INDEX

SANITARY SEWER AND WATER LINE CONSTRUCTION

DIVISION III - CONSTRUCTION SPECIFICATIONS			PAGE NO.
SECTION	301	SCOPE	301
SECTION	302	APPLICABLE SPECIFICATIONS	301
SECTION	303	RIGHT-OF-WAY CLEARING AND RESTORING	301
	303.1	Description	301
	303.2	Materials and Tests	301
	303.4	Construction	301
	303.5	Methods of Measurement	303
	303.6	Basis of Payment	303
SECTION	304	STREET AND ALLEY, RIGHT-OF-WAY CROSSINGS	303
	304.1	Description	303
	304.2	Materials and Tests	303
	304.4	Construction	304
	304.5	Method of Measurement	304
	304.6	Basis of Payment	304
SECTION	306	EXCAVATION AND BACKFILL	304
	306.1	Description	304
	306.4	Construction	305
	306.5	Method of Measurement	306
	306.6	Basis of Payment	306
SECTION	307	PIPE, VITRIFIED CLAY	307
	307.1	Description	307
	307.2	Materials and Tests	307
	307.4	Construction	307
	307.5	Method of Payment	308
	307.6	Basis of Payment	308
SECTION	308	PIPE, REINFORCED CONCRETE	308
	308.1	Description	308
	308.2	Materials and Tests	308
	308.4	Construction	308
	308.5	Method of Payment	309
	308.6	Basis of Payment	309
SECTION	309	PIPE, CAST IRON AND DUCTILE IRON	309
	309.1	Description	309
	309.2	Materials and Tests	309
	309.4	Construction	309
	309.5	Method of Payment	311
	309.6	Basis of Payment	311
SECTION	310	PIPE, STEEL	311
	310.1	Description	311
	310.2	Materials and Tests	311
	310.4	Construction	311
	310.5	Method of Payment	312
	310.6	Basis of Payment	312

SECTION	311	THERMOPLASTIC POLYVINYL CHLORIDE (PVC) WATER PIPE	312
	311.1	Description	312
	311.2	Materials and Tests	312
	311.4	Construction	312
	311.5	Method of Payment	312
	311.6	Basis of Payment	313
SECTION	312	FIELD TESTS AND REVISIONS	313
	312.1	Description	313
	312.2	Materials and Tests	313
	312.6	Basis of Payment	315
SECTION	313	FITTING	315
	313.1	Description	315
	313.2	Materials and Tests	315
	313.5	Method of Payment	315
	313.6	Basis of Payment	316
SECTION	314	MANHOLE	316
	314.1	Description	316
	314.2	Materials and Tests	316
	314.4	Construction	316
	314.5	Method of Payment	317
	314.6	Basis of Payment	318
SECTION	315	LAMPHOLE	318
	315.1	Description	318
	315.2	Materials and Tests	318
	315.4	Construction	318
	315.5	Method of Payment	318
	315.6	Basis of Payment	318
SECTION	316	CONNECTION	318
	316.1	Description	318
	316.4	Construction	318
	316.5	Method of Measurement	319
	316.6	Basis of Payment	320
SECTION	317	VALVE AND FIRE HYDRANTS	320
	317.1	Description	320
	317.2	Materials and Tests	320
	317.4	Construction	320
	317.5	Methods of Measurement	321
	317.6	Basis of Payment	321
SECTION	318	ENCASEMENT, CONCRETE	322
	318.1	Description	322
	318.2	Materials and Tests	322
	318.4	Construction	322
	318.5	Method of Payment	322
	318.6	Basis of Payment	322
SECTION	319	PIERS, REINFORCED CONCRETE	322
	319.1	Description	322
	319.2	Materials and Tests	322
	319.4	Construction	322
	319.5	Method of Payment	323
	319.6	Basis of Payment	323

SECTION	320	BORING	323
	320.1	Description	323
	320.3	Equipment	323
	320.4	Construction	323
	320.5	Method of Payment	323
	320.6	Basis of Payment	323
SECTION	321	CONDUIT FOR STEEL ENCASEMENT	323
	321.1	Description	323
	321.2	Materials and Tests	323
	321.3	Equipment	323
	321.4	Construction	324
	321.5	Method of Payment	324
	321.6	Basis of Payment	324
SECTION	322	CONCRETE STRUCTURE, SPECIAL	324
	322.1	Description	324
	322.2	Materials and Tests	324
	322.4	Construction	324
	322.5	Method of Payment	328
SECTION	323	STRUCTURE, SPECIAL	328
	323.1	Description	328
	323.5	Method of Payment	328
SECTION	324	MATERIALS FURNISHED BY OWNER AND INSTALLED BY CONTRACTOR	
	324.1	Description	328
	324.5	Method of Payment	328
SECTION	325	TYPE PSM POLYVINYL CHLORIDE (PVC) SEWER PIPE AND FITTINGS	328
	325.1	Description	328
	325.2	Materials and Tests	328
	325.3	Construction	328
	325.5	Method of Payment	329
	325.6	Basis of Payment	329

DIVISION III

SANITARY SEWER AND WATER LINE CONSTRUCTION SPECIFICATIONS

301. SCOPE: This division shall consist of the furnishing and installing of water distribution lines, sanitary sewer lines, appurtenances, and related work, at the locations and grades as set out on the plans or established by the Engineer.

302. APPLICABLE SPECIFICATIONS: The cited specifications, standards, and publications (including latest amendments thereto) referenced to by basic designation only, form a part of this specification to the extent indicated by the references thereto.

303. RIGHT-OF-WAY CLEARING AND RESTORING:

303.1 Description: Work under this item shall include the removal and reconstruction or replacement of all obstructions affected, other than those covered in Section 304, by the construction of the project including, but not limited to fences, retaining walls, patios, barbecues, signs, mailboxes, outbuildings, landscaping, sidewalks, driveways, parking lot surfacing, curbs, and the like. Any such obstructions which are not to be reconstructed are so designed 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. All sidewalk, driveway, and parking lot replacement shall be of at least equal quality, thickness, compacted subgrade and base course, and surface course as that removed or damaged. 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.

303.2 Materials and Tests:

(A) Backfill materials under parking lots and driveways shall be of select material as approved by the Engineer.

(B) Portland Cement Concrete shall be 3500 psi compressive strength, high-early-strength (HES) concrete in accordance with City of Enid Standards for HES cement, for all concrete parking lots and driveways and shall be 3000 psi compressive strength concrete for all sidewalks and other concrete structures.

(C) Asphaltic Concrete - Bituminous pavement shall meet the requirements of the City of Enid Standard Specifications for Streets and Alleys.

(D) Sampling and Testing - Sampling of materials will be made in accordance with the appropriate methods specified in the Standard Specifications for Street and Alley Construction for the City of Enid. Tests will be conducted in accordance with the schedule of tests provided in the special provisions or as shown on the plans.

303.4 Construction:

(A) 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, or parking lot previously existed.

(B) Sidewalks, driveways, parking lots, and other paved areas, all or partially composed of concrete, asphaltic concrete, or bituminous material shall be saw cut, removed, and replaced to at least the standard trench width if the project crossing is at right angles to the obstruction. If a construction joint is within two (2) feet of any proposed sawed line, the cut shall be extended to the joint, or as directed by the Engineer. Curbs shall be tunneled under in all cases, unless otherwise approved in writing by the Engineer.

(C) Backfill under sidewalks, driveways, parking lots, and other paved areas shall be thoroughly compacted with sufficient moisture and by mechanical means to prevent settlement. Settlement or other failure of backfill or restored right-of-way shall be corrected immediately. The method of correction shall be as directed by the Engineer.

(D) Existing water and sewer lines: Wherever existing water or sewer lines are encountered, the contractor shall protect the same from damage. In case damage does result, the contractor shall, as directed by the Engineer, repair the same at his own expense.

(E) Vertical and horizontal separation of water and sewer lines: Where a sanitary sewer crosses any existing or proposed water main and is closer than 10-feet horizontally or 2-feet vertically the sanitary sewer shall be ductile iron pipe for a distance of 20-feet horizontal. If the sanitary sewer crosses above the water main, the sanitary sewer shall be ductile iron pipe and concrete encased. Where a sanitary sewer is constructed closer than 50 feet to a water well (existing or proposal) the sanitary sewer shall be ductile iron pipe.

Where a water main crosses any existing or proposed sanitary sewer and is closer than 10-feet horizontally or 2-feet vertically, the sanitary sewer shall be replaced for a distance of 20-feet horizontally with ductile iron pipe. If the water main crosses below the sanitary sewer, the sanitary sewer shall be replaced with ductile iron pipe and concrete encased.

(F) Existing structures which are to be abandoned shall be broken off or removed to a depth of not less than six (6) inches below the foundation grade of new structures. Any blasting or other operation which might endanger the new work shall be completed prior to the construction of any part of the new structure. After the removal of any existing structures, all excavations not to be occupied by new structures and all holes created shall be cleaned up and the site left in a neat and orderly condition.

(G) If an obstruction is of public ownership, the contractor shall notify the appropriate agency, and obtain any necessary permit or license forty-eight (48) 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.

The contractor shall notify all utility companies prior to beginning construction and shall provide an electrical or mechanical device or use such other means he may select, to locate any hidden utility line, oil or gas pipe line, water pipe line, sewer pipe line, telegraph and telephone line or other structures provided for in these specifications and locate such line or structures shown on the plans and any uncharted line or structure whether shown on the plans or not and protect, adjust to grade, disconnect and replace, relocate and replace, remove, provide supports during the construction and settlement of backfill and protect against freezing or unnecessary damage by the elements of existing utility lines,

oil or gas pipe lines, water pipe lines, sewer pipe lines, telegraph and telephone lines, railroad right-of-way lines and other structures and shall pay all fees to County, City, State or Federal agencies which may be required in the performance of this work. In the event injury does result to any gas lines, power lines or poles, telephone lines or poles, etc., the contractor shall, holding the owner entirely blameless, make proper restitution.

303.5 Method of Measurement:

(A) Remove and replace paved driveways, paved parking lots and other paved areas, except sidewalks, shall be measured by the square yard. This area will be derived by multiplying the length along the centerline of the pipe by the standard trench width and converting to square yards, unless otherwise approved by the Engineer.

(B) Remove and replace sidewalks shall be measured by the square foot, whereby the area was measured in the same manner as paved driveways in Section 303.5(A) above.

(C) Gravel and rock driveways, parking lots, and other areas will not be measured for payment, but rather shall be considered incidental to the work.

(D) Temporary materials required for maintenance of traffic through pavement cut locations will not be measured for payment.

(E) Compaction of backfill to 90% Standard Density in driveways, parking lots, etc. will not be measured for payment, and the cost of this work shall be included in other bid items.

(F) Other structures and obstructions shall not be measured for payment, unless shown on the proposal, and the cost of this work shall be included in other bid items.

303.6 Basis of Payment: Accepted quantities, measured as provided above will be paid at the contract unit price for:

Pavement repair, HES concrete . . . . . Sq. Yd.
Pavement repair, asphaltic . . . . . Sq. Yd.
Sidewalk repair, concrete . . . . . Sq. Yd.

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

304. STREET AND ALLEY, RIGHT-OF-WAY CROSSINGS:

304.1 Description: Work under this item shall consist of backfilling, compacting, and pavement repair, where applicable, of all trenches crossing streets and alleys, dedicated or proposed to be dedicated to the public in accordance with the lines, grades and dimensions shown on the plans or as directed by the Engineer.

304.2 Materials and Tests:

(A) Backfill materials and streets and alleys shall be in accordance with Section 413 and shall be compacted to 95% Standard Density at its optimum moisture content.

(B) Portland Cement Concrete shall be high-early-strength (HES) 3500 psi compressive strength and shall be in accordance with Section 303.2(B).

(C) Asphaltic Concrete - Bituminous Pavement shall meet the requirements of the City of Enid Standard Specifications for Streets and Alleys.

(D) Sampling and Testing - Sampling and testing of work and materials shall be in accordance with Section 303.2(D).

304.4 Construction:

(A) Compaction - The contractor shall place the select soil in horizontal layers not to exceed eight (8) inches (loose measurement) and shall compact the select soil to 95% Standard Density at its optimum moisture content.

(B) Pavement Removal - Removal of paved surfaces shall be in accordance with the standard drawings.

(C) Pavement Repair - Concrete and Bituminous Pavement shall be repaired in accordance with the standard drawings and the Standard Specifications for Streets and Alley Construction for the City of Enid, Oklahoma, latest edition.

304.5 Method of Measurement:

(A) Compacted backfill in unpaved streets and alleys will be measured by the cubic yard. This volume will be derived by multiplying the length along the centerline of the pipe by the standard trench width and by the average depth of the trench and converting to cubic yards, unless otherwise approved by the Engineer.

(B) Compaction of backfill to 95% Standard Density in paved streets and alleys will not be measured for payment, and the cost of this work shall be included in removal and replacement of pavement.

(C) Remove and replace concrete and bituminous pavement will be measured by the square yard. This area will be derived by multiplying the length along the centerline of the pipe by the standard trench width plus 12-inches on each side of the trench and converting to square yards.

(D) Over-breakage (the removal of more paving than is specified in Section 304.4(C) above) will not be measured for payment but shall be repaired in accordance with these specifications at the expense of the contractor.

304.6 Basis of Payment: Accepted quantities of the type specified on the proposal, measured as provided above, will be paid for at the contract unit price for:

Remove and replace pavement . . . . . Sq. Yd.

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

306. EXCAVATION AND BACKFILL:

306.1 Description: 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, composition 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. The contractor shall fully inform himself of the conditions to be encountered and shall include all payment for same in his bid prices stated in the proposal. No payment will be made for extra work caused by unusual conditions not anticipated by the contractor.

306.4 Construction:

(A) 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 Engineer. It shall be excavated a maximum of one hundred fifty feet (150') in advance of pipe laying, or less, as permitted 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 Drawings, 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 Engineer determines that encasement then is required, said 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 Engineer. In the event suitable material is not available, sand shall be used. When rock is encountered and concrete encasement 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 crushed stone in order to provide a stable base for the pipe.

(B) Class "D" bedding shall be used for bedding of all pipe as shown on the Standard Drawings, unless otherwise specified on the plans or as designated in the Standard Drawings, due to trench condition.

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 Engineer, is suitable for backfilling. In the event the excavated material is not suitable, sand or other approved material shall be used. From trench bottom to six inches above the pipe, the trench shall be backfilled by hand or by mechanical methods approved by the Engineer. 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 operations shall be completed within one hundred fifty (150) feet or less of the finished line at all times, as directed by the Engineer.

(C) All trenches excavated across any sidewalk, driveway, parking lot, or other paved area, excluding streets and alleys shall be backfilled and compacted to the same density as the existing soil adjacent to the side of the trench, but shall not be less than 95% Standard Density, provided the excavated material consists of soil that can be readily compacted at the optimum moisture. If the excavated material consists of mostly clay or silt containing an excess of moisture, such excavated material shall be removed from the site of the work and a Class "A" bedding shall be provided, that is, the trench filled with sand or select soil. Trenches excavated across existing or proposed street or alley paving shall be

backfilled in accordance with Section 304. 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. Boring will be required at all paved street crossings unless otherwise specified or approved by the Engineer.

306.5 Method of Measurement:

(A) For the purpose of determining pay quantities, trenches will be measured through manholes, junction boxes and similar structures, based on the applicable width of trench for size of sewer under consideration unless otherwise specified. Should size of sewer change at a manhole or other structure, the appropriate width of trench for each size shall apply, with the consideration, for the purpose of ascertaining pay quantities, that the change of size takes place at the center line of the manhole or structure.

(B) Payment for excavation of sanitary sewer shall be made at the unit price bid per linear foot for widths and class as shown in the attached Standard Details and depths from 0 feet to 6 feet, 6 feet to 8 feet, 8 feet to 10 feet, 10 feet to 12 feet, and so forth at 2 foot intervals. Such unit price shall be construed to apply to separate layers of trench excavation and not the full depth from ground surface to bottom excavation, except in the first classification, that is to say the depth from 0 feet to 6 feet means from the ground surface to an elevation of depth 6 feet below the surface, the depth from 6 feet to 8 feet means that yardage of excavation between an elevation 6 feet below the ground surface and 8 feet below the ground surface; and likewise other classifications of depths of 8 feet to 10 feet, 10 feet to 12 feet, and so forth at 2 foot intervals, means the yardage between depths or elevations 8 feet and 10 feet, 10 feet and 12 feet, etc., respectively.

No extra payment will be made for material excavated outside the neat lines of the standard trench width as given in the attached Standard Details. No additional payment will be made for: backfilling; compaction of backfill; materials used for backfill under existing and/or proposed roadway fills, street, alleys, driveways, sidewalks, parking lots as shown on the drawings; removing and replacing of topsoils and obstructions, tunneling of trees, storm sewer or other obstructions; blasting; bracing and shoring; dewatering; pumping and draining; grade base stabilization; removal of excess excavated materials; or restoration of the site. It is mutually understood that subterranean water, quick sand, or other unstable earth may be encountered and the contractor has taken such into consideration in making this bid. Where such is encountered, the 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 trench width as given in attached Standard Details; or for crushed stone. No additional compensation shall be made for extra excavation and backfill required because of underground obstructions.

(C) Payment for trench excavation for water lines shall be included under unit bid price for pipe.

306.6 Basis of Payment: Accepted quantities, measured as provided above, will be paid at the contract unit price for:

EXCAVATION AND BACKFILL (Sanitary Sewer)

0' to 6' of depth . . . . . Lin. Ft.
6' to 8' of depth . . . . . Lin. Ft.
8' to 10' of depth. . . . . .Lin. Ft.

and so forth in 2 foot increments, which shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

307. PIPE, VITRIFIED CLAY:

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

307.2 Materials and Tests: Materials shall be in accordance with Section 407 and testing shall be in accordance with Section 312.

307.4 Construction:

(A) The pipe shall be laid on a firm trench bottom constructed in accordance with Section 306, true to the lines and grades shown on the drawings, and/or as given in the field by the Engineer. 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 shoulders or unevenness of any kind. The pipe grade shall be obtained by using batter boards and a "top line" set at grade stakes not further than twenty-five (25) feet apart. Not less than three (3) batter boards shall be maintained in correct position continuously during the construction of the sewer. Batter boards shall be of good straight, sound material, fastened to substantial stakes or uprights. Batter boards ten (10) feet or less in length shall not be smaller than 1 x 4's, and when longer than ten (10) feet shall not be smaller than 1 x 6's or 2 x 4's. Stakes shall not be smaller than 2 x 4's. Steel stakes with suitable clamps may be used when approved by the Engineer. A suitable find cord or wire approved by the Engineer shall be stretched tightly between batter boards over the exact centerline of the sewer. A graduated pole or rod shall be provided for measuring from the cord stretched between boards to the bottom of the trench while the trench is being prepared, and to the sewer invert while the sewer is being placed. At the option of the contractor, the laser beam method may be used to establish grade and alignment of pipe. Any errors, discrepancies, or displacement of grade stakes shall be called to the attention of the Engineer for correction.

(B) 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.

(C) Double joints of eight-inch pipe may be prepared and laid, provided the double joints are prepared by jointing the pipes 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 at the ends, when the pipes are lowered into the trench.

307.5 Method of Payment: Vitrified Clay Pipe (VCP) shall be measured for payment by the linear foot of pipe of the size specified in the proposal and on the plans 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 bends in the pipe or fittings used with drop manholes.

307.6 Basis of Payment: Accepted quantities of Vitrified Clay Pipe (VCP), measured as provided above, will be paid for at the contract price for:

VITRIFIED CLAY PIPE (VCP). . . . . Lin. Ft.

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

308. PIPE, REINFORCED CONCRETE:

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

308.2 Materials and Tests: Materials shall be in accordance with Section 406 and testing shall be in accordance with Section 312.

308.4 Construction:

(A) For water lines, the AWWA Standard for Installation of Cast Iron Water Mains, AWWA designation C-600, shall govern the installation as applicable. The method of bedding shall be in accordance with Section 306 and as shown on the attached Standard Details. 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 before these drawings are prepared. The ends of the pipes to be jointed shall be cleaned immediately prior to joining and the rubber gasket thoroughly lubricated with a thin film of gasket lubricant before it is placed in position on the spigot end.

Gasket lubricant shall be as supplied by the pipe manufacturer and approved by the Engineer. 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 lubricant 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 Details.

(B) For sanitary 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 thoroughly lubricated with gasket lubricant 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 the 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.

(C) For all lines, after the pipe has been jointed, a band at least 5-1/2 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 bank 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.

308.5 Method of Payment: Reinforced Concrete Pipe (RCP) shall be measured for payment by the linear foot of pipe of the size specified in the proposal and on the plans 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 bends in the pipe, fittings used with drop manholes, fittings or specials included as pipe, or for concrete blocking.

308.6 Basis of Payment: Accepted quantities of Reinforced Concrete Pipe (RCP), measured as provided above, will be paid for at the contract unit price for:

REINFORCED CONCRETE PIPE (RCP) . . . . . Lin. Ft.

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

309. PIPE, CAST IRON AND DUCTILE IRON:

309.1 Description: The work under this item shall include furnishing, hauling, placing, and jointing of Cast Iron and Ductile Iron Pipe in the trench in specific conformity with the lines and levels given. For all pipe, the AWWA Standard for Installation of Cast Iron Water Mains, AWWA Designation C-600 shall govern the installation as applicable. The method of bedding shall be in accordance with Section 306 and as shown on the attached Standard Details.

309.2 Materials and Tests: Materials shall be in accordance with Section 404 and testing shall be in accordance with Section 312.

309.4 Construction:

(A) Proper implements, tools and facilities satisfactory to the Engineer shall be provided and used by the contractor for the safe and convenient performance of the work. All pipe, valves and hydrants shall be carefully lowered into the trench piece by piece by means of a derrick, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to water main materials and protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench. If damage occurs to any pipe or water main accessories in handling, the damage shall be immediately brought to the Engineer's attention. The Engineer shall prescribe corrective repairs or rejection of the damaged items. All pipe and fittings shall be carefully examined for cracks and other defects while suspended above the trench immediately before installation in final position. Defective pipe or fittings shall be laid aside for inspection by the Engineer, who will prescribe corrective repairs or rejection. All lumps, blisters, and excess coating shall be removed from the bell and spigot end of each pipe, and the outside of the spigot and the inside of the bell shall be wire brushed and wiped clean and dry and free from oil and grease before the pipe is laid.

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe. As each length of pipe is placed in the trench, the spigot end shall be centered in the bell and pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material tamped under it except at the bells. Precautions shall be taken to prevent dirt from entering the joint space.

(B) Joining of Push-On Joint Pipe: The inside of the bell and the outside of the spigot end shall be thoroughly cleaned to remove oil, grit, excess coating and other foreign matter. The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the bell socket.

A thin film of gasket lubricant shall be applied to either the inside surface of the gasket or the spigot end of the pipe or both. Gaskets lubricant shall be as supplied by the pipe manufacturer and approved by the Engineer.

The spigot end of the pipe shall be entered into the socket with care used to keep the joint from contacting the ground. The joint shall then be completed by forcing the plain end to the bottom of the socket with a forked tool or jack-type tool or other device approved by the Engineer.

Pipe that is not furnished with a depth mark shall be marked before assembly to assure that the spigot end is inserted to the full depth of the joint. Field-cut pipe lengths shall be filed or ground to resemble the spigot end of such pipe as manufactured.

(C) Joining of Mechanical-Joint Pipe: The outside of the spigot and inside of the bell of mechanical-joint pipe shall be thoroughly cleaned to remove oil, grit, excess coating and other foreign matter from the joint, and then a thin film of gasket lubricant shall be applied to either the inside surface of the gasket or the spigot end of the pipe or both. Gasket lubricant shall be as supplied by the pipe manufacturer and approved by the Engineer.

The cast-iron gland shall be coated with the lubricant and placed on the spigot end with the thick edge toward the gland. The entire section of the pipe shall be pushed forward to seat the spigot end in the bell. The gasket shall then be pressed into place within the bell; care shall be taken to locate the gasket evenly around the entire joint.

When tightening bolts, the gland shall be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This shall be done by partially tightening the bottom bolt first then the top bolt, next the bolts at either side, and last, the remaining bolts. This cycle should be repeated until all bolts are within the range of torques as shown below:

BOLT SIZE (INCHES)	RANGE OF TORQUE (FT. - LB.)	LENGTH OF WRENCH (IN.)
5/8	40 - 60	8
3/4	60 - 90	10
1	70 - 100	12
1-1/4	90 - 120	14

The torque loads may be applied with torque-measuring or torque-indicating wrenches, which may also be used to check the application of approximate torque loads applied by men trained to give an average pull on a definite length or regular socket wrench. If effective sealing is not attained at the maximum

torque indicated, the joint should be disassembled, thoroughly cleaned, and reassembled. Overstressing of bolts to compensate for poor installation practice shall not be allowed.

(D) For water lines, all fittings or specials included as pipe shall be blocked in accordance with the attached Standard Details.

(E) For sanitary sewers, a joint between cast iron pipe and vitrified clay pipe or reinforced concrete pipe shall be made with special adapters as approved by the Engineer. If adapters are not available, the joint shall be made as instructed by the Engineer and encased with concrete one foot (1 ft.) each side of the joints and six inches (6 in.) in thickness.

309.5 Method of Payment: Cast Iron and Ductile Iron Pipe (CIP and DIP) shall be measured for payment by the linear foot of pipe of the size specified in the proposal and shown on the plans and placed as shown on the drawings. Total footage shall be the actual horizontal measurement along the center line of the pipe. No additional payment shall be made for vertical bends in the pipe, fittings used with drop manholes, fittings or specials not included in Section 313, or for concrete blocking.

Deductions will not be made for bends or specials.

309.6 Basis of Payment: Accepted quantities of Cast Iron and Ductile Iron Pipe (CIP and DIP) measured as provided above, will be paid for at the contract unit price for:

CAST IRON PIPE . . . . . Lin. Ft.
DUCTILE IRON PIPE. . . . . Lin. Ft.

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

310. PIPE, STEEL:

310.1 Description: The work under this item shall include furnishing, hauling, placing, and jointing of steel pipe in the trench in specific conformity with the lines and levels given. For all lines, the AWWA Standard for Installation of Cast Iron Water Mains, AWWA Designation C-600 shall govern the installation, as applicable. The method bedding shall be in accordance with Section 306 and as shown on the attached Standard Details. The drawings show the plan and grade for the pipeline. The contractor shall submit detail 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 Details.

310.2 Materials and Tests: Materials shall be in accordance with Section 405 and testing shall be in accordance with Section 312.

310.4 Construction:

(A) 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. If requested, coupons shall be cut across the field welds and tested by an approved testing laboratory.

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.

(B) 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.

310.5 Method of Payment: Steel pipe shall be measured for payment by the linear foot of 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 bends in the pipe, fittings used with drop manholes, fittings or specials included as pipe, or for concrete blocking.

310.6 Basis of Payment: Accepted quantities of steel pipe measured as provided above, will be paid for at the contract unit price for:

STEEL PIPE . . . . . Lin. Ft.

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

311. THERMOPLASTIC POLYVINYL CHLORIDE (PVC) WATER PIPE:

311.1 Description: Thermoplastic Polyvinyl Chloride (PVC) water pipe 8-inches or smaller in diameter, shall be allowed only on the gathering lines in the water well field of the City of Enid. PVC water or sewer pipe shall not be permitted in either the water distribution system or the sanitary sewage collection system of the City of Enid.

311.2 Materials and Tests: Materials shall be in accordance with Section 408 and testing shall be in accordance with Section 312.

311.4 Construction: Pipe shall be laid to the lines and grades established by the Engineer. The bottom of the trench shall be relatively uniform and in no case shall pipe be laid on rock. Where rock is encountered, Class "A" bedding shall be required.

Long plastic pipe lines, over three hundred feet (300 ft.) in length without an abrupt change in direction, shall be "snaked" in the trench to provide for expansion and contraction. Snaking shall be equivalent to the pipe touching opposite sides of a twenty-four inch (24 in.) wide trench within a distance of eighty feet (80 ft.). It is recommended that, during warm weather, whenever practical, pipe lines be filled with cold water or allowed to cool overnight before backfilling trench. Push-on joints shall be made with extreme care and by following the manufacturer's recommendation as to installation procedures. If the design of the joint permits for linear expansion of the pipe, the trench width may be reduced. Adequate thrust blocks as approved by the Engineer will be required at all bends, tees, and crosses.

311.5 Method of Payment: Thermoplastic Polyvinyl Chloride (PVC) water pipe shall be measured for payment by the linear foot of pipe of the size specified in the proposal and on the plans 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 bends in the pipe.

311.6 Basis of Payment: Accepted quantities of Thermoplastic Polyvinyl Chloride (PVC) water pipe, measured as provided above, will be paid for at the contract unit price for:

THERMOPLASTIC POLYVINYL CHLORIDE (PVC) PIPE . . . . . Lin. Ft.

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

312. FIELD TESTS AND REVISIONS:

312.1 Description: Field tests and revisions of water and sewer mains shall be successfully completed prior to final acceptance. All discrepancies shall be corrected by the contractor to make a complete and workable system.

312.2 Materials and Tests:

(A) Sewer:

(1) Alignment: After joints have been inspected and approved and trench backfilled as specified, the Engineer shall check alignment between manholes or manhole locations. Any misplaced pipes detected shall be corrected to line and grade at the contractor's expense.

(2) Leakage Test: Leakage tests shall be required for all new construction. The leakage test shall be an exfiltration test, whereby a minimum positive head of two (2) feet shall be exerted on a section of line by plugging the lower end and filling the manhole upstream with water. The leakage outward shall not exceed 200 gallons per inch of pipe diameter per mile per day (200 gal./in./mi./day) for any section of the system. If infiltration is observed due to hydrostatic ground water leakage the infiltration shall be reduced so as not to exceed 200 gal./in./mi./day.

Where test results, in the opinion of the City Engineer, indicated construction deficiencies, the contractor shall make all effort to locate same and make satisfactory corrections. Infiltration through manhole walls shall be corrected regardless of the results of these tests.

(B) Water:

(1) Hydrostatic and Leakage Test: After the pipe has been laid and backfilled, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic gauge pressure of 200 psi, for a duration of two hours, said pressure not to vary more than five pounds, except that PVC pipe shall be tested a design working pressure.

Each valved section of pipe shall be slowly filled with water and the specified test pressure, based on the elevation of the lowest point of the line of lowest point of the section under test, and corrected to the elevation of the test gauge shall be applied by means of a test pump connected to the pipe in a manner satisfactory to the Engineer. The contractor shall make arrangements for metering the amount of water used during the test.

The contractor shall backfill all pipe and provide all reaction blocking before hydrostatic testing. It shall be the contractor's responsibility to locate and repair any and all leaks that may develop. The Engineer may direct the contractor to leave certain joints and connections uncovered until testing has been completed.

Before applying the specified test pressure, all air shall be expelled from the pipe. If hydrants or blow-offs are not available at high places taps at points of highest elevation shall be made before test is made and plugs inserted after the test has been completed. Any cracked or defective pipe, fittings, valves or hydrants discovered in consequence of this pressure test shall be removed and replaced with sound material and the test shall be repeated until satisfactory to the Engineer.

(2) In conjunction with the hydrostatic test, a leakage test shall be conducted as detailed in Section 4 of ANSI/AWWA Specification C-600, a portion of which is stated below.

Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valued section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{ND\,P^{1/2}}{7400}$$

in which "L" is the allowable leakage in gallons per hour; "N" is the number of joints in the length of pipe test; "D" is the nominal diameter of the pipe, in inches; and "P" is the average test pressure during the leakage test, in pounds per square inch gage. Allowable leakage per 1000 ft. of pipeline in gallons per hour at 200 psi for selected pipe diameters is listed below for 18-foot nominal lengths. Leakage tests for PVC pipe shall be at the design working pressure.

NOMINAL PIPE DIAMETER (INCHES)	ALLOWABLE LEAKAGE PER 1000 FT. OF PIPELINE (GPH.)
2	0.22
3	0.33
4	0.44
6	0.65
8	0.87
10	1.09
12	1.31
14	1.53
16	1.74
18	1.96
20	2.18
24	2.61
30	3.27
36	3.92
42	4.58
48	5.23
54	5.88

When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal./hr./in. of nominal valve size shall be allowed. When hydrants are in the test section, the test shall be made against the closed hydrant. Acceptance shall be determined on the basis of allowable leakage. If any test of pipe laid discloses leakage greater than that specified, the contractor shall, at his own expense, locate and repair the defect until the leakage is within the specified allowance. All visible leaks are to be repaired regardless of the amount of leakage.

(3) Disinfection of Water Lines: All water lines shall be flushed and disinfected, after testing and before being placed in service, by the methods detailed in AWWA C-601 except as modified herein.

Chlorine shall be introduced into the main in a liquid solution or as dry gas in a continuous feed unless otherwise approved by the Engineer.

The results of the disinfection procedure shall produce a residual of a minimum of ten parts per million (10 ppm) of chlorine in the portion of the main farthest from the point of application, after a period of twenty-four (24) hours has elapsed, as well as any other portion of the main. Samples shall be taken at location determined by the Engineer for tests of residual chlorine.

(C) Water and sewer lines shall be constructed at the locations shown on the plans or as directed by the Engineer. Planned locations, grades or depths shall be adhered to unless, in the opinion of the Engineer, actual field conditions dictate revisions thereof. When the Engineer considers it necessary to deviate from planned locations, the contractor shall construct said water or sewer lines to new alignment and/or grades established by the Engineer or as directed by the Engineer, such directions, construction stakes showing alignment and depth of cut, or revised construction plans issued by the Engineer.

312.6 Basis of Payment: No extra payment will be made for construction to revised locations other than increased or decreased quantities of pipe, fittings, manholes, or other items tabulated on the proposal. No extra payment will be made for additional excavation required by deviations from planned alignment or grades. Leakage tests will not be measured for payment but the cost shall be included in other bid items. The contractor's bid price for water lines to include all costs of hydrostatic and leakage test and sterilization as no separate payment will be made for these items.

313. FITTING:

313.1 Description: 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 outlet constructed in to the wall of steel or concrete pipe. If cast or ductile iron pipe is used, the outlet shall consist of a tee with the outlet flanged. If a gate valve or butterfly 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 Details, except where the fittings have flanged, welded, or harnessed joints, the Engineer may under certain conditions delete the blocking. Concrete blocking shall be placed so that joints are accessible for repair.

313.2 Materials and Tests: Materials shall be in accordance with Section 404.1.3, Section 405.1.3, Section 406.1, and 408.3, and testing shall be in accordance with Section 312.

313.5 Method of Payment: Cast iron and ductile iron fittings will be measured for payment based on the weight in pounds of the bar fitting in accordance with the American Standard for Gray Iron and Ductile Iron Fittings, 3-inch through 48-inch for water and other liquids, AWWA Designation on C-110 with no separate

measurement of payment being made for glands, bolts, gaskets or other joint accessories. The contractor's bid price for fittings is to include all costs of concrete anchors for thrust restraint, tension rods, metal harnessing, clamps, lugs or other anchoring devices.

313.6 Basis of Payment: Accepted quantities of fittings, measured as provided above, will be paid for at the contract unit price for:

CAST IRON FITTINGS . . . . . Lbs.
DUCTILE IRON FITTINGS. . . . . Lbs.

which shall be full compensation for furnishing all materials, equipment, and incidentals to complete the work as specified.

314. MANHOLE:

314.1 Description: The work under this item shall include all excavation, materials, 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 Engineer.

314.2 Materials and Tests: Materials shall be in accordance with Section 403, Section 409 and Section 411, and testing shall be in accordance with Section 312.

314.4 Construction:

(A) 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.

(B) New manholes shall be constructed around existing lines without disturbance of the line. When the manhole is completed, the existing top half of the pipe shall be removed. 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 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.

Pipe, steps, inserts, and all metal shall be placed and secured in position before concrete is placed. Cast iron frames, other than those set in concrete, shall be bedded in cement mortar mixed in the proportion of one (1) part of portland cement to three (3) parts of clean sharp sand.

(C) During the construction of each manhole, either PS-1 or PS-3, as manufactured by M.A. Industries or approved equal, as shown in the Standard Drawings 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. PS-1 type steps shall be installed after construction in holes of appropriate diameter to securely hold the step. PS-3 type steps shall be installed during construction.

No steps shall be placed closer than eighteen inches to the manhole top. Steps shall be built firmly into the wall allowing the steps to project five inches inside the manhole. The centerline of the steps shall be as shown on the attached Standard Details.

(D) The use of concrete masonry units shall not be allowed on sanitary sewers.

(E) 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-eighths 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 tip 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.

(F) For cast-in-place manholes, the concrete shall be mixed and placed in accordance with Section 322.4, construction of special concrete structures. The manhole bases shall be poured monolithically with the rest of the manhole. The bases shall have a minimum thickness including the area under the pipe as follows:

0 ft to 8 ft	manhole heights	8-inches
8 ft to 12 ft	manhole heights	10-inches
12 ft and above	manhole heights	12-inches

Cast-in-place manholes shall be constructed as shown on the Standard Drawings.

Cast-in-place manholes less than 4-feet in depth will not be allowed, but rather shall be constructed as a special concrete structure under Section 322 and as shown in the Standard Drawings.

(G) For pre-cast manholes, base sections may be either pre-cast or cast-in- place, and risers and tips shall conform to ASTM specifications C-478, with steps in accordance with Section 312.4(C). Joint construction shall be in accordance with the item for pipe, reinforced concrete, except that no exterior grout band is required. Wall thickness shall be a minimum of five inches. No more than eight inches of concentric rings may be used to bring the manhole to finish grade. Every ring shall have a full mortar joint, not exceeding three-eighths inch in thickness. Inside joints are to be rubbed full and struck.

314.5 Method of Payment:

(A) Manholes will be measured for payment based on the unit price bid per manhole, 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 linear foot of manhole depth over six feet. No additional payment will be made for excavation, backfilling, pipe or concrete bottoms.

(B) Manhole frame and cover and steps shall be included in the unit price bid for standard manholes.

314.6 Basis of Payment: Accepted quantities of manholes, measured as provided above, will be paid for at the contract unit price for:

MANHOLE . . . . . Ea.
MANHOLE, ADDITIONAL DEPTH . . . . . Lin. Ft.

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

315. LAMPHOLE:

315.1 Description: The work under this item shall include all excavation, furnishing all materials required, construction, pipe connection thereto, finishing, and backfilling of new lampholes.

315.2 Materials and Tests: Materials shall be in accordance with Section 407 and Section 409, and testing shall be in accordance with Section 312.

315.4 Construction: Lampholes shall be used only for special conditions as directed by the City Engineer and shall not be substituted for manholes. When the cast-in-place concrete lamphole frame base is completed, a standard lamphole frame is to be set in place and closed with a lamphole cover as shown in the Standard Drawings.

315.5 Method of Payment: Lamphole shall be measured for payment based on the unit price bid per lamphole constructed as specified on the proposal. No additional payment shall be made for excavation, backfilling, or pipe.

315.6 Basis of Payment: Accepted quantities of lampholes, measured as provided above, will be paid for at the contract unit price for:

LAMPHOLE . . . . . EA.

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

316. CONNECTION:

316.1 Description: The work under this item shall include all excavation, furnishing all materials required, construction, finishing, and backfilling of connections to existing mains, valves, manholes, drop connections to manholes, special connections, service line connections, or plugs, as indicated on the drawings or as directed by the Engineer.

316.4 Construction:

(A) 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, the contractor will make the pressure and wet connections to existing mains as shown on the drawing unless specifically noted otherwise. In making these connections all material, equipment, and personnel necessary for the job shall be assembled at the site and all work possible shall be done before the service is interrupted. The order and time of the work will be under the jurisdiction of the Engineer. If deemed necessary, the Engineer may order the contractor to make the connection at night so as to inconvenience the public as little as possible.

(B) Where called for on the plans, or by the specifications, tapping valves and sleeves shall be used to make connections with existing water mains. The contractor, when ready to make any of these connections, will notify the Engineer 48 hours in advance. The contractor shall furnish all material, labor and equipment to make the taps.

The tapping valves and sleeves furnished shall be M & H, Mueller, A.P. Smith, Rensselaer, Darling, or approved equal, satisfactory to the Engineer. The tapping sleeves shall be the bolted type, heavy duty, using iron bolts, cast iron, shearardized, or equal, satisfactory to the Engineer.

(C) Connections to existing manholes shall be made by cutting into the manhole at the specified grade, inserting the pipe, and encasing the joint with concrete. 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. 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 the attached standard details if they are not properly located after the connection is made. Any and all diversion or pumping of water or sewage in a wet connection is included in this item.

(D) Methods of construction shall be the same for sewer service line reconnections as for main sewers. Cast iron pipe shall be used for all lines in parking areas, across open or closed storm sewers, across backfilled ditches, or within public rights-of-way. Vitrified clay pipe shall be used in all other locations, unless cast iron pipe is specifically required by the Engineer. All reconnections shall be constructed in conformance with the Plumbing Code of the City of Enid, unless modified herein. New pipe used shall be of the same diameter as the existing line.

(E) 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.

(F) Service line connections for water services shall be constructed as shown on the standard drawings and materials shall be in accordance with Section 414.

(G) At points indicated on the plans or by the Engineer, risers of the size indicated on the plans, or as required by the Engineer, shall be constructed. A 45 degree bell and spigot bend shall be jointed to the wye to a point level with lower side of bell of 45 degree bend. Pipe for risers shall be regular length joints of sewer pipe. Risers using full joints of pipe shall be set so that the top of riser is near to but not less than ten (10) feet below finished ground grade at rear of building location. If the owner desires, the contractor may, at the owner's expense, extend risers to a point not less than six (6) feet below finished grade at rear of the building locations, but, in no case, shall there be less than four (4) feet of cover over riser.

When contained wholly on the public right-of-way, or within the boundaries of utility easements, risers may be laid on a slope of 45 degrees.

316.5 Method of Measurement: Connections will be measured for payment per each classification of connection as shown on the proposal. No additional payment will be made for excavation, backfilling, furnishing and placing concrete, removing and replacing manhole steps, or for diversion or pumping of water or

sewage necessary to make the connection. Connections shown on the plans but not classified on the proposal shall be considered incidental to the work and will not be measured for payment but the cost shall be included in other items.

316.6 Basis of Payment: Accepted quantities measured as provided above will be paid for at the contract unit price as shown on the proposal for each connection which shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

317. VALVE AND FIRE HYDRANTS

317.1 Description: The work under this item shall include furnishing, hauling, and installation of valves and fire hydrants at the locations shown on the drawings, and in accordance with the attached standard details. The AWWA Standard for the installation of cast iron water mains, AWWA Designation 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 Materials and Tests: Materials shall be in accordance with Section 404, Section 405, Section 406, and Section 408, and testing shall be in accordance with Section 312.

317.4 Construction:

(A) Gate valves when specified shall conform to Standard of AWWA C-500, shall be bronze double disc valves with non-rising stems with the stem plumb, open left and have mechanical joint connections of the size shown on the plans. Tapping valves shall have the same features as above double disc gate valves and shall have piloted flange or centering lip on the valve flange to fit the tapping sleeve flange. The minimum design water working pressure shall be 250 psi for all types of valves. Ball valves shall be set with the handwheel horizontal. Air relief valves shall be set so that the square operating nut on the 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.

(B) Butterfly valves when specified shall conform to the standards of AWWA C-504 for rubber-seated butterfly valves and shall be designed and tested for a minimum water working pressure of 250 psi. Operations shall be side mounted with plumb, non-rising, stems, open left, and have mechanical joint connections of the size shown on the plans. The operator shall be mounted so that the square operating nut on the valve can be operated from the top.

(C) Valve boxes shall consist of a cast iron valve box, encased with a concrete collar over a section of 6-inch PVC pipe, SDR-35 typically, which is of adequate length enabling the valve box to be set at ground level as shown on the standard drawings.

(D) Fire hydrants shall be located as shown or as directed so as to provide complete accessibility and minimize the possibility of damage from vehicles or injury to pedestrians.

When placed behind the curb, the hydrant barrel shall be set so that no portion of the pumper or hose nozzle cap will be closer than three (3) feet nor more than six (6) feet from the face of the curb.

When set in the lawn space between the curb and the sidewalk, no portion of the hydrant or nozzle cap shall be within six (6) inches of the sidewalk.

All hydrants shall stand plumb and shall have their nozzles parallel with, or at right angles to the curb, with the pumper nozzle facing the curb, and centerline nozzles at least eighteen (18) inches above the ground.

Each hydrant shall be connected to the main with a six (6) inch ductile iron branch controlled by an independent six (6) inch gate valve, unless otherwise specified.

Each hydrant shall be placed upon a slab of stone or concrete not less than six (6) inches thick and fifteen (15) inches square. The rear side of the hydrant, opposite the pipe, shall be blocked with concrete or stone, firmly wedged between the hydrant and the vertical face of the end of the trench of undisturbed earth or it shall be tied to the pipe with suitable straps or metal tension rods as shown on the standard drawings or as directed by the Engineer.

Dry walls shall be constructed of crushed stone or coarse gravel having a volume of approximately one-half cubic yard and shall be placed beneath and around the drain ports of the hydrant so the hydrant will properly drain when closed.

(E) Fire hydrant extensions shall be required to bring the fire hydrant up to the existing or proposed grade of the surrounding areas, whereby an 18-inch minimum distance from the ground level to the center of the pumper nozzle may be obtained as shown on the standard drawings.

317.5 Method of Measurement:

(A) Valves shall be measured by the number of units of the type and size of valve installed. Valve boxes and valve vaults, where required, shall not be measured for payment.

(B) Fire hydrants shall be measured by the number of units installed. Blocking, ties, foundation, dry walls, and pipe between the hydrant and the waterline, except where the length of pipe is shown on the plans as a pay item, will not be measured for payment.

(C) Fire hydrant extensions, when required, will be measured by the number of units of each length installed.

(D) Excavation and backfill necessary to complete the work specified in these specifications will not be measured for payment.

317.6 Basis of Payment: Accepted quantities measured as provided above, will be paid at the contract unit price for:

VALVE . . . . . EA.
FIRE HYDRANT . . . . . EA.
FIRE HYDRANT ASSEMBLY . . . . . EA.

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

318. ENCASEMENT, CONCRETE

318.1 Description: The work under this item shall include the installation of concrete encasement as shown on the drawings or as directed by the Engineer, in accordance with the attached standard details. Care shall be taken so as to assure that placing of encasement does not deflect the pipe from the proper grade and alignment.

318.2 Materials and Tests: Materials shall be in accordance with Section 403 and testing shall be in accordance with Section 312 and Section 403.6. Concrete for encasement shall be 3,000 psi compression strength.

318.4 Construction: Sanitary sewers shall be concrete encased where shown on the plans or as directed by the Engineer. Placing concrete shall meet the requirements of Section 322.4(C) and (D) and be in accordance with the lines and dimensions shown on the standard drawings. When concrete encasement is required, in the opinion of the Engineer, because of trench widths greater than those specified on the standard drawings, it shall be placed at the expense of the contractor unless otherwise approved by the Engineer. When a water main crosses below a sanitary sewer line or when the water line crosses above the sanitary sewer, but vertical separation is less than two (2) feet, the sanitary sewer line shall be ductile iron pipe and encased in six (6) inches of concrete for a distance of ten (10) feet each way from the water line crossing, all in accordance with Section 304.4(E) and as shown on the standard drawings.

318.5 Method of Payment: Concrete encasement will be measured by the linear foot of concrete placed as encasement. No payment will be made for concrete used as fill.

318.6 Basis of Payment: Accepted quantities of concrete encasement, measured as provided above, will be paid for at the contract unit price for:

CONCRETE ENCASEMENT . . . . . LIN. FT.

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

319. PIERS, REINFORCED CONCRETE

319.1 Description: The work under this item shall include all materials, forming, pipe anchorage, construction and finishing of above ground standard reinforced concrete piers and below ground, restraining collar, reinforced concrete piers. Piers shall be located and constructed as shown on the drawings and the attached standard drawings.

319.2 Materials and Tests: Materials shall be in accordance with Section 403 and testing shall be in accordance with Section 403.6.

319.4 Construction: 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. Any honeycomb or other unevenness in the concrete shall be patched with cement mortar immediately after form removal. Construction of piers shall be in accordance with Section 322.4(C) and (D).

319.5 Method of Payment: Reinforced concrete piers and restraining collars shall be measured by the number of units constructed. No additional payment will be made for excavation, forming, bracing, dewatering, backfilling, reinforcing steel, or pipe anchorage.

319.6 Basis of Payment: Accepted quantities of reinforced concrete piers, measured as provided above, will be paid at the contract unit price for:

REINFORCED CONCRETE PIER, Standard . . . . . EA.
REINFORCED CONCRETE PIER, Restraining Collar . . . . . EA.

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

320. BORING

320.1 Description: The work under this item shall consist of dry boring, where conduit is not to be installed, under streets, trees, and other obstructions as shown on the plans.

320.3 Equipment: The equipment to be used in boring shall be of a type which does not require water. The equipment shall be capable of boring the entire length of the shaft at the diameter, line, and grade as shown on the plans or as directed by the Engineer.

320.4 Construction: Boring shall be performed to the line and grades as shown on the plans or as directed by the Engineer. The excess hole bored to accommodate the bell of the pipe shall be pumped completely full of mud by a mud jack or pump.

320.5 Method of Payment: Boring shall be measured for payment on the unit price bid per linear foot of bore of the size specified on the proposal and placed as shown on the plans. All carrier pipe shall be paid for under other bid items for pipe. No additional payment shall be made for excavation, backfilling, dewatering, or sandfill.

320.6 Basis of Payment: Accepted quantities of bore, measured as provided above, shall be paid for at the contract unit price for:

BORING . . . . . LIN. FT.

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

321. CONDUIT FOR STEEL ENCASEMENT

321.1 Description: The work under this item shall include the installation of encasement pipe for railroad, street, or other crossings by boring, tunneling, or open trench as shown on the plans.

321.2 Materials and Tests: Materials shall be in accordance with Section 410.

321.3 Equipment: The equipment to be used in boring shall be in accordance with Section 320.3 for dry bore, except as amended herein.

321.4 Construction: The conduit pipe shall be installed to the line and grades as shown on the plans or as directed by the Engineer. Voids between the outside of the conduit and the surrounding earth shall be filled with cement grout or other material approved by the Engineer.

Cutting blades shall be such that the boring bit may be withdrawn without removing or pulling the encasement pipe.

321.5 Method of Payment: Conduit shall be measured for payment based on the unit price bid per linear foot of conduit installed by the method and of the size specified in the proposal and shown on the plans. All carrier pipe shall be paid under other items. No additional payment shall be made for excavation, backfilling, boring, tunneling, dewatering, or sandfill.

321.6 Basis of Payment: Accepted quantities of conduit, measured as provided above will be paid at the contract unit price for:

CONDUIT . . . . . LIN. FT.

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

322. CONCRETE STRUCTURE, SPECIAL

322.1 Description: The work under this item shall include the furnishing of all materials and performing all work necessary to complete any special concrete structures as shown on the drawings.

322.2 Materials and Tests: Materials shall be in accordance with Section 403 and testing shall be in accordance with Section 312 and Section 403.6.

322.4 Construction:

(A) Mixing: 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 minimum time for mixing each batch, after all materials are in the mixer, shall be one (1) minute for ½ cu. yd. to 1-1/2 cu. yd. mixers; and to 1-1/2 minutes for mixers over 1-1/2 cu. yd. The mixer shall revolve a minimum of 12 revolutions after all materials have been placed therein, and at a uniform speed. Neither the speed nor the volume capacity of the mixer shall exceed those recommended by the manufacturer. Excessive overmixing, requiring additions of water to preserve the required consistency, will not be permitted.

The entire contents of the drum shall be discharged before recharging. Retempering concrete which has partly hardened will not be permitted.

(B) Consistency: All reinforced concrete which is required to be spaded or puddled in forms or around reinforcing steel shall be of such consistency that:

All aggregates 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 at any time within thirty minutes after placing.

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.

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.

(C) Placing Concrete: Before beginning a run of concrete, surfaces of the forms, reinforcing steel, and concrete previously placed, shall be thoroughly cleaned of hardened concrete or foreign materials. Forms shall be thoroughly oiled in accordance with Section 322.4(J).

Concrete shall be placed in the forms immediately after mixing. It shall be so deposited 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.

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

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

(D) Placing in Cold Weather: No concrete shall be placed without the specific permission of the Engineer when the air temperature is at or below thirty-five (35) degrees Fahrenheit.

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 (50) degrees Fahrenheit, nor more than eighty (80) degrees Fahrenheit. The concrete shall be adequately protected in order to maintain this temperature for a minimum of seventy-two (72) hours after it has been placed and a temperature above thirty-two (32) degrees Fahrenheit for a period of two additional days. The work shall be done entirely at the contractor's risk.

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

(E) Ready-Mixed Concrete: 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, ASTM Designation C-94, when not in conflict with the specifications herein, shall control the furnishing of ready-mix concrete.

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.

(F) Construction Joints: 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.

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.

(G) Finishing of Concrete Surfaces: All surfaced 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.

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.

(H) Curing Concrete: 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. In dry, hot weather, forms shall be removed as early as practicable and curing started immediately. The Engineer may require the frequent wetting of the concrete and the use of means to protect it from the direct rays of the sun.

(I) Placing Reinforcement: 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.

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 Engineers before any concrete has taken its initial set.

(J) Forms: Forms shall be so designed and constructed that they may be removed without injuring the concrete. The material to be used in the forms for exposed surfaces shall be sized and dressed lumber or metal in which all bolt and rivet heads are counter sunk. 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 cast-in-place.

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. 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.

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 form will be permitted to remain in the finished work.

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.

(K) Removal of Forms: 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:

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 (24) to forty-eight (48) hours after placing, depending upon weather conditions.

Girder, beam, and joist sides only, column, pier, abutment, and wall forms may be removed within twenty-four (24) to forty-eight (48) 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.

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.

322.5 Method of Payment: Special concrete structures will be measured for payment on the unit price bid as specified in the proposal, and constructed as shown on the drawings. No additional payment will be made for excavation, backfill, foundations, or any particular element of construction.

323. STRUCTURE, SPECIAL

323.1 Description: 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.

323.5 Method of Payment: Special structures will be measured for payment based on the unit price bid 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 unless otherwise specified. No additional payment will be made for excavation backfill, foundations, or any particular element of construction.

324. MATERIALS FURNISHED BY OWNER AND INSTALLED BY CONTRACTOR

324.1 Description: The work under this item shall include all labor, equipment, expendable items, and appurtenances. All necessary clearing, excavation, other site preparation, backfill and restoration, shall be performed by the contractor. The owner's responsibility shall be only for the delivery of the materials to the contractor. All other work shall be performed by the contractor.

324.5 Method of Payment: Materials furnished by the owner and installed by the contractor will be measured for payment based on the price bid per item of the type specified in the proposal and actually installed in accordance with the drawings. All necessary clearing, excavation, other site preparation, backfill and restoration shall be paid for under other bid items.

325. TYPE PSM POLYVINYL CHLORIDE (PVC) SEWER PIPE AND FITTINGS

325.1 Description: Type PSM Polyvinyl Chloride (PVC) sewer pipe ranging in size from 4 inches to 15 inches, may be installed within the City of Enid collection system, as approved by the City Engineer. The work under this item shall include furnishing, hauling, placing, and joining of PVC sewer pipe within the trench in specific conformity with lines and levels given. For all pipe, the ASTM Standard 2321-89 "Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications" shall govern with respect to install-ation of the pipe. The method of bedding shall be in accordance with Section 306 and any exceptions listed below, and as shown on the attached standard details.

325.2 Materials and Tests: Materials shall be in accordance with Section 416 and testing shall be in accordance with ASTM Standard F1417-92 "Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air".

325.3 Construction:

A. The pipe shall be laid on a firm foundation as required in overexcavated areas, and a bedding with a minimum thickness of 4 inches (6 inches in rock cuts). Haunching material shall be placed to the springline of the pipe and be installed in layers with a maximum thickness of 6 inches. The haunching material shall be worked around the pipe by hand, and the shovel slicing

method to provide uniform support of the pipe. The initial backfill shall be placed in layers to a minimum depth of 6 inches to the top of the pipe, and be placed in layers with a maximum thickness of 6 inches. All material for foundation, bedding, haunching and initial backfill shall be compacted to 85% or 95% of Standard Proctor as required according to the USCS soil classification system, and in conjunction with ASTM Standard D2321-89. Maximum particle size for all backfill material shall be 3/4 inch. All backfill shall be free from clods, lumps, boulders and frozen matter.

B. Place pipe and fittings in the trench with the invert conforming to the required elevations, slopes and alignment. Provide bell holes in the pipe bedding, no larger than necessary, in order to ensure uniform pipe support. Fill all voids under the bell by working in bedding material. In special cases where the pipe is to be installed to a curved alignment, maintain angular "joint deflection" (axial alignment) or pipe bending radius, or both, within acceptable design limits.

C. Comply with manufacturers recommendation for assembly of joint components, lubrication, and making of joints. When pipe laying is interrupted, secure piping against movement and seal open ends to prevent the entrance of water, mud, or foreign material.

D. For elastomeric seal joints conforming to ASTM D3212-92 "Standard Specification for Joints for Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seal", the pipe ends shall be marked to indicate insertion stop position, and ensure that the pipe is inserted into pipe or fitting bells to this mark. Push spigot into bell using methods recommended by the manufacturer, keeping pipe true to line and grade. Protect end of the pipe during homing and do not use excessive force that may result in over-assembled joints or dislodged gaskets. If full entry is not achieved, disassemble and clean the joint and reassemble. Use only lubricant supplied or recommended for use by the pipe manufacturer. Do not exceed manufacturer's recommendation for angular "joint deflection" (axial alignment).

E. Where coarse and open-graded material is placed adjacent to finer material and within anticipated ground water elevations, a geotextile filter fabric shall be placed around the bedding and initial backfill material to prevent the migration of the surrounding fines into the open voided area.

F. After installation of the pipe has been completed and air tested, the contractor shall pull a mandrel that has been machined to 5% of the inside diameter of the pipe from manhole to manhole. The pulling of the mandrel shall be performed no earlier than 30 days from the date of the air testing.

325.5 Method of Payment: Type PSM Polyvinyl Chloride (PVC) sewer pipe shall be measured for payment by linear foot of pipe of the size specified in the proposal and on the plans 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 bends in the pipe or fittings used with drop manholes.

325.6 Basis of Payment: Accepted quantities of Polyvinyl Chloride (PVC) sewer pipe, measured as provided above, will be paid for at the contract price for:

Polyvinyl Chloride (PVC) Sewer Pipe . . . . . Lin. Ft.

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.