCH WIDTH + 2 FT.

NOTE:

1A. BEDDING MATERIAL WITHIN 4 INCHES OF FLEXIBLE GRAVITY PIPE SHALL BE COMPACTED 3/4" TO NO. 4 CRUSHED STONE (GRAD NO. 67).

1B. BEDDING MATERIAL FOR RIGID AND SEMI-RIGID PIPE SHALL BE AS NOTED IN STDS. 304, 305 AND 751.

2. REMOVE AND REPLACE PAVEMENT TO NEAREST JOINT IF PROPOSED SAW CUT IS LESS THAN 5 FEET FROM JOINT.

3. NO PAYMENT WILL BE MADE FOR RE-PLACEMENT OF PAVEMENT OUTSIDE OF STANDARD PAY WIDTH DUE TO TRENCH EXCAVATION WIDER THAN STANDARD TRENCH WIDTH.

4. PAY QUANTITY WILL INCLUDE RE-PLACEMENT OF PAVEMENT DUE TO SQUARING OF DIAGONAL CUTS.

5. WHERE TRENCH EXCAVATION IS WITHIN 12" OF BACK OF CURB, COMPACTED BACKFILL SHALL BE ODOT TYPE "A" AGGREGATE BASE.

6. SEE STD. 731 FOR MINIMUM PAVING PANEL DIMENSIONS.

7. THE MAXIMUM RATIO OF PAVING PANEL DIMENSIONS SHALL BE 1.5:1

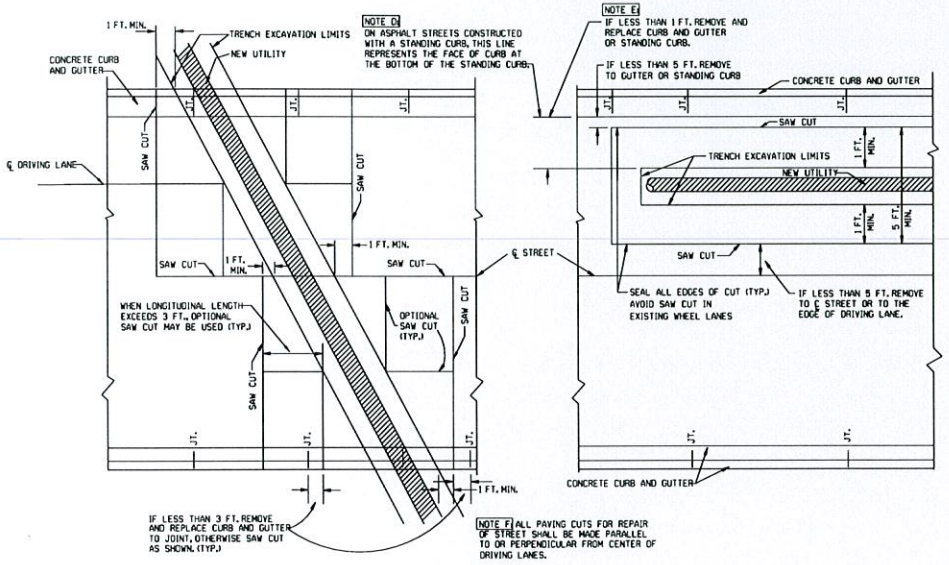
8. JOINT SHALL NOT BE PLACED IN VEHICLE WHEEL PATH.

9. FOR ASPHALT DIMENSIONS AND TYPE REFER TO STD. 725.

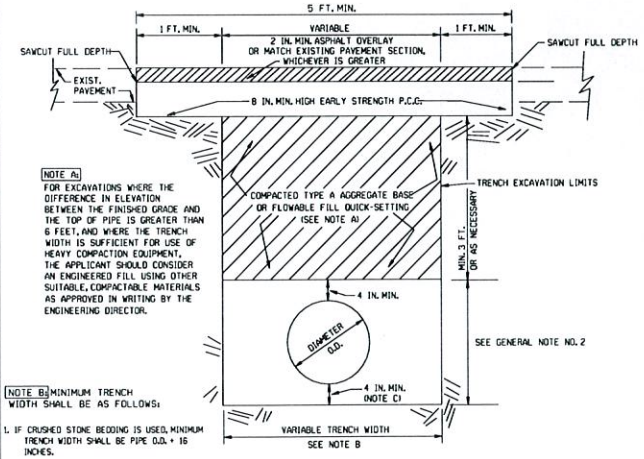
10. FOR FLOWABLE FILL BEDDING AND BACKFILL ATERNATIVES REFER TO STANDARDS 730 AND 731.

STANDARD DETAIL FOR PAVEMENT REMOVAL AND REPLACEMENT	
CITY OF TULSA, OKLAHOMA ENGINEERING SERVICES DEPARTMENT	
DRAWN BY: R.M.O. CHECKED BY: DATE: APRIL 2019	APPROVED
NOT TO SCALE	STANDARD NO. 713

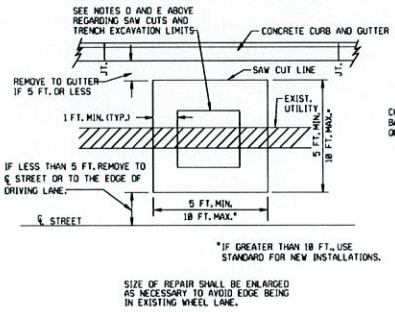
PATH NAME: /E1/PARTS/STD/DOA.5100/751-BEDDING-LG-PIPE-STM.DGN RMO 04/08/2019



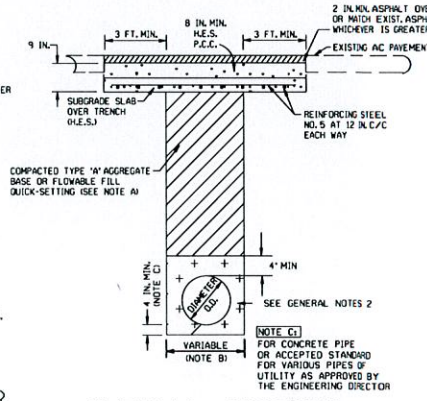
DIAGONAL INSTALLATIONS LONGITUDINAL INSTALLATIONS



TYPICAL SECTION



TYPICAL UTILITY REPAIR



TYPICAL SECTION

FOR STATE HIGHWAYS THAT ARE ARTERIAL STREETS

GENERAL NOTES

1. A STREET CUT PERMIT SHALL BE OBTAINED FOR ANY STREET CUTS BEFORE WORK PROCEEDS.
2. MATERIAL WITHIN 4 IN. OF PIPE SHALL BE EITHER COMPACTED 3/4" TO NO. 4 CRUSHED STONE, FLOWABLE FILL CONCRETE, OR MAY BE ANY SUITABLE MATERIAL APPROVED IN WRITING BY THE ENGINEERING DIRECTOR. IF FLOWABLE FILL IS USED AS BACKFILL MATERIAL, THEN EMBEDMENT MATERIAL MUST BE FLOWABLE FILL.
3. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH CURRENT ODOT SPECIFICATIONS, THE CITY OF TULSA STANDARDS AND SPECIAL PROVISIONS AS NOTED.
4. WHERE MATERIALS ARE TRANSPORTED IN THE PROSECUTION OF THE WORK, VEHICLES SHALL NOT BE LOADED BEYOND THE LOADING CAPACITY RECOMMENDED BY THE MANUFACTURER OF THE VEHICLE OR PRESCRIBED BY ANY FEDERAL, STATE, OR LOCAL LAW OR REGULATION. WHERE IT IS NECESSARY TO CROSS CURBING OR SIDEWALKS, PROTECTION AGAINST DAMAGE SHALL BE PROVIDED BY THE CONTRACTOR AND ANY DAMAGE TO ROADS, CURBING, OR SIDEWALKS SHALL BE REPAIRED BY THE C.O.T. PAVEMENT CUT CONTRACTOR AT THE EXPENSE OF THE PERMIT HOLDER.
5. TRAFFIC CONTROL: ALL WORK SHALL BE DONE IN COOPERATION WITH THE CITY TO ESTABLISH, INSTALL, MAINTAIN, AND OPERATE COMPLETE, ADEQUATE, AND SAFE TRAFFIC CONTROL DURING THE ENTIRE CONSTRUCTION PERIOD. BARRICADES, SIGNS, LIGHTS SHALL BE APPROVED BY THE TRAFFIC ENGINEER OF THE C.O.T. ALL TRAFFIC CONTROL ITEMS SHALL BE PROMPTLY REMOVED UPON COMPLETION OF THE WORK.
6. ALL LONGITUDINAL TRENCHES EXCEEDING 300 LINEAR FEET SHALL BE BACKFILLED AND MADE DRIVEABLE PRIOR TO EXCAVATING ANY ADDITIONAL TRENCH.
7. ALL SIDEWALK AND/OR CURB CONSTRUCTION OR RECONSTRUCTION, WITHIN THE STREET RADIUS, SHALL INCLUDE THE INSTALLATION OF A STANDARD WHEELCHAIR RAMP AS A PART OF THE CONSTRUCTION.
8. CONTACT THE CITY OF TULSA TRAFFIC ENGINEERING DIVISION AT 918-596-9766 BEFORE REMOVING OR REPLACING ANY TRAFFIC CONTROL DEVICES, INCLUDING, BUT NOT LIMITED TO, STRIPING AND REFLECTORS, SCHOOL CROSSING STRIPING AND DEVICES, ETC.
9. ALL EXISTING PAVEMENT CONTROL JOINTS SHALL BE RE-ESTABLISHED.
10. COMPACTION SHALL BE PER SECTION 303.04(a) AND (d) OF THE CURRENT EDITION OF THE STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION, AND APPLICABLE SUPPLEMENTS, AS PUBLISHED BY THE OKLAHOMA DEPARTMENT OF TRANSPORTATION.
11. JOINTS SHALL NOT BE PLACED IN VEHICLE WHEEL PATH.

CONSTRUCTION NOTES

1. BACKFILL
   - 1A. BACKFILL UNDER PAVEMENT SHALL BE BY ONE OF THE FOLLOWING METHODS:
     1. AGGREGATE BASE MATERIAL SHALL BE PLACED IN 8 IN. MAXIMUM LIFTS AND SHALL BE COMPACTED TO 100% STANDARD DENSITY AASHTO 180, METHOD D AS MEASURED BY THE NUCLEAR DENSITY METHOD. COMPACTION SHALL BE DONE BY A VIBRATORY HAND TAMPER, PER GENERAL NOTE 10.
     2. QUICK-SET FLOWABLE FILL
   - 1B. BACKFILL OUTSIDE OF PAVEMENT
     COMPACTION SHALL BE 95% STD. DENS. PER SECTION 303.04 (c) AND (d) OF THE CURRENT EDITION OF THE STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION, AND APPLICABLE SUPPLEMENTS, AS PUBLISHED BY THE OKLAHOMA DEPARTMENT OF TRANSPORTATION.
   - 1C. AGGREGATE BASE MATERIAL
     THIS MATERIAL COMMONLY CALLED 1 1/2 IN. TYPE A AGGREGATE BASE SHALL HAVE THE FOLLOWING GRADATION WHICH IS ODOT SECTION 703.01 TYPE A.

SQUARE 090	TYPE A
1-1/2 IN. (37.5)	100
3/4 IN. (19.0)	48-100
3/8 IN. (9.5)	30-75
NO. 4 (4.75)	25-60
NO. 10 (2.00)	20-43
NO. 40 (0.425)	8-26
NO. 200 (0.075)	4-12

   - 1D. THE SAND SHALL HAVE 100% PASSING THE 3/4 INCH SIEVE AND 0% - 20% PASSING THE NO. 200 SIEVE.
   - 1E.

FLOWABLE FILL	
QUICK SETTING (MASTER BUILDERS OR APPROVED EQUAL)	
TYPE I CEMENT	100 LBS.
FLY ASH	0 LBS.
SAND	2925 LBS.
WATER	585 LBS.
POZZUTEC 20	80 OZ.
FLOW	4-1/2 IN. MIN.

   28 DAY COMPRESSIVE STRENGTH SHALL BE 25 PSI TO 60 PSI.
2. CONCRETE
   BEFORE ANY RESTORATION, PAVEMENT THAT HAS BEEN UNDERMINED SHALL BE REMOVED TO STABLE MATERIAL BY SAWCUT AS PER DETAIL. ALL PAVEMENT REMOVAL SHALL BE A MINIMUM OF 5 FEET BY 5 FEET. CONCRETE FOR THE REPLACEMENT OF PAVEMENT, CURBS AND SIDEWALKS SHALL BE HIGH EARLY STRENGTH CLASS A AS PER ODOT SECTION 701.01.
3. ASPHALT
   ALL ASPHALT SHALL BE ODOT TYPE "S4". THE ASPHALT SHALL BE COMPACTED TO 92% MAXIMUM DENSITY AS DETERMINED BY AASHTO T-209 METHOD.
   SPREADING AND FINISHING OF ASPHALT TO MEET ODOT SECTION 411.04 (g)
   EDGES OF CUT SHALL BE SAW CUT TO FULL DEPTH.
   PRIOR TO PLACEMENT OF ASPHALT IN CUT A TACK COAT SHALL BE UNIFORMLY APPLIED.
   TACK COAT SHALL BE IN ACCORDANCE WITH SECTION 407 OF THE ODOT SPECIFICATIONS.
   ALL SURFACE EDGE JOINTS OF THE CUT/OVERLAY SHALL BE SEALED WITH AN ASPHALT RUBBER MEETING THE REQUIREMENTS OF SECTION 701.00(f) OF THE ODOT SPECIFICATIONS.
   IF CURB AND GUTTER ARE REMOVED THEY SHALL BE REPLACED TO THE STANDARDS AND SPECIFICATIONS OF THE TYPICAL EXISTING CURB AND GUTTER MATERIALS FOR ASPHALTIC CONCRETE SHALL MEET ODOT SECTION 788.
4. REVEGETATION
   ALL AREAS OUTSIDE THE PAVED PORTION OF THE RIGHT OF WAY WHERE VEGETATION HAS BEEN REMOVED SHALL BE RESTORED BY SODDING, AND MAINTAINED UNTIL FINAL ACCEPTANCE.
5. JOINTS
   WHEN ONE OR MORE LONGITUDINAL CONSTRUCTION JOINT IS REMOVED FOR A STREET CUT, THE JOINT SHALL BE RE-ESTABLISHED AS PER THE PAVEMENT STANDARDS FOR PORTLAND CEMENT CONCRETE.
6. DOWEL BARS
   DOWEL BARS SHALL BE INSTALLED IN ACCORDANCE WITH THE ENGINEERING SERVICES DEPARTMENT CRITERIA FOR LOAD TRANSFER DEVICES, AS SHOWN IN THE DETAILS ON THIS SHEET.
7. IF FLOWBLE FILL IS UTILIZED, IT SHALL BE PLACED IN LIFTS TO PREVENT FLOTATION OF THE PIPE.

REVISION	BY	DATE

CITY ENGINEER

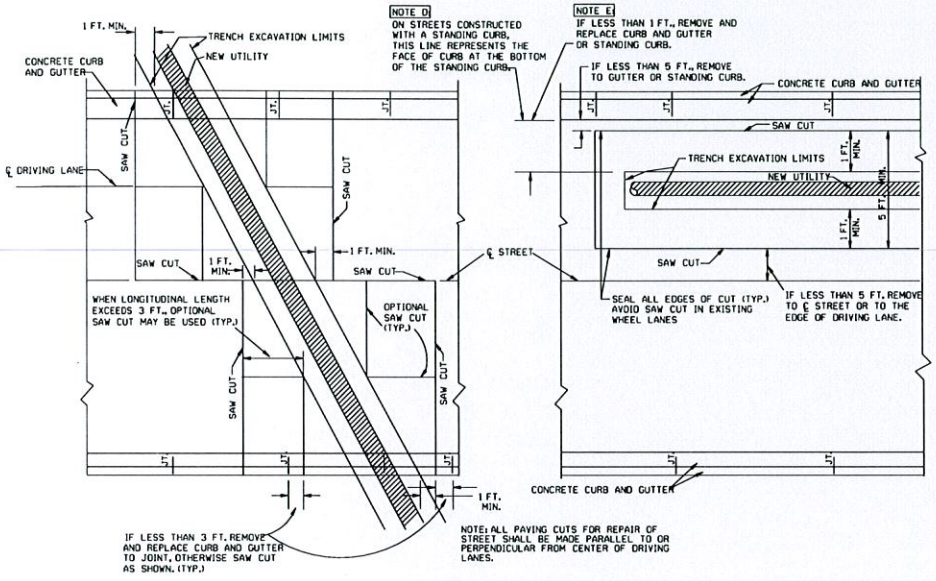
DESIGN MANAGER

CITY OF TULSA, OKLAHOMA
ENGINEERING SERVICES DEPARTMENT

STANDARD ASPHALT PAVEMENT CUT AND REPAIR

DATE: APRIL 2019 STD. 730

PART NAME: /E1/PARTS/STD/DGN.STDS/730-ASPHCUTREPAIR.DGN RMD 04/24/2019



DIAGONAL INSTALLATIONS LONGITUDINAL INSTALLATIONS

GENERAL NOTES

1. A STREET CUT PERMIT SHALL BE OBTAINED FOR ANY STREET CUTS BEFORE WORK PROCEEDS.
2. MATERIAL WITHIN 4 IN. OF PIPE SHALL BE EITHER COMPACTED 3/4" TO NO.4 CRUSHED STONE, FLOWABLE FILL CONCRETE, OR MAY BE ANY SUITABLE MATERIAL APPROVED IN WRITING BY THE ENGINEERING DIRECTOR. IF FLOWABLE FILL IS USED AS BACKFILL MATERIAL, THEN EMBEDMENT MATERIAL MUST BE FLOWABLE FILL.
3. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH CURRENT ODOT SPECIFICATIONS, THE CITY OF TULSA STANDARDS AND SPECIAL PROVISIONS AS NOTED.
4. WHERE MATERIALS ARE TRANSPORTED IN THE PROSECUTION OF THE WORK, VEHICLES SHALL NOT BE LOADED BEYOND THE LOADING CAPACITY RECOMMENDED BY THE MANUFACTURER OF THE VEHICLE OR PRESCRIBED BY ANY FEDERAL, STATE, OR LOCAL LAW OR REGULATION. WHERE IT IS NECESSARY TO CROSS CURBING OR SIDEWALKS, PROTECTION AGAINST DAMAGE SHALL BE PROVIDED BY THE CONTRACTOR AND ANY DAMAGE TO ROADS, CURBING, OR SIDEWALKS SHALL BE REPAIRED BY THE C.O.T. PAVEMENT CUT CONTRACTOR AT THE EXPENSE OF THE PERMIT BIDDER.
5. TRAFFIC CONTROL: ALL WORK SHALL BE DONE IN COOPERATION WITH THE CITY TO ESTABLISH, INSTALL, MAINTAIN, AND OPERATE COMPLETE, ADEQUATE, AND SAFE TRAFFIC CONTROL DURING THE ENTIRE CONSTRUCTION PERIOD. BARRICADES, SIGNS, LIGHTS, AND ALL TRAFFIC CONTROL ITEMS SHALL BE PROMPTLY REMOVED UPON COMPLETION OF THE WORK.
6. ALL LONGITUDINAL TRENCHES EXCEEDING 300 LINEAR FEET SHALL BE BACKFILLED AND MADE DRIVEABLE PRIOR TO EXCAVATING ANY ADDITIONAL TRENCH.
7. ALL SIDEWALK AND/OR CURB CONSTRUCTION OR RECONSTRUCTION, WITHIN THE STREET RADIUS, SHALL INCLUDE THE INSTALLATION OF A STANDARD WHEELCHAIR RAMP AS A PART OF THE CONSTRUCTION.
8. CONTACT THE CITY OF TULSA TRAFFIC ENGINEERING DIVISION AT 918-596-9766 BEFORE REMOVING OR REPLACING ANY TRAFFIC CONTROL DEVICES, INCLUDING, BUT NOT LIMITED TO, STRIPING AND REFLECTORS, SCHOOL CROSSING STRIPING AND DEVICES, ETC.
9. ALL EXISTING PAVEMENT CONTROL JOINTS SHALL BE RE-ESTABLISHED.
10. COMPACTION SHALL BE PER SECTION 303.04(c) AND (d) OF THE CURRENT EDITION OF THE STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION, AND APPLICABLE SUPPLEMENTS, AS PUBLISHED BY THE OKLAHOMA DEPARTMENT OF TRANSPORTATION.
11. MINIMUM PAVING PANEL DIMENSIONS SHALL BE 5 FEET BY 5 FEET.
12. THE MAXIMUM RATIO OF PAVING PANEL DIMENSIONS SHALL BE 1.5:1
13. JOINTS SHALL NOT BE PLACED IN VEHICLE WHEEL PATH.

CONSTRUCTION NOTES

1. BACKFILL

1A. BACKFILL UNDER PAVEMENT SHALL BE BY ONE OF THE FOLLOWING METHODS:
   1. AGGREGATE BASE MATERIAL SHALL BE PLACED IN 8 IN. MAXIMUM LIFTS AND SHALL BE COMPACTED TO 95% STANDARD DENSITY AASHTO T99 AS MEASURED BY THE NUCLEAR DENSITY METHOD. COMPACTION SHALL BE DONE BY A VIBRATORY HAND TAMPER, PER GENERAL NOTE 10.
   2. QUICK-SET FLOWABLE FILL

1B. BACKFILL OUTSIDE OF PAVEMENT
COMPACTION SHALL BE 90% STD. DENS. PER SECTION 303.04 (c) AND (d) OF THE CURRENT EDITION OF THE STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION, AND APPLICABLE SUPPLEMENTS, AS PUBLISHED BY THE OKLAHOMA DEPARTMENT OF TRANSPORTATION.

1C. AGGREGATE BASE MATERIAL
THIS MATERIAL COMMONLY CALLED 1-1/2 IN. TYPE A AGGREGATE BASE SHALL HAVE THE FOLLOWING GRADATION WHICH IS ODOT SECTION 703.01 TYPE A.

SQUARE (MM)	TYPE A
1-1/2 IN. (37.5)	100
3/4 IN. (19.0)	40-100
3/8 IN. (9.5)	30-75
NO. 4 (4.75)	25-60
NO. 10 (2.00)	20-43
NO. 40 (0.425)	8-26
NO. 200 (0.075)	4-12

1D. THE SAND SHALL HAVE 100% PASSING THE 3/4 INCH SIEVE AND 0% - 20% PASSING THE NO. 200 SIEVE.

FLOWABLE FILL

QUICK-SETTING RAPID SET		MASTER BUILDERS	
RAPID SET CEMENT	100 LBS.	TYPE I CEMENT	100 LBS.
FLY ASH	0 LBS.	FLY ASH	0 LBS.
SAND	2970 LBS.	SAND	2925 LBS.
WATER	500 LBS.	WATER	585 LBS.
CITRIC RETARDER	2%	POZZUTEC 20	80 OZ.
FLOW	4-1/2 IN. MIN.	FLOW	4-1/2 IN. MIN.

28 DAY COMPRESSIVE STRENGTH SHALL BE 25 PSI TO 60 PSI

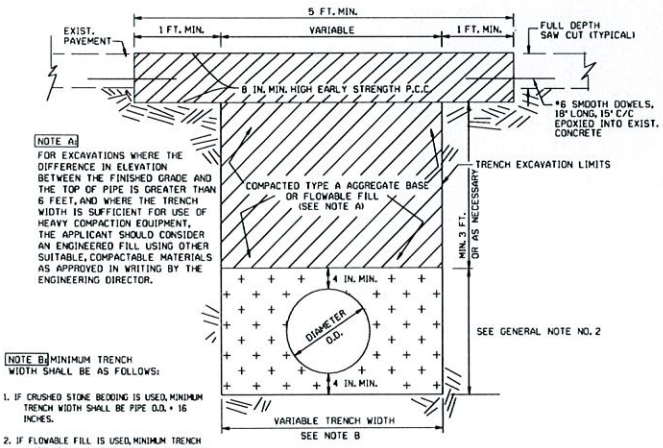
2. CONCRETE
BEFORE ANY RESTORATION, PAVEMENT THAT HAS BEEN UNDERMINED SHALL BE REMOVED TO STABLE MATERIAL BY SAWCUT AS PER DETAIL. ALL PAVEMENT REMOVAL SHALL BE A MINIMUM OF 5 FEET BY 5 FEET. CONCRETE FOR THE REPLACEMENT OF PAVEMENT, CURBS, AND SIDEWALKS SHALL BE HIGH EARLY STRENGTH CLASS A AS PER ODOT SECTION 701.01.

3. REVEGETATION
ALL AREAS OUTSIDE THE PAVED PORTION OF THE RIGHT OF WAY WHERE VEGETATION HAS BEEN REMOVED SHALL BE RESTORED BY SODDING, AND MAINTAINED UNTIL FINAL ACCEPTANCE.

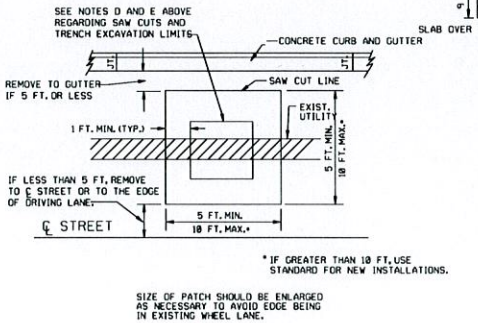
4. JOINTS
WHEN ONE OR MORE LONGITUDINAL CONSTRUCTION JOINT IS REMOVED FOR A STREET CUT, THE JOINT SHALL BE RE-ESTABLISHED AS PER THE PAVEMENT STANDARDS FOR PORTLAND CEMENT CONCRETE.

5. DOWEL BARS
DOWEL BARS SHALL BE INSTALLED IN ACCORDANCE WITH THE ENGINEERING SERVICES DEPARTMENT CRITERIA FOR LOAD TRANSFER DEVICES.
   - FOR TRANSVERSE JOINT ALIGNED WITH EXIST. DOWELLED JOINT, USE 1-1/4" X 18"L @ 12" C/C.
   - FOR MID-SLAB TRANSVERSE JOINT USE #18 DEF. BAR 18"L @ 18" C/C.
   - FOR LONGITUDINAL JOINT USE #5 DEF. BARS 30"L @ 30" C/C.

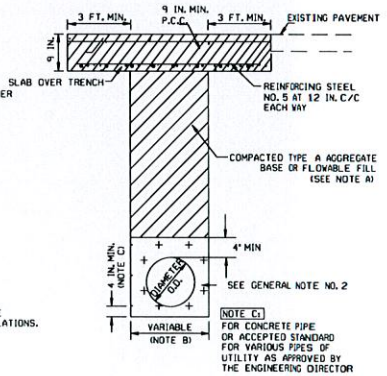
6. IF FLOWBLE FILL IS UTILIZED, IT SHALL BE PLACED IN LIFTS TO PREVENT FLOTATION OF THE PIPE.



TYPICAL SECTION



TYPICAL UTILITY REPAIR



TYPICAL SECTION

FOR STATE HIGHWAYS THAT ARE ARTERIAL STREETS

REVISION	BY	DATE

CITY ENGINEER

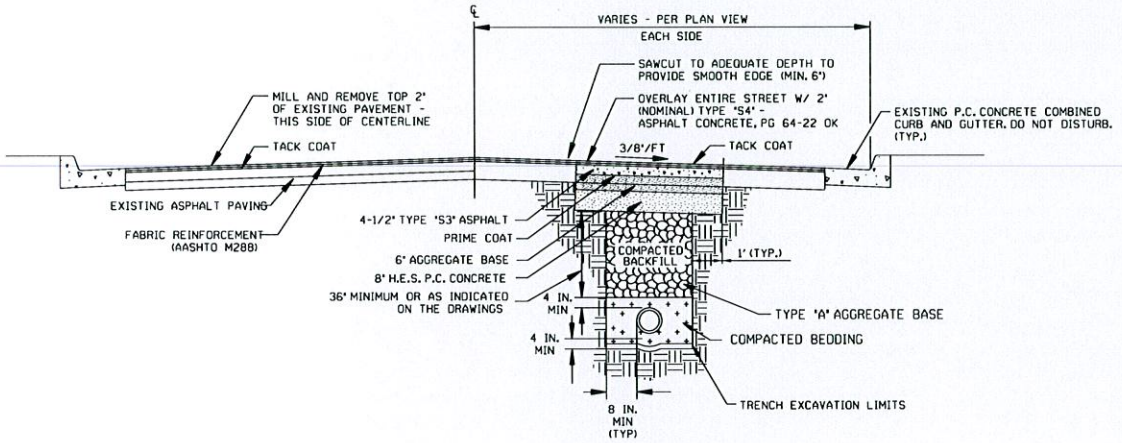
DESIGN MANAGER

CITY OF TULSA, OKLAHOMA
ENGINEERING SERVICES DEPARTMENT

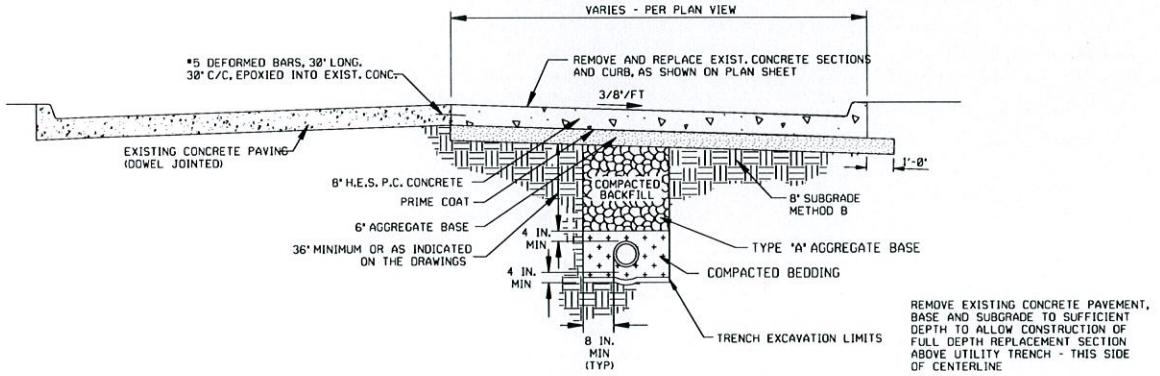
STANDARD CONCRETE PAVEMENT CUT AND REPAIR

DATE: APRIL 2019 STD. 731

PATH NAME: /E1/PARTS/STD/DGN STDS/731-CONCCUTREPAIR.DGN RMD 04/04/2019



TYPICAL SECTION
ASPHALT PAVEMENT REMOVAL
AND REPLACEMENT W/ OVERLAY



REMOVE EXISTING CONCRETE PAVEMENT, BASE AND SUBGRADE TO SUFFICIENT DEPTH TO ALLOW CONSTRUCTION OF FULL DEPTH REPLACEMENT SECTION ABOVE UTILITY TRENCH - THIS SIDE OF CENTERLINE

TYPICAL SECTION
CONCRETE PAVEMENT REMOVAL
AND REPLACEMENT W/ CURBED AREAS

PAVING NOTES

1. ALL MATERIALS AND CONSTRUCTION, EXCEPT AS NOTED, SHALL BE IN STRICT ACCORDANCE WITH THE 1999 OKLAHOMA STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION AND SUPPLEMENTS THERETO. SUPPLEMENTS TO THE STANDARD SPECIFICATIONS GOVERN OVER THE STANDARD SPECIFICATIONS.
2. CONTRACTOR SHALL CLEAN ASPHALT PAVEMENT SURFACE AND REMOVE LOOSE MATERIAL PRIOR TO APPLYING THE TACK COAT. TACK COAT SHALL BE IN ACCORDANCE WITH SECTION 407 OF THE STANDARD SPECIFICATIONS.
3. UPON REQUEST, A ONE QUART TACK COAT SAMPLE FROM THE CONTRACTOR'S TACK COAT TRUCK SHALL BE DELIVERED BY THE CONTRACTOR TO THE INSPECTOR 24 HOURS PRIOR TO APPLICATION. OIL CONTENT MUST BE 23% OR GREATER.
4. MINIMUM TACK APPLICATION RATE IS 0.1 GAL./SQ. YD. EQUIPMENT HEATER, AGITATOR AND SPRAY BAR SHALL BE OPERABLE. CONTRACTOR SHALL BROOM OFF EXCESS TACK. TACK SHALL BE COMPLETELY CURED BEFORE LAYING ASPHALT.
5. ASPHALT TEMPERATURE SHALL NOT EXCEED 350°F OR MAXIMUM DESIGN TEMPERATURE AT PLANT DISCHARGE.
6. AMBIENT TEMPERATURE AT LAYDOWN SHALL BE IN ACCORDANCE WITH SPECIFICATION NO. 411.04(F). SURFACE MUST BE DRY.
7. ASPHALT TEMPERATURE AT LAYDOWN SHALL BE A MAXIMUM OF 325°F AND A MINIMUM OF 285°F.
8. PAVING OPERATION SHALL BE CONTINUOUS WITH A STEADY FLOW OF TRUCKS.
9. CONTRACTOR SHALL ESTABLISH ROLLING PATTERN BY TRACKING DENSITIES WITH A NUCLEAR GAUGE. CONTRACTOR SHALL VERIFY PATTERN WITH TESTING LABORATORY. EXTRACTION/ GRADATION SAMPLES SHALL BE TAKEN DAILY.
10. CONTRACTOR SHALL FURNISH, WITH QUALIFIED OPERATORS, A BREAKDOWN ROLLER (STEEL), A PNEUMATIC ROLLER (RUBBER TIRE) AND A FINISH ROLLER (STEEL). ROLLER SPRAY SYSTEMS SHALL BE OPERABLE AT ALL TIMES DURING THE PERFORMANCE OF THE WORK.
11. CONTRACTOR SHALL ROLL OUT AND COMPACT ASPHALT MATERIAL ABOVE 180°F ASPHALT TEMPERATURE.
12. CONTRACTOR SHALL TAKE THREE (3) CORINGS FOR EACH DAYS PRODUCTION OR EVERY 500 TONS. LOCATIONS TO BE DESIGNATED BY THE ENGINEER.
13. CONTRACTOR SHALL APPLY A TACK COAT TO THE FACE OF THE GUTTER PRIOR TO PLACEMENT OF PAVING.
14. WHERE NEW PAVEMENTS ARE TO BE CONSTRUCTED, THE EXISTING ASPHALT CONCRETE, CONCRETE, ANY UNDERLYING GRANDULAR BASE, ANY SURFACE VEGETATION AND TOPSOIL SHALL BE REMOVED FULL-DEPTH, AFTER REMOVING THE SURFACE MATERIALS AND COMPLETING ANY REQUIRED CUTS, THE EXPOSED SUBGRADE SHALL BE PROOFROLLED, UNDER THE OBSERVATION OF THE ENGINEER, ACCORDING TO THE REQUIREMENTS OF SECTION 203 OF THE ODOT SPECIFICATIONS.
15. ANY SOFT OR UNSTABLE SOILS IDENTIFIED DURING THE PROOFROLLING PROCEDURE SHALL BE OVEREXCAVATED FULL-DEPTH AND REPLACED WITH APPROVED ENGINEERED FILL, IF THEY CANNOT BE STABILIZED IN PLACE.
16. EXPOSED SUBGRADE MUST BE COMPACTED TO NO LESS THAN 95% OF THE MATERIAL'S MAXIMUM LABORATORY DRY DENSITY DETERMINED IN ACCORDANCE WITH ASTM D-698 (AASHTO T-99). THE RECOMMENDED MOISTURE CONTENT SHALL BE MAINTAINED IN THE COMPACTED SUBGRADE AND FILLS UNTIL FILLS ARE COMPLETE AND PAVEMENTS CONSTRUCTED.
17. FOR FLOWABLE FILL BEDDING AND BACKFILL ALTERNATIVES REFER TO STD 730 AND 731.
18. SAW CUTS SHALL BE FULL DEPTH OF THE PAVEMENT.

BEDDING AND BACKFILL NOTES **

1. BACKFILL SHALL BE ODOT TYPE "A" AGGREGATE BASE.
2. BEDDING MATERIAL WITHIN 4 IN. OF FLEXIBLE GRAVITY PIPE SHALL BE COMPACTED 3/4" TO NO. 4 CRUSHED STONE (GRAD NO. 67). SHOVEL SLICE BEDDING BENEATH THE PIPE HAUNCHES.
3. BEDDING MATERIAL FOR RIGID AND SEMI-RIGID PIPE SHALL BE AS NOTED IN STDS. 304, 305 AND 751.
4. PLACE BACKFILL IN HORIZONTAL LAYERS NOT TO EXCEED 8" LOOSE THICKNESS. COMPACT WITH MECHANICAL TAMPER TO NO LESS THAN 95% STANDARD PROCTOR DENSITY AS MEASURED BY NUCLEAR DENSITY METHOD.

REVISION	BY	DATE

CITY ENGINEER

HAS
DESIGN MANAGER

CITY OF TULSA, OKLAHOMA
ENGINEERING SERVICES DEPARTMENT

STANDARD PAVEMENT REHABILITATION FOR UTILITY CONSTRUCTION

DATE: APRIL 2019 STD. 733

PATH NAME: /E|/PARTS/STD/DGN.STDS/733-SS-STR-PATCH3.DGN RMD 04/08/2019