

TECHNICAL SPECIFICATIONS

ASPHALT PAVING

1. GENERAL

- A. Asphalt paving shall consist of an asphalt surface laid hot in a single course on a prepared base, conforming to the cross sections, lines, and grades indicated on the drawings, and to the requirements specified below.
- B. Thickness: Unless otherwise indicated on the drawings or otherwise approved by the City, asphalt pavement shall be 3" thick.
- C. Requirements for base are specified under Roadway Base Section.
- D. Upon completion of the graveling and/or cementing process, an inspection will be made and if approved a 1 1/2 inch wearing surface of asphalt will be applied. The DEVELOPER may choose to apply a Seal Coat first. The first 1 1/2 inch asphalt Course will be applied at a time deemed appropriate by the City engineer or at ~~+/-~~50% buildout. The DEVELOPER will then maintain the streets until the final street paving is installed.
- E. When the development surrounding the new roadway is 100% complete, the roadway surface shall be paved with 1 1/2 inch asphalt surface laid hot in a single course on the first 1 1/2 inch asphalt surface. The total asphalt pavement shall be three (3) inches thick. The pavement surface shall conform to the approved lines, grades and cross sections.

2. ASPHALT

- A. Asphalt shall be refined asphalt, or asphalts and flux where flux is required, with 60 to 70 penetration at 77 F.
- B. Refined asphalt shall be prepared from either native asphalt or an asphaltic or semi-asphaltic petroleum, which upon refining will produce an asphalt as specified herein. Air blowing and cracking shall not be used in the manufacturing process; only straight run asphalt produced by approved methods will be acceptable. Asphalt shall contain no water, decomposition products, granular particles, or other impurities, and it shall be homogeneous. The proper portions of refined asphalt, or asphalts and flux, shall be melted together at 275 F. to 400 F. temperature and thoroughly agitated by suitable appliances until they are completely blended into a homogeneous asphalt cement, and thereafter shall not be heated to more than 350 F. Recycled asphalt is not permitted.

C. Asphalt shall comply with the following:

	<u>Min. 60/70 Pen.</u>	Max
Penetration at 77 F 100 g/5 sec.	60	70
Penetration at 32 F 200 g/60 sec.	15	
Penetration at 115 F. 50 g/3 sec.	—	325
Flash Clev. Open Cup, degrees F	500	
Ductility at 77 F. 5 cm/min.	125	
Ductility at 32 F. 114 cm/min.	Pen. at 77	
Fluidity Factor	10	
Specific Gravity at 77 F.	1.02	
Soluble in CCL 4	99.5	
Sulfur (Bomb) -%	3.5	
Paraffin Scale (Holds) -%		3.5
Spot Test (Oliensis)	Neg.	
Penetration of Residue at 77 F. F. Min.	75 % Orig.	
Evaporation Loss, 50 gm. 5 hrs. 325 F.		2.0%

* The Fluidity Factor shall be figured according to the following formula:

F.F. = (V.P.) x P/100, in which F.F. is the Fluidity Factor, V is the Viscosity at 275 F. using a viscosity thermometer calibrated for the proper immersion, and P is the Penetration at 77 F. 100 g/5 sec.

3. STONE

A. Stone shall be clean, hard, broken stone, free from weathered or soft particles, and shall conform to the following requirements when tested in accordance with applicable ASTM test:

- (1) Percentage of wear, not more than 5.
- (2) Toughness, not less than 6.
- (3) Soundness, (sodium sulfate) reversals, 5.
- (4) Immerse 10 small pieces (total weight about 1,000 grams) of the stone in a saturated solution at 70 degrees F. of sodium sulfate (NA 2 SO 4) for 20 hours, after which place them for 4 hours in a drying oven maintained at 100 degrees C. Repeat the treatment 5 times. The operation of immersion, heating reimmersing, etc., shall be continuous. Note the condition of the stone as to soundness at the end of test.

(5) Samples which exhibit marked disintegration shall be considered to have failed in this test.

B. In addition to the above specifications, the stone shall not break down or disintegrate to any appreciable extent when subjected to compaction by rolling.

4. SAND

A. Sand shall be hard, clean grained, and sharp.

5. FILLER

A. Filler shall be thoroughly dry limestone dust, or dust from equally satisfactory stone, or Portland cement, all of which shall pass a No. 50 sieve and at least 70 percent of which shall pass a No. 200 sieve.

6. COMPOSITION OF THE MIXTURE

A. Surface course shall be composed of stone, sand, tiller (if required), and asphalt cement mixed in the proportions specified below by weight. The aggregates and the asphalt cement shall be heated separately to such a temperature as will give, after mixing, a mixture of the proper temperature for the materials employed. The aggregate shall be at a temperature for the materials employed. The aggregate shall be at a temperature between 225 and 350 degrees F. The asphalt cement and aggregates shall be thoroughly mixed in a suitable approved asphalt mixing apparatus until a homogeneous mixture is produced, in which all the particles are thoroughly coated with asphalt cement.

B. Proportions of total mixture:

<u>ITEM</u>	<u>PERCENT</u>
Mineral Aggregate	92.0 - 95.0
Asphalt Cement	5.0 - 8.0

C. The gradation of the combined mineral aggregate shall meet the following following requirements:

<u>SIEVE SIZE</u>	<u>TOTAL % PASSING BY WEIGHT</u>
1/2"	100
3/8"	80-93
No. 4	54-76

<u>SIEVE SIZE</u>	<u>TOTAL, % PASSING BY WEIGHT</u>
8	35-57
30	17-29
50	10-18
100	3-10
200	0-6.5

- D. The above specified mix composition corresponds to that specified in Section 903.11 of the January 1, 1968 edition of the Tennessee Department of Highways "Standard Specifications for Road and Bridges Construction" for Grading "D".

7. MIXING PLANT

- A. The asphalt producing plant shall be provided with suitable means for heating and drying the mineral aggregate.
- B. The plant shall be of such construction that will thoroughly dry the aggregate. The hot aggregate shall then be passed through a suitable screen which will size the aggregate and reject all material larger than that specified herein. The sized aggregate shall be run from this screen into the storage bins. The aggregates shall be proportioned from the storage bins into a weighing box resting upon scales, and after being weighed shall be passed into a "Twin Plug" mixer. The filler (if used) shall be weighed cold and added to the mineral aggregate in the weigh box, and finally the asphalt cement heated to a temperature of approximately 275 F. shall be weighed and added to the material in the mixer. The materials shall then be mixed until every particle of the mineral aggregate is completely coated with asphalt cement, and a thoroughly homogeneous mixture is provided. This will require a mixing period of at least one minute.
- C. The asphalt plant shall be shut down each day at such time that will enable all loads to be hauled to the project site, laid, and completely rolled before dark.
- D. The asphalt plant shall also shut down without delay if rain falls during the work, as no loads shall be laid in the rain or on a wet foundation.

8. BASE PREPARATION

- A. The base course shall conform to final grades and sections as indicated on the drawings and shall be thoroughly compacted and set, all as specified elsewhere.
- B. Prior to laying surface course, broom the base surface to remove all loose material, and apply the tack or prime coat specified below. Keep traffic off of the area to be surfaced from the time the base course is tacked until the surface course has been laid.

9. TACK AND PRIME COATS

- A. On Gravel Base: Before laying surface course, clean the gravel surface as specified above, and apply a tack coat of bituminous material meeting THD section 402.02 standards uniformly at the rate of .05 to .15 gallons per square yard, as required by the base conditions.
- B. On Soil-Cement Base: Before laying surface course, clean the surface of the soil-cement base as specified above, and apply a prime coat of RS-1 emulsified asphalt uniformly at the rate of .40 to .60 gallons per square yard, as required by the base conditions.
- C. On Existing Asphalt: Before laying surface course, clean the surface of the existing asphalt as specified above, and apply a tack coat of bituminous material meeting THA section 402.02 standard uniformly at the rate of .05 to .15 gallons per square yard, as required by the base conditions.

10. TRANSPORTATION OF MIXTURE

- A. Haul the mixture to the pavement area in dump trucks or other suitable conveyances, which shall be suitably covered to protect the contents from excessive temperature loss. The loads shall have a temperature of from 250 F. to 350 F. upon reaching the paving areas. The City will determine the permissible range of temperature for each kind of asphalt used. All loads failing to fall within the permissible temperature are subject to rejection at pavement area.

11. SPREADING AND COMPACTING

- A. Do not lay any asphalt when the City decides that the weather conditions are unsuitable, or unless the base on which it is to be laid is thoroughly dry and has set a sufficient length of time. Do not lay any asphalt when the temperature is 40 F. and falling.
- B. The delivery conveyances shall dump the mixture into an approved self-propelled spreading and finishing machine. The machine shall spread the mixture smoothly, true to cross section, and of a uniform density throughout.
- C. After spreading, roll the surface with a 5 to 8 ton tandem roller. Continue the rolling until no surface compression is obtainable, and the surface is free from waves, roller marks, and honeycombed spots. Cross-roll the pavement where the width permits. Around manholes and other fixtures where the roller cannot reach, compress the asphalt with hot iron tampers. Paint all gutters, curbs, and street fixtures with hot asphalt to obtain proper adhesion at the joint and to prevent the entrance of water into the joint.
- D. Finished surface shall not vary more than 1/4" from a 10 foot long straight edge.

- E. Remedy all depressions which may develop before the completion of the rolling by loosening the mixture laid and adding new material to bring such depressions to a true surface. In each depression remaining after the final compaction has been obtained, immediately remove the mixture and lay sufficient new material to form a true and even surface.
- F. Samples: The City may take samples from the finished pavement to verify the thickness of the asphalt after rolling. Fill all sample holes and compact all patches to match the surrounding pavement.

12. CONDITION AT EXPIRATION OF GUARANTEE PERIOD

- A. In addition to the proper maintenance of the pavement during the guarantee period, at his own expense and just before expiration of the one year guarantee period the Contractor shall make such repairs as may be necessary to produce a pavement which shall:
 - (1) Have a contour substantially conforming to that of the pavement indicated on the drawings, and free from depressions of any kind exceeding 3/8" deep as measured between any two points 4 feet apart on a line conforming substantially to the original contour of the paved area.
 - (2) Be free from cracks or depressions showing disintegration of the surface mixture.
 - (3) Contain no disintegrated surface mixture.
 - (4) Not have been reduced more than 3/8" in thickness in any part.
 - (5) Have a base free from such cracks or defects which will cause disintegration or settling of the pavement, or impair its usefulness as a roadway or other purpose for which it is intended.

13. REPAIRING

- A. Except as otherwise specified below, make repairs by cutting out the defective asphalt surface down to the base and replacing it with new freshly prepared asphalt surface, made and laid in strict accordance with these specifications.
- B. Where defects are caused by the failure of the base, remove the defective asphalt surface and the base thereunder, and replace them with new.
- C. In all cases the surface of the finished repair shall be at the grade of the adjoining pavement, and shall conform to the contour of the adjoining paved area.
- D. The surface heater method of repairing may be used ONLY in those cases where the repairs are NOT necessitated by:

(1) Failure to base.

(2) Failure caused by the disintegration of the lower portion of the asphalt surface.

E. Where the surface heater method is used, remove all defective surface before replacing it with new material. In all cases, remove the old surface to at least 1/4" depth, and apply new surface at least 1/2" thick after compression. Apply the heat without injuring the remaining pavement. Immediately remove all burnt and loose materials, and lay the new surface in strict accordance with these specifications.

14. GUARANTEE

A. All asphaltic concrete paving shall be guaranteed against defects and workmanship for a period of one year after its acceptance by the City.

15. LABORATORY TESTS AND CERTIFICATES

A. Before use on this project, all asphaltic concrete paving materials shall have been tested by an approved independent testing Laboratory, and at his own expense the Contractor shall submit to the City acceptable certifications from the laboratory to the effect that these materials conform to these specifications.

16. PAYMENT

A. Asphalt paving will be paid for by the ton of asphalt surface in place, including prime or tack coat and surface preparation, but excluding granular, non-asphaltic base.

B. Base will be paid for separately, as specified elsewhere.

END

TECHNICAL SPECIFICATIONS

REDUCED PRESSURE BACK FLOW PREVENTER

1. REDUCED PRESSURE BACK FLOW PREVENTION DEVICE

- A. The reduced pressure zone type of backflow prevention device consists of two independently acting, spring-loaded approved check valves, separated by a reduced pressure zone. This device is installed between two tight-closing gate valves, and has properly-located test cocks. During normal operation, the pressure between the two valves is maintained at a lower pressure than the supply pressure. If either check valve should leak, the pressure relief valve will maintain a differential pressure of not less than 2 psi between the supply pressure and the zone between the two check valves by discharging to the atmosphere. Reduced pressure type backflow preventers must meet the latest revisions of the American Water Works Association (AWWA 506) and American Society of Sanitary Engineers (ASSE 1013) Standards.
- B. The reduced pressure backflow preventer is normally used in locations where an air-gap separation is impractical or there is a tendency to modify an air gap. This device is effective against backflow caused by back-pressure and backsiphonage and is used to protect a water system from substances which are hazardous to health. If hot water conditions are anticipated, inquire as to the manufacturer's recommendations.

2. INSTALLATION

- A. The reduced pressure backflow preventer should be installed with adequate space to facilitate maintenance and testing. The manufacturer's recommendations concerning space needed for repair and testing of the device should be followed.
- B. The water line should be thoroughly flushed prior to installing a reduced pressure backflow preventer to expel all debris. Debris hanging under one of the check valves is one of the most common causes of trouble with these devices.
- C. The operating effectiveness of the device is nullified if the relief port is subject to flooding. Reduced pressure backflow prevention devices should never be installed below ground level. The only case where they may be installed in a pit-type structure is where one side of the box will permit direct drainage to the atmosphere. The drain must be capable of handling the volume of water that can be discharged from the relief port. The relief port should be located a minimum of twelve inches above ground level at the point of discharge and it must never be subject to flooding. Under no circumstances, should the relief port be plugged. The device depends upon an open relief port for safe operation. Care must be taken to protect the device from freezing.

- D. Reduced pressure backflow preventer will spill or discharge water under some normal and most abnormal conditions. When the device is located inside a building, there must be a suitable means of taking care of any discharge without creating a safety or nuisance problem. If a drain is to be provided for the relief valve port, there must be a fixed air gap between the relief port and the drain.

3. DOUBLE CHECK VALVE ASSEMBLIES

- A. A double check valve assembly consists of two internally loaded, approved, independent acting check valves, either spring-loaded or weighted. They include tightly closing shut-off valves located on each end of the assembly and suitable connections for testing the water-tightness of each valve.

4. APPROVED REDUCED PRESSURE BACKFLOW PREVENTION DEVICES, TENNESSEE DEPARTMENT OF PUBLIC HEALTH, DIVISION OF WATER QUALITY CONTROL — March 1,1992

<u>Brand Name</u>	<u>Model</u>	<u>Size</u>
AMES	4000-RP	4", 6", 8", 10"
CLA VAL	RP-2	3/4", 1", 1 1/4", 1 1/2"
	RP-1 EX	2", 2 1/2", 3", 4", 6", 8", 10"
	RP-4	2", 2 1/2", 3", 4", 6", 8", 10"
	RP-4V	4"
CONBRACO	40-201-02	1/4"
	40-202-02	3/8"
	40-203-02	1/2"
	40-204-02	3/4"
	40-205-02	1"
	40-207-02	1 1/2"
	40-208-02	2"
	40-209-02	2 1/2"
	40-200-02	3"
	40-20A-02	4"
	40-20C-02	6"
40-20E-02	8"	

<u>Brand Name</u>	<u>Model</u>	<u>Size</u>
FEBCO	#825 Type YD	2 1/2", 3", 4", 6", 8", 10"
	825Y	3/4", 1", 1 1/4", 1 1/2", 2"
	825FYA	3/4", 1", 1 1/4", 1 1/2", 2"
	845	3/4", 1"
HERSEY/GRINNELL (formerly BEECO)	6CM	2 1/2", 3", 4", 6", 8", 10"
	6CM Bronze	2 1/2", 3", 4", 6"
	FRP-2	3/4", 1", 1 1/4", 1 1/2", 2"
Orion (formerly TORO)	BRP	3/4", 1", 3", 4"
	800069	1 1/2"
	9-2929	2"
RAIN BIRD	RP-QT-075	3/4"
	RP-QT-100	1"
	RP-QT-150	1 1/2"
	RP-QT-200	2"
	RPA-250-R	2 1/2"
	RP-RW-250	2 1/2"
	RPA-300-R	3"
	RP-RW-300	3"
	RPA-400-R	4"
	RPA-600-R	6"
	RPA-800-R	8"
	RPA-1000-R	10"
WATTS	909-QT	3/4", 1", 1 1/4", 1 1/2", 2"
	909-M1-QT	1 1/4", 1 1/2", 2"
	909-HW-QT	3/4", 1", 1 1/4", 1 1/2", 2"
	909-HW-M1-QT	
	909-RW	2 1/2", 3", 4", 6", 8", 10"
	909-M1-RW	8", 10"
	909-RW-Bronze	2 1/2", 3"
	909-QT-FDA	2 1/2", 3", 4", 6"
	909-M1-QT-FDA	8", 10"
	009-QT	3/4", 1", 1 1/4", 1 1/2", 2"
	009-M1-QT	1 1/4", 1 1/2", 2"
	009-RW	2 1/2", 3"

<u>Brand Name</u>	<u>Model</u>	<u>Size</u>
Wilkins (formerly NEPTUNE)	575A	3/4", 1"
	575	1 1/4", 1 1/2", 2", 2 1/2", 3", 4", 6"
	575-M8 (8x4x4 Manifold)	8"
	575-M10 (10x6x6 Manifold)	10"
	975	3/4", 1", 1 1/4", 1 1/2", 2", 2 1/2", 3", 4", 6", 8"
	975A (with removable seats)	3/4", 1", 1 1/2", 2"

NOTE: I. APPROVED UNITS REQUIRED - Only units currently approved by the Division of Water Supply are to be used for the protection of Public Water System against backflow hazards. For information on any units which may have been approved since printing of this list call (615) 741-6636.

II. HORIZONTAL INSTALLATION REQUIRED - All reduced pressure backflow prevention assemblies are to be installed horizontally. All RP assemblies currently "Approved" by the Foundation for Cross-Connection Control and Hydraulic Research have only been evaluated in a horizontal orientation. The Foundation considers vertical installation of the assembly do nullify the units "Approval".

APPROVED MODELS NO LONGER IN PRODUCTION

<u>Brand Name</u>	<u>Model</u>	<u>Size</u>
BADGER	#1	3/4", 1", 1 1/4", 1 1/2", 2", 2 1/2", 3", 4", 6"
HERSHEY/GRINNELL (formerly BEECO)	#6C	1", 1 1/2", 2", 2 1/2", 3", 4", 6", 8", 10"
	#6	2", 2 1/2", 3", 4", 6", 8", 10"
	#10	1", 1 1/4", 2", 3", 4"
	#10L	2"
	#12	3/4"
	#14	3/4", 1", 1 1/2", 2", 2 1/2", 3"
	FRP*	3/4", 1"

<u>Brand Name</u>	<u>Model</u>	<u>Size</u>
CLA-VAL	RP RP-1EX	2", 2 1/2", 4", 6, 8", 10" 8"
CRANELINE	A	1", 1 1/2", 2", 2 1/2", 3", 4", 6", 8", 10"
FEBCO	#825 #835 #835B	1 1/2", 2", 2 1/2", 3", 4", 6", 8", 10" 3/4", 1", 1 1/2", 2" 3/4", 1", 1 1/2", 2"
ITT-LAWLER	RZ12 RZ16 RZ24 RZ32 RZ40	3" 4" 6" 8" 10"
MUELLER	H9506	4", 6" 8", 10"
RAINBIRD	RPA-075-R RPA-100-R RPA-125-R RPA-150-R RPA-200-R RPA-250-R RPA-300-R	3/4" 1" 1 1/4" 1 1/2" 2" 2 1/2" 3"
ROCKWELL	#701	1 1/2", 2", 2 1/2", 3", 4", 6"
WATTS	#900 #909RW	3/4", 1", 1 1/4", 1 1/2", 2", 2 1/2", 3" 4", 6" 8", 10"
WILKINS	575	3/4", 1"

* U.S.C. Foundation for Cross Connection Control and Hydraulic Research installation requirements: Units must be installed with device rotated 45 degrees about the pipeline axis with No.2 test cock downward. The backflow preventer shall be installed as per Figure 360-I in the specifications.

END

TECHNICAL SPECIFICATIONS

GRADING AND SCREENING

1. GENERAL

- A. Do all necessary clearing, grubbing, excavating, filling, and compacting to provide the finished lines, grades and cross sections indicated and required for the project involved.
- B. Subgrade preparation for paving, excavation and backfill for concrete work and underground utilities are specified elsewhere.

2. CLEARING AND GRUBBING

- A. Clearing shall consist of felling and cutting of trees, the trimming of trees left standing; and the satisfactory removal and disposal of all trees, logs, down timber, hedge shrubs, brush, growing corn, weeds, grass, cornstalks, other herbaceous vegetation and rubbish.
- B. Grubbing shall consist of the removal and disposal of stumps, hedges, and roots.
- C. Clearing and grubbing shall be performed: (1) in areas within the slope limits of embankments, (2) in areas to be excavated and (3) in other areas as designated on the drawings.
 - (1) Down timber and logs shall be cleared from all areas within the slope limits of embankments, areas to be excavated and areas designated on the drawings.
 - (2) Hedge or shrub shall be pulled or grubbed from all areas within the slope limits of embankments, areas to be excavated, and areas designated on the drawings.
 - (3) Trees, stumps, shrubs, bushes, and roots shall be pulled, grubbed in all areas within the slope limits or embankments, areas to be excavated.
 - (4) Trees, stumps, shrubs, bushes and roots as designated on the drawings shall be removed below the elevation of the subgrade, unless otherwise directed by the City Engineer.
 - (5) All areas within the slope limits of embankments and areas to be excavated shall be cleared or stripped of any organic substances, rubbish and similar unsuitable materials. Areas designated on the drawings shall also be cleared or stripped as above when so noted on the drawings or by the City Engineer.
- D. All dead branches and all live branches, designated by the City Engineer for removal, shall be trimmed out of individual trees and groups of trees left standing. All limbs and branches required to be trimmed shall be neatly cut to the bole of the tree or to the main branches, and cut greater than 1 1/2 inches in diameter thus made shall be painted with an approved tree-wound paint.

- E. Trees, shrubs, and other vegetation to be left standing shall be protected from damage during clearing and other construction operations by methods subject to the approval of the City Engineer. Clearing and grubbing operations shall be performed in such a manner as to prevent damage to structures, trees, shrubs and other vegetation to be left standing; and to provide for the safety of the employees and others. In the event that any tree or shrub designated to be left standing is damaged by the developer, such plants shall be repaired immediately or replaced, as directed by the City Engineer, in accordance with standard horticultural practice at the developer's expense and at no expense to the City.
- F. The cleared and grubbed material shall in general be disposed of away from the site. Combustible materials may be disposed of by burning on the site, when approved by the City Engineer. Disposal of cleared and grubbed material shall be performed legally.

3. EARTH EXCAVATION

- A. Earth excavation shall consist of the excavation, removal and satisfactory disposal, all as specified herein, of all material regardless of its nature encountered within the area to be graded and/or in a borrow area except for Rock Excavation as defined herein.
- B. Rock Excavation shall consist of the excavation, removal and satisfactory disposal of:
 - (1) All boulders and rocks which occur on the surface of the earth or in sub-surface deposits mixed with the earth, sand or gravel when, in the opinion of the City Engineer, their size, number or location prevents them from being handled in a manner normal to the excavation operating being conducted in the area where the boulders and rocks occur.
 - (2) Granite, trap, quartzite, chert, limestone, hard sandstone, hard shale or slate, or similar materials, in natural ledges or displaced masses, which, in the opinion of the City Engineer, it is not possible to excavate and remove without resorting to the continuous use of pneumatic tools, or to continuous drilling and blasting.
- C. Excavation of materials shall be performed to the lines, elevations, and cross sections as shown on the drawings and as herein specified. Excavated materials that are suitable shall be used in the construction of embankments, so far as possible, and no such material shall be wasted without authority from the City Engineer.
- D. Excavation operations shall be conducted so that material outside of the limits of slopes will not be removed or loosened. In the event that such material is removed or loosened, it shall be replaced as directed by the City Engineer.

- E. Care shall be taken not to excavate material below the elevations and lines indicated on the drawings. If materials are excavated below the elevations and lines indicated on the drawings, the Contractor shall, as directed by the City Engineer, construct embankment to the said elevations and lines and/or in the case of ditches or waterways place stone or broken portland cement concrete in the ditches or waterways, all at no expense to the City.
- F. Excavated area shall be continuously maintained such that the surface shall be smooth and have sufficient slope to allow water to drain from the surface. If the developer fails to maintain partly finished work in a satisfactory manner, excavation shall be discontinued, if so ordered by the City Engineer, until the work is in satisfactory condition.
- G. All lots shall be laid out so as to provide positive drainage directly to the street at a rate of not less than 3.3 percent slope. In cases where this requirement prevents coordination of lot drainage and the general storm drainage pattern, a written waiver may be granted on an individual lot basis by the City Engineer.
- H. All areas in excavation will be proofrolled prior to any building or placing of base, etc.
 - (a) Prior to the placement of any architectural or engineered fill, the area to receive fill will be proofrolled in the presence of the City Engineer or his approved representative, with a pneumatic- tired dual wheel tandem axle truck with a gross weight as indicated in the proofrolling chart. Proofrolling shall be carried out in two directions at right angles to each other with no more than 24 inches between the tire tracks covering the entire area being proofrolled. All soft spots will be cut out and repaired prior to any fill being placed on the surface of the sub base.
 - (b) All areas in either cut or fill will be proofrolled prior to any building or placing of base material for roads or parking lots in the presence of the City Engineer or his approved representative with a pneumatic-tired, dual wheel, tandem axle truck having a gross weight as indicated in the proofrolling chart. Proofrolling shall be carried out in two directions at right angles to each other with no more than 24 inches between tire tracks covering the entire cut area. All soft spots will be cut out and repaired prior to any building or placing of base material for roads or parking lots.

COMPACTION REQUIREMENTS

<u>TYPE OF FILL</u>	<u>STD. PROCTOR ASTM</u>	<u>MOD. PROCTOR ASTM</u>	<u>PROOFROLLING GROSS WT. LBS.</u>
Compacted fill under buildings and structures.	98%	95%	50,000#
Compacted fill under roadway base and other areas to be paved.	98%	95%	40,000#

<u>TYPE OF FILL</u>	<u>STD. PROCTOR ASTM</u>	<u>MOD. PROCTOR ASTM</u>	<u>PROOFROLLING GROSS WT. LBS.</u>
Roadway base.	98%	95%	50,000#
Compacted fill in levees and dikes.	98%	95%	50,000#
Compacted fill in overlot areas.	90%	87%	40,000#

All compactor test costs shall be borne by the Contractor. Locations or number of test are to be indicated on the construction plans as approved by the City.

4. REMOVAL OF EXISTING OBSTRUCTIONS

- A. All obstructions (such as fences, walls, foundations, building, accumulations or rubbish of whatever nature, and existing structures, shall be removed from the grade site and disposed of, as directed by the City Engineer.
- B. Existing structures, buildings, walls and foundations which are not to remain in service shall be removed to at least one (1) foot in any direction from all new structures and shall be removed to at least one (1) foot below the proposed elevation of subgrade or finished ground surface, whichever is lower, except as such items are specifically noted on the drawings to remain in place.
- C. Concrete and other materials removed from existing structures, buildings, walls, foundations or other obstructions shall be broken up into sizes suitable for use as rip-rap, embankment fill or for other satisfactory disposal, as directed by the City Engineer.

5. PROTECTION OF SEWER LINES, UTILITIES STRUCTURES AND DRAINAGE FACILITIES

- A. Existing utility lines which are to be retained, as well as utility lines constructed during excavation operations, shall be protected from damage during excavation and filling operations, and if damaged, shall be repaired by the developer at his expense. In the event that existing utility lines are encountered at such location or elevation that they must be relocated to avoid conflict with the new work, and where such relocation is not included as part of the proposed work then the necessary relocation may be accomplished by "others" or by the developer as directed by the City Engineer. Such work when ordered by the City Engineer and performed by the developer shall be paid for in accordance with the provisions set forth under MEASUREMENT AND PAYMENT below.

- B. If it is necessary in the prosecution of the work to interrupt natural drainage of the surface, or the flow of artificial drains, the developer shall provide temporary drainage facilities at his expense that will prevent damage to public or private interests, and shall restore the original drains at his expense as the work will permit. The developer shall be liable for all damages which may result from his neglect to provide for either natural or artificial drainage which the work may have interrupted.

6. REMOVAL AND DISPOSAL OF SURPLUS, UNSTABLE, AND UNSUITABLE MATERIALS

- A. Prior to starting excavation of soil material:

- (1) Existing oiled earth or bituminous surfaces may be broken into pieces not exceed six (6) inches in the largest diameter, embedded in embankments with approval from the City Engineer.
- (2) Existing portland cement concrete pavement, bituminous concrete pavement and existing sidewalks shall be removed from the site of the work and disposed of in a suitable manner by the developer.

- B. Stones and boulders encountered in excavation shall, whenever possible, be removed and placed in embankments. Stones and boulders not placed in embankments shall be disposed of as directed by the City Engineer. No stones, boulders or bituminous concrete pavement over three (3) inches in diameter shall be used for backfill in trenches.

- C. Unstable material is soil material of such a nature that, in the opinion of the City Engineer, it cannot be properly consolidated in embankments or material that will not be made to function to satisfy the project conditions.

- (1) Unstable materials, shown on the drawings to be present, shall be removed and disposed of as directed by the City Engineer. The horizontal and vertical limits of unstable materials to be removed, as shown on the drawings, are approximate only. All the material of the same soil type, as that indicated to be removed to the limit of its existence regardless of the relationship between the actual limits of the type and indicated limits shown on the drawings.
- (2) Where unstable material not shown on the drawings is encountered, at or below the elevation of the finished grade line, or, at or below the original ground line on which embankment is to be constructed, the City Engineer may direct the developer to, and the developer shall, when so directed, remove and dispose of the unstable material as specified by the City Engineer. The volume of such unstable material ordered removed and replaced shall be measured for payment.

D. Surplus excavated material shall be disposed of in the following locations, as noted on the drawing or directed by the City Engineer:

- (1) Used to widen embankments or flatten slopes. Surplus materials disposed of in this manner will not be required to be rolled unless the widening is made at the same time the embankment is constructed.
- (2) Disposed of within and/or adjacent to the job site.
- (3) Disposed of within a waste area noted on the drawings.
- (4) Disposed of, in a legal manner, outside the limits of the job site at a location chosen by the developer and approved by the City Engineer, at the developer's expense.

7. TOP SOIL REMOVAL AND CONSERVATION

A. Top soil shall be removed from areas to be graded and spread on areas already graded and prepared for top soil or shall be removed, transported and deposited in storage piles for use at such time as graded areas are ready for such placement. Top soil shall be stripped to the surface of the sub soil. Top soil shall be free of subsoil, stones and other undesirable material.

8. BORROW

A. When the quantity of material required for earth fill is not available within the limits of the job site, the developer shall provide sufficient material to construct the embankments to the lines, elevations and cross sections as shown on the drawings from borrow areas. Unless borrow areas are specifically shown on the drawings as provided by the City, they shall be provided by the developer and at his expense. Borrow material shall be provided which meets the requirements and conditions of earth fill in which it is to be deposited. Borrow areas selected by the developer and the materials contained therein shall be approved by the City Engineer prior to the placing of any such materials excavated from the borrow pit.

B. When the Plans or specifications require that materials from borrow areas be furnished by the developer, the developer shall furnish the borrow areas, shall obtain from the City of said borrow areas the right to excavate material, shall pay all royalties and other charges involved and shall pay all expenses in developing the source, including the cost of right-of-way required for hauling the material.

C. Procedures and requirements specified herein for other excavation are also applicable to excavation from borrow areas.

D. The developer shall notify the City Engineer at least ten (10) days in advance of the opening of any borrow pit to permit any necessary elevations of measurements to be taken or any desired material test to be made.

9. FILL AREAS

- A. Prior to the placement of any architectural or engineered fill, the area to receive fill will be proofrolled in the presence of the City Engineer or his approved representative, with a pneumatic-tired dual wheel tandem axle truck with a gross weight as indicated in the proofrolling chart. Proofrolling shall be carried out in two directions at right angles to each other with no more than 24 inches between the tire tracks covering the entire area being proofrolled. All soft spots will be cut out and repaired prior to any fill being placed on the surface of the sub base.

- B. All areas in either cut or fill will be proofrolled prior to any building or placing of base material for roads or parking lots in the presence of the City Engineer or his approved representative with a pneumatic-tired, dual wheel, tandem axle truck having a gross weight as indicated in the proofrolling chart. Proofrolling shall be carried out in two directions at right angles to each other with no more than 24 inches between tire tracks covering the entire cut area. All soft spots will be cut out and repaired prior to any building or placing of base material for roads or parking lots.

COMPACTION REQUIREMENTS

<u>TYPE OF FILL</u>	<u>STD. PROCTOR ASTM</u>	<u>MOD. PROCTOR ASTM</u>	<u>PROOFROLLING GROSS WT. LBS.</u>
Compacted fill under buildings and structures.	98%	95%	50,000#
Compacted fill under roadway base and other areas to be paved below.	98%	95%	40,000#
Roadway base.	98%	95%	50,000#
Compacted fill in levees and dikes.	98%	95%	50,000#
Compacted fill in overlot areas.	90%	87%	40,000#

All compactor test costs shall be borne by the Contractor. Locations or number of test are to be indicated on the construction plans as approved by the City.

- C. The construction of earth fill shall consist of the preparation of the site and the placement and compacting of excavated materials, including earth, stone, gravel or other materials of acceptable quality, as specified herein, and to the lines, elevations and cross sections as shown on the drawings. Fill areas shall be inspected by a qualified soil testing laboratory to insure they are properly constructed and that footings will bear in them.

- D. Before earth fill is placed all Clearing and Grubbing, top soil removal and conservation, and removal and disposal of unstable and unsuitable material shall be performed as specified in this section on the area which is to receive the fill material. A qualified soils testing laboratory shall inspect the site and give a written recommendation before is constructed is approved.
- E. The surfaces upon which earth fill is to be constructed shall, if directed by the soils testing laboratory, be loosened by scarifying, discing, or by other approved methods to provide bond between existing ground and the embankment. Wherever an embankment is to be constructed on or against a slope steeper than four (4) feet horizontally to one (1) foot and a vertical raise, as the construction to the new embankment progresses.
- F. Snow and ice, if present, shall be removed from the area to be covered. Embankments shall not be constructed on frozen ground nor shall frozen materials be deposited in fill locations.
- G. All earth fill shall be placed by depositing excavated materials, which have been approved by the soils testing laboratory, in horizontal layers not exceeding six (6) inches loose thickness. The moisture content of the materials shall be equal to or slightly above its optimum moisture content. So far as practicable, each layer shall extend the full width. The material shall be leveled before compaction by means of equipment approved by the soils testing laboratory. The surface of the material shall be continuously maintained smooth and have sufficient slope to allow water to drain from the surface. If the developer fails to maintain partly finished work in a satisfactory manner, construction shall be discontinued, if so ordered in writing by the City Engineer, until the work is in satisfactory condition. The paths of the hauling equipment shall be distributed over the width of the work.
- H. After each layer is leveled and before the next layer is deposited, the entire area of each layer shall be compacted to the compaction requirements, under paragraph B, or to compaction requirements otherwise noted on the drawings. The determination that the compacted fill material meets the compaction requirements shall be performed by the soils testing laboratory by the Standard Methods of Test, AASHTO. The Contractor shall provide the qualified testing laboratory with sufficient opportunity to perform this determination test before proceeding with additional layers of materials.
- I. If the moisture content of the deposited material is such that the above compaction requirements cannot be obtained without drying or wetting the material, the developer shall as directed by the City Engineer, dry the material by discing, harrowing or other approved method; or wet the material uniformly with the application of water, whichever is necessary.
- J. In the construction of levee embankments and where fill materials from excavation and borrow have decidedly different values of permeability when compacted, the more impervious materials shall be placed in the river side face of the embankment.

- K. Materials used in fill area may contain stones smaller than six (6) inches in diameter, and such stone shall be interspersed through the soil. If these stones interfere with the compaction of the embankment, they shall be removed and otherwise disposed of. Stones larger than three (3) inches in diameter will not be permitted in the uppermost one (1) foot of embankment.

11. SHOULDER CONSTRUCTION

- A. At locations where shoulders are to be constructed adjacent to a rigid type surfacing, such as portland cement concrete pavement, or any bituminous surface course constructed on a portland cement concrete base course, or adjacent to curb, gutter, or curb and gutter, the following shall apply:
 - (1) After the surfacing, curb, gutter or curb and gutter have been constructed, the placing of earth for the shoulder shall be completed and the earth compacted, shaped, and finished to the lines, elevations and cross sections shown on the drawings.
- B. At locations where shoulders are to be constructed adjacent to a non-rigid type surfacing, such as gravel or crushed stone base or surface course, or any bituminous surface course not constructed on a portland cement concrete course, the following shall apply:
 - (1) When the elevation of the shoulder is to be at, or near to the surface elevation of the surface or base course, the earth for the shoulders shall be roughed in before the material for the base or surface course is deposited. The edge of the shoulder abutting the base or surface course shall be constructed as nearly vertical as practical. The earth shall be placed so that it will be possible to retain and compact the edges of the base or surface course against the shoulder. After the base or surface course is constructed, the balance of the earthwork required to complete the shoulders shall be performed, and the shoulders shall be compacted, shaped and finished to the lines, elevations and cross sections shown on the drawings.
 - (2) When the elevation of the shoulder is below the surface elevation of the surface course, the earthwork required to complete the shoulders shall be performed before the surface course is constructed. The shoulders shall be compacted, shaped and finished to the lines, elevations, and cross sections shown on the drawings.
- C. The developer shall at all times perform his shoulder construction operations in a manner such that the finished pavement, base or surface course, curb, gutter, curb and gutter or any structure will not be damaged. Any damage occurring shall be either repaired, or removed and replaced by the developer, as directed by the City Engineer, at no expense to the City.
- D. The shoulders shall be rolled with an approved pneumatic- tired roller unless otherwise directed by the City Engineer.

12. FINISHING

- A. Excavation and embankment areas, including all earth areas disturbed by the construction work, shall be shaped, trimmed, smoothed and finished uniformly in a workmanlike manner to lines, elevations and cross sections shown on the drawings and as directed by the City Engineer. The degree of finish for grading shall be that ordinarily obtainable through the use of a blade grader or similar power equipment operating under favorable conditions and operated by skilled workmen. Other methods, including hand methods, will be required in the event satisfactory finishing is not otherwise obtained.
- B. The finished surface of areas on which base and/or surface courses are to be constructed shall be constructed so that the average surface elevation of the earth shall not be higher than the average elevation of the subgrade and shall not be lower than 0.15 feet below this elevation. All other surfaces shall not vary in elevation more than 0.15 feet above or below the elevation or cross section as shown on the drawings or as established by the City Engineer.
- C. All earth surfaces shall be shaped and finished so that proper drainage is assured.

D. PROOFROLLING

- (a) Prior to the placement of any architectural or engineered fill, the area to receive fill will be proofrolled in the presence of the City Engineer or his approved representative, with a pneumatic-tired dual wheel tandem axle truck with a gross weight as indicated in the proofrolling chart. Proofrolling shall be carried out in two directions at right angles to each other with no more than 24 inches between the tire tracks covering the entire area being proofrolled. All soft spots will be cut out and repaired prior to any fill being placed on the surface of the sub base.
- (b) All areas in either cut or fill will be proofrolled prior to any building or placing of base material for roads or parking lots in the presence of the City Engineer or his approved representative with a pneumatic-tired, dual wheel, tandem axle truck having a gross weight as indicated in the proofrolling chart. Proofrolling shall be carried out in two directions at right angles to each other with no more than 24 inches between tire tracks covering the entire cut area. All soft spots will be cut out and repaired prior to any building or placing of base material for roads or parking lots.

COMPACTION REQUIREMENTS

<u>TYPE OF FILL</u>	<u>STD. PROCTOR ASTM</u>	<u>MOD. PROCTOR ASTM</u>	<u>PROOFROLLING GROSS WT. LBS.</u>
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Compacted fill under roadway base and other areas to be paved.	98%	95%	40,000#
Roadway base.	98%	95%	50,000#
Compacted fill in levees and dikes.	98%	95%	50,000#
Compacted fill in overlot areas.	90%	87%	40,000#

All compactor test costs shall be borne by the Contractor. Locations or number of test are to be indicated on the construction plans as approved by the City.

13. PLACING TOP SOIL

- A. Top soil shall be placed after the area to be covered has been shaped, trimmed and finished. If the surface which is to receive the top soil is hardened or crusted, it shall be raked or otherwise broken upon as to provide sufficient bond with the top soil to be placed thereon.
- B. Top soil shall be spread over the area and to the depth indicated on the drawings. It shall be finished in accordance with the article entitled "Finishing" in this section of the Specifications.

14. PROTECTION OF GRADED AREAS

- A. Newly graded areas shall be protected from traffic and erosion by using barricades and straw coverings, and any settlement or washing away that may occur is to be corrected, prior to final acceptance and shall be repaired by the developer at his expense. Such repairs shall begin within 24 hours after notification by the City Engineer.

15. SEEDING AND MULCHING

A. After excavation, filling, grading, and backfilling are completed, seed and mulch the following areas:

- (1) All ground surfaces on an area 15 feet wide, parallel to and back of the concrete curb. Where sidewalk is provided, seed and mulch the area between the sidewalk and curb and the area behind the sidewalk to a line 15 feet from the back of the curb.

B. Liming and Fertilizing:

- (1) Lime shall be standard agricultural type containing at least 85% total carbonates.
- (2) Fertilizer shall be 6-12-12 grade commercial type containing 6% nitrogen, 12% p₂o₅, and 12% k₂o.
- (3) Before seeding, apply lime and fertilizer at the following rates and uniformly incorporate it into the soil at least 3" deep by discing, harrowing, or other approved method.
 - (a) Lime: 4,000 pounds per acre (92 Pounds per 1,000 square feet).
 - (b) Fertilizer: 100 pounds per acre (23 pounds per square foot).

C. Seeding:

- (1) Seeds shall be uniform mixtures of the following kinds and properties:

<u>KIND</u>	<u>Group A</u> <u>% by weight</u>	<u>Group B</u> <u>% by weight</u>
Hulled Bermuda	50	20
Kentucky 31 Fescue	40	60
English Rye	10	20
TOTAL	100	100

- (2) Time of Sowing and Seed Mixture Required:

- (a) February 1 to August: Use Group A Only
- (b) Month of August Only: Use either Group A or Group B.
- (c) September 1 to December 1: Use Group B Only.
- (d) December 1 to February 1: DO NOT SOW ANY SEED

- (3) Sow 97 pounds of the required seed mixture per acre (2 pounds per 1,000 square feet) in two separate applications, and rake the seeded areas lightly to cover the seeds.
- D. Mulching: Cover all seeded areas with a 1" minimum thickness layer of weed-free straw or other approved mulch, and wet the mulch thoroughly.
- E. Watering and maintenance: Water and maintain the seeding until a living and growing stand of grass acceptable to the City has been established, and at least until final project acceptance.

16. MEASUREMENT AND PAYMENT

- A. Clearing and Grubbing: Paid for at the unit price per acre.
- B. Excavation, Unclassified and Borrow: Paid for at the unit price per cubic yard. Excavation will be measured in its original position using the cross section method, and the volume computed by the average end area method.
- C. Fill: Fill will not be measured and paid for directly; payment will be included in the unit prices for excavation.
- D. Seeding and Mulching: Paid for at the unit price per acre of SEEDING AND MULCHING; includes liming, fertilizing, seeding, mulching and watering; no payment will be made for any seeding and mulching which does not produce a satisfactory and acceptable growth of grass.

17. PLANTING SCREENS

- A. During preliminary plat review by the City of Pipeston Planning Commission, the developer may be directed to furnish and install prescribed planting screens, in certain cases, prior to completion of the development.
- B. In developments which require screening the developer will be required to furnish the as-built plans to the City Engineer prior to any construction beginning. The development plan will provide screening in accordance with the attached diagrams.
- C. At such time the subdivision plat is given final approval for recording, the developer will furnish the City a construction bond in the amount of the proposed improvements to be made. The City Engineer shall determine the amount of the bond required.

END

TECHNICAL SPECIFICATIONS

FACTORY BUILT 6' X 6' ABOVE-GROUND FIBERGLASS PUMPING STATION WITH DUPLEX SELF-PRIMING PUMPS

1. PUMPING STATION

- A. The station shall be built in two major sections, consisting of a steel reinforced concrete base to support the pumps and a fiberglass enclosure.
- B. The station enclosure shall be manufactured of molded fiberglass reinforced orthophthalic polyester resins in a ratio of 30% glass and 70% resin. Major design characteristic considerations shall be given to structural stability, corrosion resistance and watertight properties. The polyester laminates shall provide a balance of mechanical, chemical and electrical properties to insure long life. They must be impervious to micro-organisms, mildew, mold, fungus and completely non-corrosive inside or outside.
- C. The station enclosure shall contain all pumps and equipment. The enclosure shall be square with flat sides which have removable panels to permit service access to any quadrant of the station interior. Each corner post as well as the roof section shall be easily removed for major service requirements. All exposed hardware shall be of a tamperproof design.
- D. Tamperproof retaining devices shall be provided to secure the enclosure side panels to the station frame. One side panel shall have a locking access door for quick entry to the motor control center enclosure. This access door shall have a piano-type hinge and two-point latching mechanism.
- E. One enclosure panel shall have increased ventilation capabilities and shall be interchangeable with other side panels in order to maximize air flow.
- F. The station base shall be constructed of pre-cast, reinforced concrete with molded anchor recesses and drainage provision. An access opening of sufficient size shall be formed in the base for piping and service connections to the wet well.
- G. The pumps shall be "T" series as manufactured by the Gorman-Rupp Company or equal specifically designed for the pumping of raw, unscreened sewage and capable of passing a 3 inch diameter spherical solid. The shaft seal shall be the double floating, self-aligning, oil lubricated, mechanical type. The stationary and rotating sealing members shall be of tungsten-titanium carbide alloy. The impeller shall be two vane, semi-open, non-clog, cast in ductile iron and accessible through a removable cover plat. The pumps shall incorporate removable, molded, one piece, suction check valves.

2. OPERATING CONDITIONS

- A. See the Construction Drawings.

3. STATION PIPING

- A. The station suction and discharge valving and fittings shall be complete to that point where the Contractor connects the riser pipes to the suction elbows and ties in the force main to the flanged discharge outlet. The discharge check valves shall be wafer style swing checks with resilient seats and outside arm and spring as manufactured by the Price Valve Company or equal. The discharge shut off valve shall be a 3-way plug valve with neoprene coated plug as manufactured by DeZurik Corporation or equal. The pumps shall be filled with air release valves to permit automatic unattended repriming.

4. CONTROL PANEL

- A. The control panel shall consist of a circuit breaker and magnetic starter for each pump motor actuated by an air bubbler type liquid level control system. The control assembly shall provide means to operate each pump manually or automatically. When operated in the automatic mode, the control assembly shall provide means to automatically alternate the position of the "lead" and "lag" pumps after each pumping cycle.
- B. All components shall meet the National Electric Code (NEC).

5. MOTOR AND LEVEL CONTROL ENCLOSURES

- A. The motor and level controls shall be mounted in suitably sized enclosures. Each enclosure shall be J.I.C. type, steel construction with continuously welded seams. Enclosure door shall be gasketed with neoprene and equipped with a continuous hinge and captivated closing hardware.

6. OPERATION

- A. An air bubbler type liquid level control system shall continuously monitor wet well liquid level and control operation of the pumps according to level variations. The system shall actuate pump motors on an alternation "lead" - "lag" basis, with independently adjustable lead pump and lag pump start levels. One pump motor shall be actuated when wet well liquid rises to pre-set "lead pump start" level, and shall be shut down when wet well liquid has been pumped down to the pre-set "stop" level. If, after the lead pump motor has been actuated and both pump motors shall continue to operate in parallel until wet well liquid falls to pre-set "stop" level.
- B. "Lag" pump operation shall be independent of "lead" pump operation. Circuitry which provides "lag" pump operation contingent on proper "lead" pump circuit operation is not acceptable.

7. COMPONENTS

- A. All motor branch circuit breakers, motor starters and control relays shall be securely fastened to the removable back panel with screws and lock washers. Back panel shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.
- B. A mechanical disconnect mechanism shall be installed on each circuit breaker to provide a means of disconnecting power to the pump motors. Operator handles for the disconnect mechanisms shall be located on the exterior of the motor control center door, with interlocks which permit the door to be opened only when the circuit breakers are in the "OFF" position.
- C. An open frame, across-the-line NEMA rated, magnetic motor starter, Bulletin 790, Series K as manufactured by Allen Bardley or approved equal, shall be furnished for each pump motor. All motor starters shall be equipped to provide under-voltage release and overload protection on all three phases. Motor starter contacts shall be easily replaceable without removing the motor starter from its mounted position. Overload relays shall be manual reset and shall not provide means for converting to automatic reset.
- D. Pump alternator relay shall be of electrical/mechanical industrial design, Class 47, as manufactured by Furnas Electric, or approved equal.
- E. Two (2) vibrating reed type air pumps shall be furnished and wired in such a manner that one (1) air pump shall operate continuously to deliver free air at a rate of approximately 5 cubic feet per hour at a pressure not to exceed 7 psi. Each air pump discharge line shall be equipped with a valve and each air pump shall be wired in such a manner as to allow either air pump to be removed for service while the other remains in operation. Air pumps shall be Silent Giant, or approved Equal.
- F. Liquid level control system utilizing air compressors delivering greater quantities of air at higher pressure requiring pressure reducing valves, rate of flow control valves and air storage reservoirs shall not be acceptable.
- G. A manually operated switch shall be furnished to alternate the use of the air pump. An air bell shall be supplied for installation in the wet well.

8. OPERATING CONTROLS AND INSTRUMENTS

- A. Liquid level shall be controlled by pressure operated switching device with adjustments for "lead", "lag" and pump "off" levels. Pressure switch shall be Series 300 as manufactured by United Electric, with an operating of 0 - 150" and minimum differential of 6". Minimum repeatability accuracy shall be +/- one percent of full range span. Contacts shall be rated 10 amps continuous.

- B. Switches shall be furnished to alternate air pumps and to select mode of operation for each pump. They shall be military type toggle switches with contacts rated at 15 amps at 115VAC, non-inductive. Air pump selector switch shall be connected in such a manner that either air pump may be selected to operate continuously. Pump mode selector switches shall be HAND-OFF-AUTO type to permit manual control of either pump motor. Operation of pumps in manual mode shall bypass all safety shutdown circuits except pump motor overload.
- C. A thermal magnetic air circuit breaker shall provide over-current protection for control circuits and shall be connected in such a manner as to allow electrical power to be disconnected from all control circuits.

9. TIME METERS

- A. Panel shall be equipped with elapsed time meters to indicate total running time of each pump in "hours" and "tenths of hours". Elapsed item meters shall be HK Series as manufactured by Eagle Signal, or approved equal.

10. GAUGING

- A. Each pump shall be equipped with a suction compound gauge and discharge pressure gauge. Gauges shall be glycerin-filled type, graduated in "feet water column".

11. HEATER

- A. The heater shall be a Tital "Milkhouse Style" type No. 2H934 or equal. The heater shall be 1300/1500 watts with a high BTU rating of 5120. The fan shall be heavy duty and the cabinet shall be made of 20 gage steel with two-tone gray enamel finish. The heater shall also contain an automatic thermostat with an off position and automatic tipover.

12. AUXILIARY RECEPTACLE

- A. A 115 V AC 15 AM Duplex receptacle to the GFI Type shall be inside the pump station enclosure.

END

TECHNICAL SPECIFICATIONS

STORM SEWERS

1. PIPE

- A. All storm drainage pipe shall be reinforced concrete pipe and conforming to the following: ASTM C 76, ASTM C 507.
- B. Before delivery to the project, all concrete pipe shall be inspected and tested for specification compliance by an independent testing laboratory acceptable to the City, and each approved length of pipe shall be marked with the laboratory's inspection stamp. Before laying any pipe or fittings, submit laboratory test reports to the City for approval. In addition, all pipe and fittings shall be subject to inspection by the City at the trench. Do not lay any pipe not bearing the laboratory inspection stamp and not covered by laboratory test reports, but remove all such pipe and fittings from the job site. The cost of inspection and stamping of sewer pipe and fitting by the laboratory shall be borne by the pipe purchaser.

2. JOINTS

JOINTS FOR CONCRETE PIPE SHALL BE RUBBER GASKET JOINTS.

- A. Rubber Gasket Joints: Rubber gaskets shall conform to ASTM Specification C443, and shall be continuous rubber rings fitting snugly into the annular space between the parallel surfaces of the tongue and groove ends of the pipe to form a flexible and watertight seal under all conditions of service. Make rubber gasket joints as recommended by the gasket manufacturer and generally as follows: Prior to the pipe and when recommended by the gasket manufacturer, the gasket shall be cemented to the tongue end of the pipe with a special rubber cement furnished by the manufacturer of the gasket. When placing gasket, the pipe tongue surface shall be dry and clean. Affix gasket to the pipe not more than 24 hours prior to installation. Before installing pipe the entire interior of the groove shall be cleaned and lubricated, as well as the gasket over which the groove is fitted. All pipe shall be aligned with the previously installed pipe and the joint pulled together tightly. If the gasket becomes loose or displaced, the pipe section shall be removed and the joint remade satisfactorily. All joints shall be inspected both inside and outside for gasket faulting or displacement.

3. PIPE FOUNDATIONS

Whenever the Engineer finds the bottom of the trench to be on insufficient foundation for the pipe, he will determine the locations and dimensions of the necessary foundations for the pipe, which shall be one of the following types, as directed:

- A. Concrete saddles, consisting of 4,000 minimum psi concrete, poured full width of trench bottom, extending not less than 1/4 outside pipe diameter below the outside bottom of the pipe, and extending not less than 1/4 outside pipe diameter above outside bottom of pipe, or other dimensions as directed.
- B. Drain Rock Material, For Trench Drainage and Pipe Base: This shall be washed gravel, washed crushed rock, or washed crushed stone, evenly graded from 1/2" to 2" size.
- C. Granular Pipe Embedment Material, for Pipe Embedment or Support: This shall be crushed rock, crushed stone, or washed gravel, 100% passing a 1/2" screen, and 95% retained in a No.4 sieve.

4. EXCAVATION

- A. Special Requirements: See TRENCHING, PIPE LAYING, BACKFILLING, AND PAVEMENT REPAIRS, COUNTY ROADS, hereinafter for special excavation requirements in those areas.
- B. General Excavation: Unless otherwise indicated or authorized, trenches for sewers shall be open cut, and shall follow lines parallel to the equidistant from the pipe centerline. Excavate trenches to the depths and widths required to accommodate the construction of sewers as follows:
 - 1. Do not carry any excavation below the grades indicated on the drawings, unless otherwise authorized.
- C. Trench widths shall be:
 - 1. For 18" and Smaller Pipes: At least 6" but not more than 12" wider than the pipe outside diameter on each side of the pipe.
 - 2. For Pipe Larger than 18": At least 12" but not more than 15" wider than the pipe outside diameter on each side of the pipe.
 - 3. The above specified trench widths shall be measured AT THE TOPS OF THE PIPES: trenches may be wider ABOVE the tops of the pipes.
 - 4. Install all shoring, sheathing, and bracing timber INSIDE of the specified MAXIMUM trench widths.
- D. MINIMUM cover over tops of pipes shall be 12" except that where this is prevented by job conditions the cover shall be as much as possible under the conditions involved.

- E. Pipe Embedment: See PIPE EMBEDMENT hereinafter for description of bedding methods.
1. Use Method C (Normal Embedment) throughout, EXCEPT where trench bottom is found to be unstable or otherwise unsuitable for this method.
 2. Use Method B (Modified Normal Embedment) in all cases where the natural trench bottom is found to be unstable or otherwise unsuitable for normal embedment.
- F. Excavation for manholes and Inlets: Excavation for manholes and inlets to the dimensions, shapes, and elevations as indicated as required, by mechanical and/or hand methods. Excavations for manholes bases and other poured-in-place concrete shall be plumb, level, firm, clean, and free of loose earth, loose rock, vegetation, mud, water, frozen earth, and other unsatisfactory materials immediately before concrete placement. The outside dimensions of manhole excavations shall be at least 12 inches greater than the manhole outside dimensions to facilitate manhole construction and backfilling around the structure.
1. If excavation is carried below indicated or authorized elevations, or if the subgrade should be spoiled in any way, fill the over excavated or spoiled areas with concrete, unless otherwise specified or authorized.
- G. Unsatisfactory Subgrade: Where indicated and/or where the subgrade material will not provide a sufficiently firm foundation to support the pipes and superimposed loads, remove the unsatisfactory material down to the depths indicated or required, and replace it with the specified drain rock, granular pipe embedment, or granular backfill material.
- H. Maintaining Drainage: Provide and maintain in proper working order all necessary dewatering equipment for the removal of water from the excavations. Where the trench bottom is mucky or otherwise unstable because of ground water, and in all cases where the static ground water elevation is above the bottom of the trench excavation, lower the ground water level by use of drain rock or other acceptable method, as required to keep the trenches free from water and the bottom stable for pipe laying, until the pipes have been installed properly and will be unaffected by submersion.
- I. Shoring, Sheathing, and Bracing: Adequately shore and brace trenches and other excavations as required to protect personnel, adjacent structures and adjacent property. Where required by the conditions encountered, brace trenches and excavations with suitable close sheeting or sheet piling. Do all necessary cribbing up required for the proper operation of trenching machines. Repair all damage resulting from inadequate shoring, sheathing, and bracing.

- J. Removal of Sheathing: Sheathing or shoring that does not extend below the pipe centerline may be removed after the trench backfill has been placed and compacted to a level of one foot above the tops of the pipes. Immediately after such removal, fill all resulting void spaces and re-compact backfill. Sheathing may be left in place only where specifically approved. Cut off the tops of all sheathing left in place at depth below finished grade.

5. PIPE EMBEDMENT

- A. General: See Paragraphs 4E (1) and 4E (2) above to determine the bedding method required for each sewer laying condition.
- B. Bedding Method C, "Normal Embedment": This shall consist of a groove and bell holes excavated by hand in trench bottom. Place groove to fit lower quadrant of pipe barrel, and to provide uniform and continuous bearing of lower quadrant of pipe barrel on trench bottom at every point between bell holes. Shape bell holes to facilitate joining and to prevent pipe ends from bearing on trench bottom. Before preparing groove, excavate trench bottom to an elevation sufficiently above required line and grade.
- C. Bedding Method B, "Modified Normal Embedment": This shall consist of the specified granular pipe embedment material across full trench width, down at least 3" below the pipe, and up to at least the pipe centerline. Deposit the granular pipe embedment material with hand tools and thoroughly compact it.

6. LAYING STORM SEWER PIPE

- A. Lay pipe and fittings so that after completion, the interior bottom surface of the pipe will conform accurately to the lines and grades as indicated. Provide mason's lines and supports, and other necessary equipment to insure the installation of the pipe to proper line and grade. Provide approved facilities for lowering pipe into the trench without causing damage to pipe or trench.
- B. Begin laying pipe in finished trench at the lowest points, proceeding up-grade, without breaks from structure to structure, with the groove ends of the pipe up-grade. Lay all pipe on stable foundations, with the bedding method specified or required to accommodate the conditions encountered. Regardless of the bedding method used, provide uniform full length support of pipe barrel at every point between bell holes, suitable bell holes to facilitate joining and prevent pipe ends from bearing on trench bottoms, and trenches water-free and as dry as practicable during bedding, laying and joining, and until the work will not be adversely affected by submergence.
- C. Before laying, inspect each pipe and fitting for cracks and other defects. Remove all defective pipe from the job site.

- D. Test for Line and Grade: During pipe laying between adjoining manholes or structures, light from the beginning end of each straight or working section of the sewer shall remain constantly in plain view throughout the entire length of such section, and shall show the true character and shape of the interior surface of the sewer, which shall be circular in form. This test will be applied to each completed working section of sewer before its acceptance. Take up and relay all pipe which is not in true alignment or shows any settlement after laying.
- E. Protection of Pipe after Laying: As the pipe laying progresses, keep all dirt, trash, and other foreign materials cleared from the inside of the pipes. At all times when pipe laying is not in progress, keep the open ends of all pipes securely closed to prevent entrance of water, mud, or foreign matter and secure all pipes to prevent displacement by movement of backfill, flotation, and other causes.

7. MANHOLES

- A. Manholes shall be either brick or precast concrete type 4' 0" or 5' 0" inside diameter as indicated, constructed neatly, accurately, and completely as the work progresses, and when the pipe laying reaches the manhole location.
- B. Brick Manholes: These shall be of the depths required, with 8" thick circular concrete foundation slab below sewer invert elevation, 9" thick brick walls brought up vertically, corbelled inward to fit rim and cover, and plastered with 1/2" thick cement mortar of entire outside and up to corbel on inside, all as detailed on the STANDARD MANHOLE STORM DRAIN drawing included in these specifications.
 - 1. Brick, mortar, and concrete shall be as specified hereinbefore.
 - 2. Lay all brick in radial header course, and fill all joints with mortar.
 - 3. Manhole steps shall be City of Memphis, Tennessee, cast iron type on 16" vertical centers staggered, lowest step 16" maximum above bottom, and highest step 12" maximum below top, and one back step at same elevation as highest step.
 - 4. Rims and covers shall be Memphis, Tennessee standard No. 7 cast iron type, with tops marked DRAIN.
- C. Precast Concrete Manholes: These shall be of the depths required, with poured in place 8" thick circular concrete foundation slabs below sewer invert elevation, and precast reinforced concrete vertical sections.
 - 1. Precast concrete sections shall conform to ASTM Specification C478 and the following requirements:

- a. The straight section shall be furnished in 48", 32" and 16" lengths; each section shall have bell and spigot or tongue and groove ends, and lifting holes to facilitate handling and laying.
 - b. The taper section shall be one piece 36" high and conical, either concentric or eccentric, with its inside diameter tapering uniformly from bottom to 24" at top.
 - c. Each precast section shall have permanently embedded-in cast iron manhole steps of the type specified above for brick manholes, arranged to provide steps in the finished manhole on 16" uniform vertical centers.
2. Assemble manholes with 48" long straight sections and not more than one shorter straight section, to provide the required straight height. Lay section with a full mortar bed in each joint, plug all lifting holes with mortar after laying sections, and seal around all pipe entrances with mortar, all to provide strictly watertight construction.
 3. Rims and covers shall be the same type as specified above for brick manholes. Set rims and covers to proper elevations, using 24" inside diameter poured-in place concrete brick masonry, or precast spacers between casting and precast taper section.
 4. Where the highest step in the precast taper section is more than 24" below top of manhole cover, provide a step of the same type set in the spacer section 16" above the highest step in the taper section.
 5. Mortar and poured-in-place concrete shall be the same as specified for brick manholes.
- D. Provide an invert in each manhole bottom as required to accommodate the inflowing and outflowing sewers, constructed concrete or brick and mortar, with full pipe size flow channels carefully and smoothly shaped and finished. Make all changes of flow directions within manholes with the maximum practical radius curves.
- E. Remove all debris which falls into sewers during manhole construction.
- F. Set manhole tops as follows, unless otherwise indicated or authorized.
1. In streets, roads, highways, and other paved areas: flush with finished paving grade.
 2. Undeveloped areas, such as fields, woods, etc: 18" above ground.
 3. Other areas: 12" above ground.

G. Protect and maintain each manhole to grade until it is accepted by the City.

8. INLETS

- A. Drain inlets shall be of brick or concrete construction, as detailed on the STANDARD INLET Drawings included in these specifications, and of the types required.
- B. Concrete, mortar, and brick shall be as specified hereinbefore.
- C. Rims and gratings shall be cast iron City of Memphis type, Nos. 10, 11, or 12, as applicable.

9. BACKFILLING

- A. Do not backfill pipe trenches or other excavations until the City has approved the pipe and other work. Immediately after their approval, backfill the trenches and other excavations as specified below.
- B. All Locations: After pipe has been laid and approved, thoroughly and carefully hand tamp backfill into bell holes, around and over the pipes in 6" maximum thickness layers, until a 12" cover has been tamped over the tops of the pipes.
- C. Pipe Under Existing Paved Areas:
 - 1. Immediately after laying the pipe, backfill the trench with approved sand to within 8" or 10" of the finished surface. Sand to be consolidated to 98% Std. Proctor (ASTM).
 - 2. Immediately place 6" or 8" concrete to within 3" of the finished surface.
 - 3. If paving can not be accomplished on the same working day, place 2" of cold tar asphalt on gravel base and level with the existing paved surface.
 - 4. As soon as practicable, but within five (5) working days after completion of backfill in trench, cold tar asphalt will be removed and replaced with Asphaltic Concrete (Hot Mix) compacted to 90% of maximum laboratory density. If in the process of removing the cold tar asphalt, the base is disturbed, the disturbed area will be scarified and compacted to 98% Mod. Proctor (ASTM). (NOTE) WATER JETTING IS NOT PERMITTED.

D. Pipe under Areas Proposed to be Paved:

1. Immediately after laying pipe and with City approval, HAND TAMP approved fill material to an elevation of 12" above top of pipe, making certain that fill material is compacted around haunches of pipe. Area 12" above pipe to be compacted to 98% Std. Proctor (ASTM).
 2. At which time part (1) is completed and approved by the City, the Contractor has the following options regarding backfill on the remaining trench:
 - a. If the area is not to receive gravel base immediately and trenches have ample time to settle and dry prior to placing gravel base, water jetting may be utilized after part (1) has been completed and proper approval granted. NOTE: Gravel base WILL NOT be paved over trenches that have not properly settled, have excessive moisture or have moderate to excessive pumping.
 - b. Using mechanical tamping and lifts of fill material not to exceeding 8".
- E. For all pipes under non-paved areas, place all backfill from 12" above pipe tops up to finished grade by approved methods that will avoid injurious pressures on pipes, except that water jetting will be required, Windrow excess excavated material over the trenches, and after sufficient settlement satisfactory to the City has occurred, complete the surface dressing, surplus material removal, and surface clean-up.
- F. Paragraphs B, C, and D above apply principally to backfill for open trenches. For all pipes in tunneled holes, backfill only with sand, and thoroughly tamp or otherwise place all backfill in an approved manner to prevent caving and settling.
- G. For all pipes crossing streets, roads, gravel driveways, and dirt driveways which are in regular use, backfill the trenches as specified in Paragraph C, and maintain these crossings usable by vehicular traffic until acceptance of the water piping work by the City. Do not, under any circumstances, leave a street or road crossing or a private driveway unusable overnight.
- H. Up to 12" above the tops of the pipes, backfill only with selected earth which is free of rocks, stones, bricks, cinders, broken concrete, rubbish, vegetable materials, and other unapproved materials.
- I. From 12" above tops of pipes up to finished grade or paving subgrade, as the case may be, backfill with any materials removed from the excavation and suitable for backfill, except do not use as backfill material broken concrete, rocks, and stones larger than 3 inches in their greatest dimensions. Dispose of all excavated materials not replaced as backfill, as approved.

- J. Place and compact backfill around manholes and inlets in accordance with the applicable requirements for pipe trench backfilling.
- K. Refill and smooth off as required any and all backfill which settles, so that all backfill finally conforms to the original ground surfaces, not only at the time of project acceptance, but also for the duration of the guarantee period. This includes removing all pavement which may be damaged by settlement, and replacing it with new pavement.

10. PAVEMENT REPAIRS, STREETS

- A. Immediately after installing each sewer line across a street restore the street at that location to at least the conditions which existed prior to the sewer work thereon, all to the City's satisfaction.
- B. Unless otherwise authorized by the City, replace all pavement which is disturbed by the work with 8" of concrete and a 3" thick surface course of hot plant mix asphaltic concrete, with proper asphaltic prime coat applied to base course before laying the surface course thereon.

11. TRENCHING, PIPE LAYING, BACKFILLING, AND PAVEMENT REPAIRS

- A. Before cutting any Roads, obtain proper permission for each cut from the Engineer's office.
- B. Immediately after installing each sewer line across the road, restore the road and its right-of-way at that location to at least the conditions which existed prior to the beginning of the sewer work thereon, all to the City Engineer's satisfaction.
- C. The following requirements to all pipe laid under asphalt surfaced roads.
- D. Comply with all specific drawings for road crossings.

12. CUTTING AND REPLACING PAVEMENT AND OTHER SPECIAL SURFACES

- A. Restore all surface disturbed by the installation of the sewer lines to the conditions that existed before excavation, or better, as specified below. As each surface is being cut, the City will examine the existing surface in the Contractor's presence, and the type of surface to be replaced in each case shall be determined by mutual agreement between the City and the Contractor.
- B. The maximum width of all pavement and all other surface repairs allowable for payment by the City shall be the maximum trench width at the TOP of the pipes (as specified hereinbefore) plus 12" or 6" beyond the maximum trench width at the tops of the pipes. At contractor's expense, make all repairs outside of this limit. If the repairs do not reach this limit, the City will pay ONLY for the actual extent of the repairs. Replace existing surfaces which are cut, removed, or otherwise damaged by the sewer work with new surfaces as described below. All new surfaces shall conform accurately to the elevations and contours of the existing adjacent undisturbed surfaces.
 - 1. Existing Gravel Surfaces: Replace these with a 6" thick compacted layer of new approved locally available road gravel.
 - 2. Existing City Streets and County Road: As specified hereinbefore.
 - 3. Concrete Surfaces: Do not cut concrete surfaces, but install pipe under them by tunneling, unless otherwise approved. However, if concrete surfaces are cut, replace them with 6" thick compacted layer of new approved locally available road gravel base, and a surface course of 3,500 psi concrete equal in thickness to that of the adjoining concrete surface course.
- C. Where pipe is installed on the shoulders parallel to asphalt, concrete, or other surfaces, maintain ditches until they are firm and present no traffic hazard. Where authorized, place 6" thick compacted layers of new approved locally available road gravel.
- D. Do not cut streets and other surfaces except where necessary for the sewer installation. At Contractor's expense, repair all damage outside of the limits specified above, to City's satisfaction. Maintain all crossings until project completion.

13. PAVEMENT AND MEASUREMENT OF QUANTITIES

- A. Pipe, Sewer: Paid for at the unit price per linear foot of sewer pipe in place, measured as the horizontal distance between centers of manholes and/or inlets. Allowance for increased length due to slope will not be made.

- B. Classification of Cut: Cut shall be classified on the basis of the average depth of cuts to sewer invert, between 50 foot stations, measured between manholes and/or inlets, beginning at the structure with the lower invert elevation. The remaining distance between the last station and the center of the end structure or end of sewer line shall be averaged separately. (0' to 6' - 6' to 8' - 8' to 10' - 10' to 12')
- C. Standard Manholes: Paid for at the unit price per complete standard manhole in place, 4 or 5 foot diameter, as applicable, A manhole 6' – 0" or less in depth from the top of the rim to the sewer invert shall be classified as a standard manhole, either brick or precast type.
- D. Extra Depth Manhole: Paid for at the unit price per vertical foot for extra depth manhole construction, measured to nearest 1/10 of a foot. All manhole construction below the 6' – 0" depth of the standard manhole shall be classified as extra depth manhole.
- E. Inlets: Paid for at the unit price for each complete inlet in place, No. 10, 11, or 12 type, as applicable.
- F. Connections to Existing Manholes: Paid for at the unit price for each complete connection made to existing manholes.
- G. Drain Rock, Granular Pipe Embedment Material, and Granular Backfill Material: Paid for at the unit price per cubic yard of loose material in place, as evidenced by delivery tickets signed by the City.
- H. Sheathing Left in Place: Paid for at the unit price per thousand board feet of sheathing left in place, only where authorized in writing, and measured to the nearest 100 board feet.
- I. Placement of Road Gravel: Paid for at the unit price per cubic yard of compacted road gravel in place, as computed by actual measurements of surface area covered with a 6" thick compacted layer. No payment will be made for any road gravel placed without City's authorization, or for any road gravel placed outside of the specified payment limits. Includes base courses under pavement and under special surface repair.
- J. Replacement of Paving and Special Surfaces: Paid for at the unit price per square yard of each type of pavement or special surface in place, as computed by actual measurements of the areas repaired, except that no payment will be made outside of the specified payment limits. Does not include gravel base courses, which will be paid for separately as noted herein.

- K. Joint Materials, Trenching, Excavating, Boring, Tunneling, and Backfilling, Jacking Removal of existing Paving, Removing and Replacing Sod, Fences, etc: No separate payment unless specifically otherwise indicated; included in the various unit prices for pipe and other related items.
- L. Extra Depth Excavation: The MINIMUM Cover over pipes shall be 12" as specified hereinbefore: No extra payment will be made for any extra depth excavation that may be required to permit piping to pass under obstructions, whether they are indicated on the drawings or not.
- M. Other Miscellaneous Items: No separate payment, unless specifically otherwise indicated included in the various unit prices.
- N. Quantities and Payments, General: Payments will be made to the nearest complete unit as listed in the PROPOSAL. Quantities submitted for payment shall be rounded off to the nearest linear foot, cubic yard, or other applicable unit.

END

TECHNICAL SPECIFICATIONS

SIDEWALKS, CURBS, GUTTERS, WATER TABLES, DRIVEWAY APRONS AND WHEELCHAIR RAMPS

1. GENERAL

- A. Construct sidewalks, curbs, gutters, water tables, and driveway aprons to the cross sections elevations, lines, grades, and other details as indicated on the drawings. Construction requirement not shown on the drawings shall be as specified hereinafter.

2. CONCRETE

- A. All concrete shall be 4,000 psi Limestone Air Entrained ready mixed type conforming to ASTM Specification C94; composed of Portland cement, sand and wash coarse aggregate all conforming to applicable ASTM Specifications mixed with clean water, free of oil, acid, alkali, inorganic matter; and supplied by an approved ready mix plant. The design mix shall be the ready mix plant's standard for the specified strength, as established and tested by approved laboratory, in accordance with applicable ASTM standard specifications.
- B. If so requested, before using the proposed concrete on the job, submit to the City for approval a copy of laboratory test reports of the proposed concrete mix and materials.

3. FORMS

- A. Forms shall be steel or 2" thick lumber, true to proper dimensions, smooth, free from wrap, sufficiently braced to resist springing out of shape, and accurately set to proper lines and grades. Remove mortar and dirt from previously used forms, and thoroughly treat them with oil before reusing them. Cross forms shall be 1/4" thick steel, of the full width and depth of the concrete work; leave these in place until the wearing surface has been floated and has attained its initial set.
- B. Set sidewalk forms to provide 1/4" per foot sidewalk fall with 1/2" per foot fall in grass toward the curbs, for proper drainage.

4. JOINT FILLER

- A. Joint filler for all expansion joints shall be an approved suitable elastic waterproof pre-molded compound which will become soft and push out in hot weather, nor become hard and brittle and chip out in cold weather.
- B. For Sidewalks: Filler shall be at least 1/2" but not more than 1" thick, at least as wide as the slab thickness, and length equal to that of the expansion joint involved.

- C. For Curbs, Gutters, Water Tables, and Driveway Aprons: Filler shall be not more than 3/8" thick, and shall expand the full depth of the concrete work involved.

5. SUBGRADE

- A. Prepare subgrade by excavating or filling to proper depth to set finished tops of concrete work at the elevations indicated on the drawings. Provide gravel base where indicated on the drawings.
- B. Remove vegetation and material that will not compact properly and replace it with suitable fill material. Do all filling required to bring the subgrade up to proper elevation, in 4" maximum thickness layers, and thoroughly ramp, tamp or roll each layer until the fill is compact and firm. In all case bring the subgrade or base to proper grade in a uniformly firm condition before placing concrete. Do not place any concrete until the City has inspected and approved the subgrade or base.

6. SIDEWALK MARKINGS

- A. Cut surface of concrete walks into flags by marking with and edging tool having a 1/4" radius. Flags shall not be longer than 6 feet on any side, and not longer than the sidewalk width. Round all surface edges and cross marking between slabs to a 1/4" radius.

7. CURB AND GUTTER CONSTRUCTION

- A. Finish the edges as indicated on the drawings. Block out the walk in 20 foot maximum length sections, and install each section in one continuous operation so that the curb and gutter will be monolithic. Place only on approved sub-grade or base.

8. HANDICAP RAMPS

- A. The developer shall install handicap ramps at crosswalks. All such ramps shall be constructed in accordance with the design specifications of the Tennessee Department of Transportation and Bureau of Highways.

9. EXPANSION OF JOINTS

- A. Sidewalks: Provide expansion joints with filler as specified hereinbefore, at the following locations:
 - 1. On 25 foot maximum centers.
 - 2. In a square outline around each object in sidewalks, such as fire hydrants, utility poles, lighting standards, etc.
 - 3. At other locations indicated.

- B. Curbs, Gutters, and Water Tables: Provide expansion joints with filler as specified hereinbefore, on 20 foot maximum centers, and at other locations indicated. Score joints on 10' centers.
- C. Driveway Aprons: Provide expansion joints with filler as specified hereinbefore, at each end of each apron, where it abuts the curb and gutter.

10. PLACING CONCRETE

- A. Place concrete only on a moist upgrade or base course, and not adjacent to or around utility structures, etc. until such structures have been set to the proper grade. Do not deposit any concrete until the subgrades and forms have been inspected and approved by the City.
- B. Transport concrete from the mixer and place it by methods that will prevent segregation of materials and loss of ingredients. Deposit each successive batch in one layer by a continuous operation. Do not under any circumstances place any concrete that has taken its initial set.
- C. Space and/or vibrate the concrete so that it will flow together and completely fill all void spaces without honey combing, especially along forms and cross joints. Strike off and tamp the concrete until mortar is flushed freely to the surface and a dense surface is obtained, free from porous and rough spots, and at the required section and grade.
- D. The method of placing the various sections shall produce a straight clean-cut joint between them, and make each section between expansion joints an independent unit. No concrete in excess of that needed to complete a section at the stopping of work shall be used.

11. FINISHING

- A. After the concrete has been brought to required grade with a strike board and sufficiently tamped to bring the mortar to the surface, finish it as specified below.
- B. Sidewalks: Float concrete to a true even surface, and finish it with a steel trowel finish. After it has taken its initial set, brush the surface lightly with a soft bristle brush, at right angles with the street centerline.
- C. Curbs, Gutters, Water Tables, and Driveway Aprons: Finish surface with trowel and float to an approximately true plane.
- D. Do not apply heat cement to any concrete surface to hasten its hardening.

12. CURING AND PROTECTION

- A. As soon as the finished concrete work has hardened sufficiently to prevent damage thereto, keep the surface damp for at least three (3) days. Cover the surfaces with approved curing compound, burlap, straw, earth, sand or other approved materials. Apply water as required to keep forms and covering materials saturated continuously throughout the curing period. Sprinkling the surfaces with water without covering will not be acceptable.
- B. Protect the freshly finished concrete from hot sun and drying winds until it can be sprinkled and covered as above specified. The concrete surface shall not be damaged or pitted by rain drops; provide all necessary protective covers in case of rain before the concrete has hardened sufficiently. Protect all concrete from traffic for at least three (3) days after its completion.
- C. Cold Weather Protection: Air temperature shall be 40 and rising before any concrete is placed. Whenever the air temperature may be expected to reach the freezing point, spread straw or other blanketing material to sufficient depth to keep concrete from freezing, or provide enclosure and heating device capable of maintaining concrete temperature of at least 50 degrees Fahrenheit. Maintain such protection for at least five (5) days. The Contractor shall be responsible for removing and replacing any concrete injured by frost action.

13. NAME STAMP, SIDEWALKS

- A. At each end of each 150 linear feet of sidewalk or fraction thereof, stamp the sidewalk contractor's name and year in which the sidewalk is constructed. Stamped letters shall be 1" high and 1/4" deep.

14. PAYMENT

- A. Sidewalks: Paid for at the unit price per square foot of 4" thick sidewalk in place.
- B. Curbs and Gutters: Paid for at the unit price per linear foot of curb and gutter in place, measured through driveways.
- C. Water Tables: Paid for at the unit price per square foot of water table in place.
- D. Driveway Aprons: Paid for at the unit price per square yard of 6" thick apron in place, measured from the back of the curb to a line 5'-0" back of the curb, and width as indicated on the drawings.

END

TECHNICAL SPECIFICATIONS

ROADWAY BASE

1. GENERAL

- A. Asphalt Surfaces: All asphalt surfaces shall be laid on one of the following types of surfaces, whichever is selected or approved by the City for the project involved.
1. Gravel Base.
 2. Asphalt Base, hereinafter referred to as "black base".
 3. Soil Cement Base.
- B. Concrete Surfaces: ONLY where indicated on the drawings or authorized, concrete curbs, gutters, water tables, and driveway aprons shall be laid on gravel base.
- C. All Types of Base:
1. The base shall be of the cross section and arrangements indicated on the drawings, and of the minimum thickness specified hereinafter.
 2. Maintenance: Maintain the base in good condition until the asphaltic concrete or concrete surface has been placed thereon. Repair all faulty areas immediately prior to placing the surface over the base.

2. CLAY GRAVEL BASE

- A. Thickness: Unless otherwise approved by the City, gravel base shall be at least 6" thick after compaction for right-of-ways of less than sixty (60) feet or 8" thick after compaction for right-of-way of sixty (60) feet and over. Right-of-ways over sixty (60) feet shall have incorporated into the gravel base cement at a rate of six (6) to eight (8) percent cement by weight of gravel.
- B. Materials: Gravel base materials shall be road type gravel, consisting of hard durable particles or fragments of granular aggregates mixed or blended with fine sand, clay, below. Pit run materials may be used, provided that it conforms to the specified requirements.
1. Gradation: Total percentage by dry weight passing each U.S. Standard square hole sieve shall be:

Sieve Size	Percent passing
2"	100
1-1/2"	95 - 100
3/8"	40 - 65
No. 40	10 - 30

Clay content, as determined by 1-12 AASHO T-88 Hydrometer Test

2. All material passing the No. 40 sieve shall have a liquid limit of not more than 25, and a plasticity index of not more than 6, when tested in accordance with AASHO T89 and T90.
3. If binder is insufficient to bond the aggregate properly, add a satisfactory binding material to make the resultant mixture comply with these specifications.

C. Subgrade Preparation:

1. Before placing base, grade and shape the subgrade to the required lines and grades.
2. All areas in either cut or fill will be proofrolled prior to any building or placing of base material for roads or parking lots in the presence of the City Engineer or his approved representative with a pneumatic-tired, dual wheel, tandem axle truck having a gross weight as indicated in the proofrolling chart. Proofrolling shall be carried out in two directions at right angles to each other with no more than 24 inches between tire tracks covering the entire cut area. All soft spots will be cut out and repaired prior to any building or placing of base material for roads or parking lots.

COMPACTION REQUIREMENTS

<u>TYPE OF FILL</u>	<u>Std. Proctor ASTM</u>	<u>Mod. Proctor ASTM</u>	<u>Proofrolling Gross Wt. Lbs.</u>
Compacted fill under buildings and structures	98%	95%	50,000#
Compacted fill under roadway base and other areas to be paved	98%	95%	40,000#
Roadway Base	98%	95%	50,000#
Compacted fill in levees and dikes	98%	95%	50,000#
Compacted fill in overlot areas	90%	87%	40,000#

All compactor test cost shall be borne by the Contractor. Locations or number of test are to be indicated on the construction plans as approved by the City.

D. Spreading and Compacting Gravel Base:

1. After spreading gravel, wet it and compact it to at least 95% Modified Proctor density, using a tandem or wobble wheel roller weighing at least 10 tons. Repeat wetting and rolling as required to obtain the specified density. Begin rolling at gutters, and work gradually to the street crown.
2. Loosen the surface of all low points, pockets, and depressions developed by the rolling, place additional gravel thereon, and re-roll as required to obtain an approved smooth surface.

3. SOIL-CEMENT BASE

- A. General: Soil cement base shall consist of soil and portland cement uniformly mixed, moistened, compacted, finished, and cured.
- B. Thickness: Unless otherwise approved by the City, soil-cement base shall be at least 6" thick after compaction on local streets and 8" thick on all other streets.
- C. Materials:
 1. Portland cement shall conform to ASTM C150, C175, or C595.
 2. Soil shall consist of the material existing in the area to be paved, or approved selected soil, or a combination of these materials. The soil shall not contain gravel or stone retained on a 3" sieve, or more than 45% retained on a No. 4 sieve.
 3. Soil mix design will be designed by a soil Lab with a registered Engineer specifying the design, thickness and cement content.
- D. Laboratory Soil Tests: Prior to beginning any work on the base, at the Contractor's expense an approved independent testing laboratory shall make tests of the soil materials proposed for use in the base.
 1. To provide a satisfactory soil cement base, the following fundamental requirements shall be determined by these laboratory tests in accordance with AASHTO Test methods T134, T135, and T136:
 - a. The minimum amount of cement required to harden the soil adequately. Pounds of cement per square yard.
 - b. The density to which the soil cement shall be compacted.
 - c. The optimum moisture content.
 2. Submit laboratory test reports to the Owner for approval.

3. After approval of laboratory test reports, construct the base in strict accordance with the requirements established by the laboratory on the basis of their soil materials tests.
- E. Equipment: Provide suitable equipment which will construct the soil cement base as specified hereinafter.
 - F. Subgrade Preparation: Before constructing the soil cement base, grade and shape the subgrade to the required lines and grades, place all additional soil as required, and remove all unsuitable soil and replace it with acceptable soil. Subgrade shall be firm and able to support the construction equipment and specified compaction without displacement.
 - G. Pulverization: Pulverize the soil so that after moist-mixing 100% by dry weight passes a 1" sieve, and at least 80% passes a No. 4 sieve, exclusive of the gravel or stone retained on these sieves.
 - H. Cement Application, Mixing and Spreading: Mix soil, cement, and water by the mixed in place or central plant mix method. Do not spread any mixture when the soil or subgrade is frozen or when the ambient temperature in the shade is below 40 F. The percentage of moisture in the soil at the time of cement application shall not exceed the quantity that will permit a uniform and intimate soil cement mixture during mixing operations, and it shall not exceed the required optimum moisture content.
 1. Mixed In Place Method: Distribute the required amount of cement uniformly on the soil; replace all cement that has been displaced before mixing is started. After spreading cement, mix it with the soil until it has been sufficiently blended therewith to prevent formation of cement balls when water is applied. Immediately after mixing cement and soil, incorporate water into the mixture, using a water supply and pressure distributing equipment that will apply all required water to work section involved within 3 hours; avoid excessive concentration of water at or near the surface. After application of all mixing water, continue mixing as required to obtain a uniform and intimate mixture of soil, cement, and water.
 2. Central Plant Method: Mix soil, cement, and water in a batch of continuous flow type pugmill equipped with feeding and metering devices which will add the ingredients into the mixer in the required quantities. Mix soil and cement sufficiently to prevent formation of cement balls when water is added. Continue mixing as required to obtain a uniform and intimate mixture of soil, cement, and water. Haul the mixture to the pavement area in covered trucks, and place it on a moistened subgrade in a uniform layer, using suitable spreaders; dumping mixture in piles or windows will not be permitted. Not more than 30 minutes shall elapse between the placement of soil cement mixture in adjacent lanes at any location except at longitudinal construction joints, and not more than 60 minutes shall elapse between the commencing of moist mixing and commencing of compaction.

- I. Compaction: At the start of compaction, the percentage of moisture in the mixture and in unpulverized soil lumps, based upon over dry weights, shall be below or no more than 2 percentage points above the required optimum moisture, and not less than the quantity which will cause the soil cement mixture to become unstable during compacting and finishing. Prior to beginning of compacting the mixture shall be in a loose condition through its full depth. Compact the loose mixture uniformly to the required density within 2 hours.
- J. Finishing: After compacting the soil cement to the required density, shape it to the required lines and grades. Lightly scarify the surface as required to remove marks left by equipment, and recompact the resulting surface to the required density. Maintain the moisture content at least to the required optimum during finishing operations. Complete the surface compaction within 2 hours, and provide a smooth, dense surface free of contraction planes, cracks, ridges, or loose material. Correct all portions of the surface that have a density below the required density.
- K. Curing: Protect the finished soil cement from drying for at least 7 days, as specified below. Within 24 hours after finishing, apply approximately 0.2 gallons of bituminous material per square yard of base surface, using approved heating and distributing equipment. Apply water as required to keep the soil cement continuously moist until the bituminous material is placed, to fill the surface voids immediately before applying bituminous material, and to prevent penetration of bituminous material during its application. Exact bituminous material application rate and temperature shall be as required for complete coverage without excessive runoff. Then barricade from all traffic during the curing period.

4. PAYMENT

- A. All Types of Base: Paid for at the unit price per square yard of base in place, including all operations specified above for the type of base involved.

END

TECHNICAL SPECIFICATIONS

WATER MAINS

1. TYPES OF PIPES TO BE USED

- A. Types of pipes for various applications on the project shall be as follows:
1. All mains: Ductile Iron Pipe (CL-50)
 2. Customer service pipe, larger than 2" Type K Copper Tubing, Ductile iron pipe, or plastic pipe, as indicated.
- B. Requirements for various piping materials, joints, and installation shall be as specified hereinafter.

2. DUCTILE IRON PIPE, DUCTILE AND/OR CAST IRON FITTINGS, AND JOINTS

- A. NOTE: For locations where ductile iron pipe may be used, see TYPES OF PIPES TO BE USED, hereinbefore.
- B. Except as otherwise specified or indicated, joints in ductile iron pipe shall be ANSI/AWWA Standard C111 mechanical of push up type with plain rubber gaskets.
- C. All 3" and larger iron pipe shall conform to ANSI/AWWA Standard C151 with the minimum iron strength being 60/42 and the minimum pipe thickness class shall be tabulated below. All pipe shall have ANSI/AWWA Standard C104 standard thickness bituminous sealed cement-mortar lining, bituminous outside coating, and ends as required for the types of joints specified below for the various pipe locations and services.

<u>PIPE SIZE</u>	<u>WALL THICKNESS</u>	<u>MINIMUM THICKNESS CLASS</u>
3	0.25"	51
4	0.26"	51
6	0.25"	50
8	0.27"	50
10	0.29"	50
12	0.31"	50
14	0.33"	50
16	0.34"	50
18	0.35"	50
20	0.36"	50

<u>PIPE SIZE</u>	<u>WALL THICKNESS</u>	<u>MINIMUM THICKNESS</u>
24	0.38"	50
30	0.39"	50
36	0.43"	50
42	0.47"	50
48	0.51"	50
54	0.57"	50

D. Fittings for ductile iron pipe shall be ANSI/AWWA C110 standard cast and/or ductile iron or ductile iron short body pattern, Class 250, bituminous coated inside and outside, with ends as required for the types of joints specified above for the various pipe locations and services.

1. Tees for connecting fire hydrants to mains shall be mechanical joint anchoring types, each with a 6" spigot outlet and a locked-on rotating mechanical joint gland rings.

E. Furnish to the City in duplicate the certificates from the manufacturer certifying that ductile iron pipe and iron fittings furnished for this project comply with the above specifications.

3. VALVES AND BOXES

A. Valves shall be iron body, bronze mounted, double disc, parallel seat, non-rising stem gate type, for at least 175 psi working pressure, conforming to AWWA Specifications C500. All valves shall have "O" rings type stem seals, 2" square operating nuts, and shall be opened by COUNTER-CLOCKWISE direction of rotation. All valves shall have AWWA Specifications C111 mechanical or push-on joint ends with plain rubber gaskets, unless otherwise specified or indicated.

B. Provide over each valve operating stem a standard two piece coal tar coated 5-1/4" inside shaft diameter screw type adjustable cast iron valve box, consisting of a cover marked WATER, an upper telescoping section, and a lower section, Mueller 461-S or approved make. Where necessary to provide extra depth, provide extension pieces as required.

4. FIRE HYDRANTS

A. Fire hydrants shall be break away standard compression type conforming to the AWWA Specifications C502 complete with: 5" minimum valve opening; 6" AWWA Specifications C111 mechanical joint inlet connection; 3 foot bury; two 2-1/2" National standard fire hose thread nozzle; one 4½" National Standard fire hose thread pumper connection nozzle, 1" square operating nut and cat nuts; and CLOCKWISE direction of opening.

- B. All interior working parts of the hydrant shall be solid bronze or bronze mounted. The hydrant shall be so designed that all interior parts can be removed without removing the stand pipe from its set position. Each hydrant shall be equipped with a drip valve that will positively drain the stand pipe when the main valve is closed. Submit cutaway view drawings prior to the purchasing of hydrants.
- C. All nozzles shall be equipped with caps anchored to the standpipe with chains. Crimp "S" hooks and secure caps.
- D. Each hydrant shall be factory painted on the outside below grade line with black asphalt paint, and above grade line with silver paint. After setting, paint all parts of the hydrant above grade line as specified hereinafter. Re-paint exposed silver parts of Fire Hydrant if weathered or paint scratched before acceptance.

5. TRENCHING, EXCAVATING, SHORING, BRACING AND DE-WATERING

- A. Except as otherwise indicated on the drawings, specified herein, or authorized, make all excavations open cut.
 - 1. See HIGHWAY CROSSING, RAILROAD CROSSING, AND TRENCHING, PIPELAYING, BACKFILLING, AND PAVEMENT REPAIRS, FOR COUNTY ROADS, for special exception requirements outside the City Limits.
- B. Excavate trenches to the indicated lines and locations to provide uniform and continuous bearing and support of each pipe barrel on firm undisturbed earth at every point between bell holes, with an ample bell hole at each joint to facilitate proper jointing and to prevent bells from bearing on the trench bottom. Trench depths shall be as required to provide the specified MINIMUM cover over the tops of pipes; as required to permit pipes to pass under culverts, railroads, highways, existing pipelines, and other obstructions; and as required to accommodate valves and boxes. Trench widths shall be as required for the proper laying and jointing of pipes and the proper placing and compacting of backfill, but in no case shall a trench be more than 24" wider than the inside diameter of the pipe to be laid therein. Machine or hand-cut trenches, except that in all cases prepare the final subgrade accurately with hand tools, and in special cases where required, cut the trenches entirely by hand. Where excavation is carried below proper subgrade, before laying pipe bring the trench bottom up to proper subgrade by backfilling with approved material placed in 6" maximum thickness loose layers, and thoroughly compact each layer as required to provide uniform and continuous bearing and support for the pipe barrel at every point between bell holes.
- C. Where trench conditions are unsuitable for pipe support, lay pipe on washed gravel bedding as authorized. Gradation of gravel bedding material shall be: 100% passing 1/2" screen; and 95% retained on a No. 4 sieve.

D. Minimum cover over tops of pipes shall be as follows:

1. All pipes, except as otherwise specified below:
30" MINIMUM cover, as measured from top of pipe.
2. Hydrant leads, where they cross side ditched ONLY:
18" MINIMUM cover.
3. Hydrant leads, all other locations: 30" MINIMUM cover.
4. Customer's service lines: 24" MINIMUM cover.
5. Special Conditions: MINIMUM cover as indicated on the drawings.
6. Under streets or roads unless concrete encased:
48" MINIMUM cover.

E. IN ALL CASES, THE SPECIFIED MINIMUM COVER OVER PIPES SHALL BE BASED UPON FINAL FINISHED SURFACES, INCLUDING PAVING, IF ANY. Where grading is involved, do not cut trenches under roads, streets, or other areas until the final finish grading has been done, unless otherwise authorized.

F. Shore and brace trenches and excavations as required, to protect personnel, adjacent structures, and adjacent property. Where required by the conditions encountered, brace trenches, and excavations with suitable close sheeting or sheet piling. Do all necessary cribbing up required for the proper operation of trenching machines.

G. Provide and maintain in proper working order all necessary dewatering equipment required to remove water from the excavations. Where quicksand or other water bearing strata are encountered, install and connect the necessary number of well points with pumping equipment of sufficient capacity to prevent rise of water in the excavation until the work has been installed properly and will be unaffected by submersion.

H. Do not install any work until excavations are free of water, mud, and loose earth. Do not install any work on frozen ground.

I. Install pipe crossing concrete driveways, sidewalks, asphalt driveways and other special conditions by tunneling or boring, or as authorized. Install pipes crossing dirt or gravel drives by open cut, unless otherwise authorized.

J. Where the trench bottom at required subgrade is found to be unstable or to include ashes, cinders, any type of refuse, vegetable or other organic material, or large pieces fragments of inorganic material which in the City's opinion should be removed, excavate and remove such unsuitable material. Before laying pipe, bring the trench

bottom up to proper subgrade by backfilling with approved material placed in 6" maximum thickness loose layers, and thoroughly compact each layer as required to provide uniform and continuous bearing and support for the pipe barrel at every point between bell holes.

6. INSTALLATION OF DUCTILE IRON WATER MAINS AND APPURTENANCES (ANSI/AWWA C600). HANDLING AND LAYING DUCTILE IRON PIPE AND FITTINGS

- A. Provide and use suitable equipment for the safe and convenient handling of pipe fittings, valves, and other water piping materials. Unload all water piping materials carefully, and lower them carefully into the trenches, piece by piece, with suitable equipment, in a manner that will prevent damage to the materials and their protective coatings and linings. Do not under any circumstances drop or dump water piping materials, either from the transportation vehicles, or into trenches.
- B. Inspect each length of pipe and each fitting for defects, and while suspended above ground ring each with a light hammer to detect cracks.
- C. Before laying pipe and fittings remove all lumps, blisters, and excess coal tar coating from each spigot and the inside of each bell; wire brush and wipe all dirt and other foreign matter from the outside of each spigot and the inside of each bell; swab out the inside of each length of pipe and each fitting; and remove all dirt and other foreign matter from all gaskets, glands, bolts, and nuts. Use every precaution to prevent dirt and other foreign matter from entering pipe and fittings while they are being laid. Spigot ends, insides of bells, gasket grooves, gasket, glands, bolts, and nuts shall be kept free from dirt and other foreign matter after they have been cleaned and before the joints have been made up.
- D. Mechanical Joints: After placing pipe and fittings into the trench, slide gland over spigot, apply proper lubricant to gasket and spigot, slip gasket over spigot, center spigot end in bell, force pipe home, and bring it into correct line and grade. Press gasket evenly in place into bell slide gland into position for bolting, insert all bolts, screw on and hand tighten all nuts, then tighten all nuts with an approved wrench. Tighten diagonally opposite nuts alternately to obtain uniform pressure on all parts of the gland, with torque's of 40 to 60 foot pounds for 5/8" bolts, and 60 to 90 foot pounds for 3/4" bolts. Realign pipe as required and secure it in place with approved backfill material tamped around pipe, except at bells.
 - 1. On retainer type glands, after pipe has been aligned properly, tighten all set screws as specified hereinafter under ANCHORAGE.
- E. Push-on Joints: Make up push-on joints in accordance with the manufacturer's recommendations, generally as follows: after placing pipe and fittings into the trench, insert gasket in gasket groove, apply proper lubricant to gasket and spigot, center spigot end in bell, and force pipe home with proper jacks, bars, chains, cables,

or other suitable equipment, align pipe as required, and secure it in place with approved backfill material tamped around pipe, except at bells. Taper each field cut spigot end back about 1/8" at a 30 degree angle, using a coarse file or portable grinder, to prevent gasket damage.

- F. Do not "buckle-in" any pipe without the City's specific approval.
- G. At all times when pipe laying is not in progress, keep all open ends closed tightly with approved caps or plugs to prevent foreign material from entering any part of the pipe work.

7. ALIGNMENT OF PIPE

- A. Ductile Iron Pipe: In straight trenches, lay pipe to follow the trench centerline as closely as possible, using appropriate fittings at all shape breaks in grade, and using appropriate fittings or deflecting joints and using shorter than standard lengths of pipe as necessary to make the required curves. Do not deflect any joint in excess of pipe manufacturer's recommendations.

8. ANCHORAGE

- A. Provide anchorage for each bend, tee, plug, dead-end, and other fitting subject to blowing off of the line under pressure.
- B. Unless otherwise indicated, anchorage shall consist of a 1:2:4 concrete blocking poured between firm undisturbed earth and the unbalanced sides of the items to be anchored, with sufficient earth bearing area to prevent displacement of joints under pressure. Pour concrete blocking before applying pressure test on piping and arrange it so that the pipe and fitting joints will be accessible for repair.
- C. Set Screw Type Retainer Glands: These shall be U.S. ,CLOW, ACIPCO, or as approved ductile iron set screw type mechanical joint retainer glands, installed in accordance with manufacturer's directions, with set screws tightened uniformly to about 80 foot pounds torque, This type of anchorage MAY be used, subject to approval, at the following locations:
 - 1. Where indicated on the drawings.
 - 2. Where concrete anchorage is not practical.
- D. Anchoring Type Tees for Fire Hydrant Connections: These shall be as specified hereinbefore under DUCTILE IRON PIPE, FITTINGS, AND JOINTS. Anchor fire hydrant cut off valves directly to the locked-on gland rings of the tee outlets.

9. INSTALLATION OF VALVES AND BOXES

- A. Install valves with their operating stems plumb, at approximate locations indicated, but at exact locations as approved and as specified. Leave all valves in normal operating positions, free from leakage.
 - 1. Fire Hydrant Cut Off Valves: Install these directly on the spigot outlets of the ANCHORING TYPE tees in the mains.
 - 2. All Other Valves: Insofar as practical, install these one pipe length from centers of tees and crosses at intersections, and at locations in runs where easy to find in the future.
 - 3. Provide all valves three (3) to fourteen (14) inches inclusive, nominal size, and all bypass valves with screw tops adjustable metal boxes, approximately five (5) inches in diameter constructed so that removable cover will not be thrown out by travel over same. Provide boxes with approved hoods at base of lower section to relieve any strain superimposed on valve bonnet.
- B. Set and support each valve box, after the prime cost is installed on the street, so that no stress or shock can be transmitted to the valve, with the box centered and plumb over the valve wrench nuts, and the box top exposed and flush with finished grade. Re-adjust boxes as required so that all boxes conform to these requirements at the time of acceptance of the system. Leave all valves in normal operating position, free of leakage.
- C. For each valve installed for future use, install one full length of pipe in outlet of valve, plug outer end of pipe with a standard cast iron plug, and anchor plug as specified hereinbefore.

10. SETTING OF HYDRANTS

- A. Install hydrants at approximate locations indicated, but at exact locations as approved. Unless otherwise indicated or approved, locate hydrants at the intersections of private property lines, and between curbs and sidewalks. All hydrants leads shall be 6" pipe.
- B. Set each hydrant on a 4" thick 18" square minimum size precast concrete slab, in true plumb position, with lowest nozzle not less than 12" above finished grade. Securely block or anchor hydrant to prevent it from blowing off of lead, and place at least 1/4 cubic yard of broken stone or coarse gravel around the base to at least 12" above and 12" below the drain hole for proper drainage.
- C. Hydrant Extensions: Provide hydrant extension units at the unit price bid, only where authorized for satisfactory hydrant settings under abnormal or adverse job conditions beyond the contractor's control. No payment shall be made for any

hydrant extension units which may be required as a result of Contractor's error or negligence, and all such hydrant extensions necessary for satisfactory hydrant setting in all such cases shall be provided by the Contractor at his own expense, as required. Otherwise, install standard 3 foot bury hydrants. All hydrant settings, regardless of length, shall conform to all of the above specified setting requirements.

- D. After setting, and after testing and final cleanup of the work, finish paint each hydrant above ground line with one coat of highest quality outside paint, color as selected by the city.

11. BACKFILLING

- A. Do not backfill pipe trenches until the City has inspected and approved the work. Immediately after approval, backfill the trenches as specified below. Testing for leaks on the surface of the pipe prior to backfilling will not be required, but other test procedures, as specified under TESTING AND STERILIZING, shall be followed after backfilling trenches.
 - 1. See PIPELAYING, BACKFILLING, AND PAVEMENT REPAIRS, COUNTRY ROADS, hereinafter, for special requirements applying to pipes laid under Country roads ONLY.
- B. AREAS NOT TO BE PAVED: After the pipe work has been approved, thoroughly hand tamp all backfill into bell holes, around and over the pipe work until a 12" cover has been tamped over the tops of the pipes. Then use suitable backfill material and roll in carefully until it is slightly higher than final grades.
- C. Pipe Under Existing Paved Areas:
 - 1. Immediately after laying the pipe, backfill the trench with approved sand to within 8" or 10" of the finished surface. Sand to be compacted to 98% STD. PROCTOR (ASTM).
 - 2. Immediately place 8" of concrete to within 3" of the finished surface. Gravel to be compacted to 98% MOD. PROCTOR (ASTM).
 - 3. If paving cannot be accomplished on the same working day, place 3" of cold tar asphalt on gravel base and level with the existing paved surface.
 - 4. As soon as practicable, but within five (5) working days after completion of backfill in trench, cold tar asphalt will be removed and replaced with Asphaltic Concrete (Hot Mix) compacted to 90% of maximum laboratory density. If in the process of removing the cold tar asphalt, the base is disturbed, the disturbed area will be scarified and compacted to 98% MOD. PROCTOR (ASTM). NOTE: WATER JETTING IS NOT PERMITTED.

D. Pipe Under Proposed Areas to be Paved:

1. Immediately after laying pipe and with City approval, HAND TAMP approved fill material to an elevation of 12" above top of pipe, making certain that fill material is compacted around haunches of pipe. Area 12" above pipe to be compacted to 98% Std. Proctor (ASTM) using mechanical tamping methods.
2. At which time part (1) is completed and approved by the City, the contractor has the following options regarding backfill on the remaining trench:
 - a. If the area is to receive gravel base immediately after backfill operations are complete, backfill is to be placed in 6" lifts and compacted to 98% Std. Proctor (ASTM) for the remainder of the backfill operation.
 - b. If the area is not to receive gravel base immediately and trenches have ample time to settle and dry prior to placing gravel base, water jetting may be utilized after part (1) has been completed and proper approval granted. NOTE: Gravel base WILL NOT be placed over trenches that have not properly settled, have excessive moisture or have moderate to excessive pumping.

E. Paragraph, B, C, and D, above apply principally to backfill for open trenches. For all pipes in tunneled holes, and for all mains in bored holes without casings, backfill only with sand, and thoroughly tamp or otherwise place all backfill in an approved manner to prevent caving and settling.

F. For all pipes crossing streets, roads, gravel driveways, and dirt driveways which are in regular use, backfill the trenches as specified in Paragraph C, and maintain these crossings usable by vehicular traffic until acceptance of the water piping work by the City. Do not under any circumstances leave a street or road crossing or a private driveway unusable overnight.

G. Up to 12" above the tops of the pipes, backfill only with selected earth which is free of rocks, stones, bricks, cinders, broken concrete, rubbish, vegetable materials, and other approved materials.

H. From 12" above tops of pipe up to finished grade of paving subgrade as the case may be, backfill with any materials removed from the excavation and suitable for backfill, except do not use as backfill material broken concrete, rocks, and stones larger than 6" in their greatest dimensions. Dispose of all excavated material not replaced as backfill, as approved.

- I. Refill and smooth off as required all backfill which settles, so that all backfill finally conforms to the original ground surfaces, not only at the time of project acceptance, but also for the duration of the guarantee period. This includes removing and repairing all pavement which may be damaged by settlement.

J. PROOFROLLING

- 1 Prior to the placement of any architectural or engineered fill, the area to receive fill will be proofrolled in the presence of the City Engineer or his approved representative, with a pneumatic-tired, dual wheeled, tandem axled truck with a gross weight as indicated in the proofrolling chart. Proofrolling shall be carried out in two directions at right angles to each other with no more than 24" between the tire tracks covering the entire area being proofrolled. All soft spots will be cut out and repaired prior to any fill being placed on the surface of the sub-base.

2. All areas in either cut or fill will be proofrolled prior to any building or placing of base material for roads or parking lots in the presence of the City Engineer or his approved representative with a pneumatic tired, dual wheel, tandem axle truck having a gross weight as indicated in the proofrolling chart. Proofrolling shall be carried out in two directions at right angles to each other with no more than 24" between tire tracks covering the entire cut area. All soft spots will be cut out and repaired prior to any building or placing of base material for roads or parking lots.

COMPACTOR REQUIREMENTS

<u>TYPE OF FILL</u>	<u>STD. PROCTOR ASTM</u>	<u>MOD. PROCTOR ASTM</u>	<u>PROOFROLLING GR WT. LBS.</u>
Compacted fill under building and structures	98%	95%	50,000#
Compacted fill under roadway & other areas to be paved below 3' of subgrade	95%	92%	40,000#
The uppermost 3' forming subgrade for roadway and other pavements	98%	95%	50,000#
Compacted fill in levees and dikes	98%	95%	50,000#
Compacted fill in overlot areas	90%	87%	40,000#

All compactor test costs shall be borne by the contractor. Locations or number of tests are to be indicated on the construction plans as approved by the City.

12. SERVICE CONNECTIONS

- A. Install customer services at locations required.
- B. Each 3/4" single service unit shall consist of: One Mueller H-15008 or as approved 3/4" corporation stop with straight coupling nut; one 3/4" Type K soft copper tubing service pipe from street main to meter location, length as required; one Mueller H-14348 or as approved meter stop.
- C. Each 3/4" duplex service unit shall consist of: One Mueller H-15008 or as approved 3/4" corporation stop with straight coupling nut; one 3/4" Type K soft copper tubing service pipe from street main to a point between the two meter locations, length as required; one Mueller H-15380 or as approved 3/4" tee on property end of service pipe between the two locations; 3/4" Type K soft copper tubing branch service pipes from outlets of tee to each of the two meter locations, lengths as required; two Mueller H-14348 or as approved 3/4" meter stops.
- D. Each service unit larger than 3/4" shall consist of all items specified above for 3/4" service units, except that each item shall be the same size as the service pipe.
- E. All joints between copper tubing and fittings shall be flared type. Couplings for copper tubing shall be Mueller H-15403 Compressor or as approved; use these ONLY where permitted by the City and in open trenches ONLY.
- F. Set the corporation stop in the main at an angle of 45 degrees with the vertical, except that only where necessary to facilitate installing services under deep side ditches, the corporation stop may be installed in the side of the main in horizontal position.
- G. Under existing concrete and asphalt pavement, install all service piping without cutting the pavement, by jacking a pilot pipe or boring under the pavement and pulling the service pipe into place through the hold forms thereby.
- H. Provide a casing around each service pipe under the railroad, as specified hereinafter.
- I. All service pipe shall have 24" minimum cover.
- J. Terminate each service at the property line with the meter stop at proper elevation for connection to meter. Mark the location of each meter stop with a stake or RED painted "W" on curb as directed, and maintain these stakes or marks until the project is accepted by the City or until the meters and boxes have been installed by them, whichever is the earlier. (See METERS AND BOXES).

K. Connect services to various types of mains as follows:

1. 4" and Larger Ductile Iron Pipe: Tap directly into wall of main in accordance with the MAXIMUM permissible direct tapping sizes for various sizes of mains listed below; where service size exceeds the maximum allowable size direct tapping for the main involved, use the approved service or tee fittings:

6" Main: 1" Maximum size direct tapping
8" Main: 1-1/4" Maximum size direct tapping
10" Main: 1-1/2" Maximum size direct tapping
12" Main: 2" Maximum size direct tapping

13. SEPARATION OF WATER MAINS AND SEWERS

A. General: The following factors should be considered in providing adequate separation:

1. Materials and type of joints for water and sewer pipes
2. Soil conditions
3. Service and branch connections into the water main and sewer line;
4. Compensating variations in the horizontal and vertical separations;

B. Parallel Installation

1. Normal Conditions: Water mains shall be laid at least 10 feet horizontally from any sanitary sewer, storm sewer or sewer manhole, whenever possible; the distance shall be measured edge-to-edge.
2. Unusual Conditions: When local conditions prevent a horizontal separation of 10 feet, a water main may be laid closer to a storm or sanitary sewer provided that:
 - a. The bottom of the water main is at least 18 inches above the top of the sewer;
 - b. Where this vertical separation cannot be obtained, the sewer shall be constructed of materials and with joints that are equivalent to water main standards of construction and shall be pressure tested to assure water tightness prior to backfilling.

C. Crossings

1. Normal Conditions: Water mains crossing house sewers, storm sewers or sanitary sewers shall be laid to provide a separation of at least 18 inches between the bottom of the water main and the top of the sewer, whenever possible.
2. Unusual Conditions: When local conditions prevent a vertical separation as described in C (1), the following construction shall be used:
 - a. Sewers passing over or under water mains should be constructed of the materials described in B (2) (b).
 - b. Water mains passing under sewers shall, in addition, be protected by providing
 1. A vertical separation of at least 18 inches between the bottom of the sewer and the water main.
 2. Adequate structural support for the sewers to prevent excessive deflection of joints and settling on and breaking the water mains.
 3. That the length of water pipe be centered at the point of crossing so that the joints will be equidistant and as far as possible from the sewer.

D. Sewer Manholes: No water pipe shall pass through or come into contact with any part of a sewer or sewer manhole.

14. METERS AND BOXES

- A. Meters and meter boxes will be furnished and installed by the City.
- B. Meter couplings and gaskets shall be furnished by the City.

15. RAILROAD CROSSINGS

- A. Before commencing work thereon, obtain permission from the Railroad Company involved for each required crossing of the railroad tracks by the water lines. Copies of all correspondence with the Railroad Company shall be sent to the City of Piperton.

- B. Do all work on the railroad rights of way under the supervision of the Railroad Company involved, and in strict accordance with their requirements. **DO NOT UNDER ANY CIRCUMSTANCES PLACE ANY EXCAVATED MATERIALS, CONSTRUCTION MATERIALS, CONSTRUCTION EQUIPMENT, OR OTHER ITEMS ON THE TRACKS OR ANY OTHER LOCATION WITHIN RAILROAD TRAFFIC CLEARANCE LIMITS.** Arrange all work to conform with the railroad operating schedules, and to avoid all unnecessary interference therewith. As soon as practicable after installation of each water line across the tracks, restore all railroad property at that location to at least the conditions that existed prior to the beginning of the work thereon.
 - 1. Pay all charges that the Railroad Company may make for supervising the Contractor's work on their property.
- C. Provide a pipe casing around each water main and each service pipe which crosses railroad tracks. Depths of casings below tracks and lengths of casing beyond each side of tracks shall be as indicated or required by the Railroad Company. Bore holes as required under the tracks and install the casing through these holes, as prescribed and/or approved by the Railroad Company. Install pipes in casings by methods that will positively prevent separation of pipe joints and damage to pipes.
- D. Casings for Mains: These shall be 1/4" minimum wall thickness black steel pipe, with an inside diameter at least 4" larger than the outside diameter of the water pipe bells. All casing joints shall be welded.
- E. Casings for Service Pipes: These shall be Schedule 40 galvanized steel pipe with threaded and coupled joints, with an inside diameter approximately 1" larger than the outside diameter of the service pipe.

16. **HIGHWAY CROSSINGS**

- A. Before commencing work thereon obtain permission from the Highway Department for each crossing of the highway by the water lines. Copies of all correspondence with the Highway Department shall be sent to the City of Piperton.
- B. Do all work on the highway rights of way under the supervision of the Highway Department, and in strict accordance with their requirements. **DO NOT UNDER ANY CIRCUMSTANCES PLACE ANY EXCAVATED MATERIALS, CONSTRUCTION MATERIALS, CONSTRUCTION EQUIPMENT, OR OTHER ITEMS ON THE HIGHWAY PAVEMENT.** Arrange all work to avoid all unnecessary interference with highway traffic. As soon as practicable after installation of each water line across the highway, restore all highway property at that location to at least the conditions that existed prior to the beginning of work thereon.

- C. Provide a pipe casing around each water main and each service pipe which crosses the highway. Depths of casings below paving and lengths of casings beyond each side of Highway shall be as indicated or as required by the Highway Department. Bore holes as required under the pavement and shoulders and install the casings through these holes, as prescribed and/or approved by the Highway Department. Open cut will be permitted only beyond pavement and shoulders. Install pipes in casings by methods that will positively prevent separation of pipe joints and damage to pipes.
- D. Casings for Mains: These shall be 1/4" minimum wall thickness black steel pipe with an inside diameter of at least 4" larger than the outside diameter of the pipe bells. All casing joints shall be welded.
- E. Casing for Service Pipes: These shall be Schedule 40 galvanized steel pipe with threaded and coupled joints with an inside diameter approximately 1" larger than the outside diameter of the service pipe.

17. CONNECTIONS TO EXISTING WATER SYSTEM

- A. Unless otherwise indicated or authorized, make connections to existing water mains by removing plug from existing plugged fitting, or inserting a tee and proper sleeve in existing main, as applicable, at each point of connection between new and existing mains. This type of connection is classified as a "Non Pressure Connection".
- B. BEFORE SHUTTING OFF EXISTING WATER MAINS TO MAKE CONNECTIONS, OBTAIN APPROVAL OF THE CITY WATER AND FIRE DEPARTMENT, AND ADVISE ALL AFFECTED WATER CUSTOMERS ACCORDINGLY. AFTER SHUTTING OFF, DO ALL NECESSARY WORK AND RESTORE WATER SERVICE AS QUICKLY AS POSSIBLE.
- C. Where indicated or authorized and WITH A CITY REPRESENTATIVE PRESENT, make connections to existing water main by installing a mechanical joint split tapping valve, and cutting proper hole in existing main with special tapping machine, without shutting off the water in the existing main. Tapping valves and their boxes shall conform in all respects to the requirements of VALVES AND BOXES, except that on end of the valve shall be flanged to match tapping sleeve flange, and the other end of the valve shall be a mechanical joint end. This type of connection is classified as a "Pressure Connection".

18. TESTING AND STERILIZING

- A. After backfillings, subject all pipe work to pressure and leakage tests. Piping may be tested in sections between valves as the work progresses. Admit water slowly into the section to be tested, and expel air through corporation stops installed in the high points of the pipe lines, and through other openings, as required. After all air has been expelled apply a pressure equal to the design 1.5 times the working pressure of

the pipe and not to exceed 150 psi and maintain it for not less than two (2) hours, during which time the leakage shall not exceed that permitted by AWWA STANDARD C600 for mechanical joint and push on joint pipe. Repair all apparent leaks.

LEAKAGE should not exceed "L" gallons/hour where:

$$L = \frac{ND P}{7400}$$

N = Number of joints in pipeline section

D = Nominal pipe diameter in inches

P = Average test pressure in psi gage

Should the measured leakage exceed the maximum specified allowable leakage, locate and repair the leaks and repeat the tests on section of pipe involved until all tests have been approved. Furnish approved testing equipment, consisting of a suitable pump to apply and maintain test pressure accurate pressure gauges, suitable equipment to measure volume of water pumped, and other necessary equipment, and conduct all tests in the City's presence in an approved manner. Determine leakage by measuring the volume of water pumped to maintain the required test pressure for the duration of the leakage test. Obtain a copy of AWWA STANDARD C600, and keep it on the job in good condition for the Contractor's and City's use in computing the permissible leakage in each section to be tested.

- B. After all tests have been approved, and before placing the pipe lines in service, disinfect all new pipe work with chlorine for a period of not less than 24 hours. Introduce sufficient chlorine into pipe line to provide a chlorine strength of not less than 50 ppm throughout the entire piping system using either liquid chlorine or chlorine bearing compounds similar to "HTH", and determining the required quantity of chlorinating agent in accordance with the manufacturer's directions for the calculated volume of water to be tested. Inject chlorine solution into the pipe lines through corporation stops installed at proper locations in the pipe line, or by other approved means. After a retention period of not less than 24 hours, thoroughly flush the chlorinated water out of the pipe lines from its extremities, take samples of water from approved locations in the pipe line and have the samples analyzed for bacterial purity by an approved laboratory. Continue this process until the samples indicate that the water is free of contamination and safe for domestic use, all to the satisfaction of the City and the County's Health Department. Furnish all necessary approved disinfection equipment. The costs of all laboratory services shall be borne by the Contractor.
- C. Water for testing, sterilizing and flushing will be furnished by the City from their existing water facilities, without cost to the Contractor, but the Contractor shall furnish all piping and equipment to convey the water to the pipe lines.

- D. Corporation stops shall be Mueller No. H-15000 or as approved; provide these as required, and leave them in place after testing and sterilizing, with the outlets plugged. Customer service corporation stops may also be used for testing and sterilizing.
- E. DO NOT UNDER ANY CIRCUMSTANCES OPEN THE SECTIONALIZING VALVES BETWEEN THE EXISTING MAINS AND THE NEW MAINS UNTIL THE BACTERIAL ANALYSIS OF THE MAINS INVOLVED HAS BEEN APPROVED BY THE CITY. EXCEPT THAT UPON THEIR APPROVAL, VALVES MAY BE OPENED ONLY AS REQUIRED TO ADMIT WATER INTO THE NEW MAINS FOR TESTING, STERILIZING, AND FLUSHING.
- F. VALVES BETWEEN THE EXISTING AND NEW MAINS SHALL BE OPENED ONLY BY WRITTEN PERMISSION FROM THE CITY. TIME OF INITIAL OPENING AND FINAL CLOSING SHALL BE RECORDED AND GIVEN DAILY TO THE CITY.

19. CLEANING UP OF DISTRIBUTING SYSTEM

- A. Clean up the distribution system as the work progresses. Negligence in proper cleaning up which causes undue inconvenience to the public or private citizens, or presents an unsightly or dangerous condition, or causes embarrassment to civic officials will be sufficient reason for rejection of construction estimates until the unsatisfactory conditions have been remedied.
- B. After all work is completed, make a final cleanup of all areas where work has been done, and leave them in a broom clean conditions.

20. VALVE AND HYDRANT CHECK

- A. After completion of all water line work and before the work will be accepted, make a final check of each valve and hydrant installed under this project, and of each existing valve that has been operated in connection with the work under this project.
- B. Make this final check in the City's presence and demonstrate that each valve is in fully open position, and that each hydrant operates properly.

21. PAYMENT REPAIRS, CITY'S STREETS

- A. Immediately after installing each water line across a City street, restore the street at that location to at least the conditions which existed prior to the water line work thereon, all to the City's satisfaction.
- B. Unless otherwise authorized by the City, replace all pavement which is disturbed by the work with 8" thick concrete base, and a 2" thick surface course of hot plant mix asphaltic concrete, with proper asphaltic prime coat applied to base before laying the surface course thereon.

22. TRENCHING, PIPE LAYING, BACKFILLING, AND PAVEMENT REPAIRS, COUNTRY ROADS

- A. Before cutting any roads, obtain proper permission for each cut from the County Engineer.
- B. Immediately after installing each water line across the road, restore the road and its right of way at that location to at least the conditions which existed prior to the beginning of the water line work thereon, all to the County Engineer's satisfaction.
- C. The following requirements to all pipe laid under asphalt surfaced County roads.
- D. Comply with any specific drawings for road crossings.

23. CUTTING AND REPLACING PAVEMENT AND OTHER SPECIAL SURFACES

- A. Restore all surfaces disturbed by the installation of the pipe lines to the conditions that existed before excavation, or better, as specified below. As each surface is being cut, the City will examine the existing surface in the Contractor's presence, and the type of surface to be replaced in each case shall be determined by mutual agreement between the City and the Contractor.
- B. As specified under TRENCHING, EXCAVATING, SHORING, BRACING, AND DE-WATERING, the maximum pipe trench width shall be 24" greater than the inside diameter of the pipe laid therein. The maximum width of all pavement and other surfaces repairs allowable for payment by the City will be the inside diameter of the pipe plus 36" or 6" beyond each side of the maximum allowable trench width. At contractor's expense, make all repairs outside of this limit. If the repairs do not reach this limit, the City will pay ONLY for the actual extent of the repairs. Replace existing surfaces which are cut, removed, or otherwise damaged by the water line work with new surfaces as described below. All new surfaces shall conform accurately to the elevations and contours of the existing adjacent undisturbed surfaces.
 - 1. Existing Gravel Surfaces: Replace these with a 6" thick compacted layer of new approved locally available road gravel.
 - 2. Existing City Streets and County Roads: As specified hereinbefore.
 - 3. Concrete Surfaces: Do not cut concrete surfaces, but install pipe under them by tunneling, unless otherwise approved. However, if concrete surfaces are cut, replace them with a 6" thick compacted layer of new approved locally available road gravel base, and a surface course of 3,000 psi concrete equal in thickness to that of the adjoining concrete surface course.

- C. Where pipe is installed on the shoulders parallel to asphalt, concrete, or other surfaces, maintain ditches until they are firm and present no traffic hazard. Where authorized, place 6" thick compacted layers of new approved locally available road gravel.
- D. Do not cut streets and other surfaces except where necessary for the water main installation. At Contractor's expense, repair all damage outside of the limits specified above, to City's satisfaction. Maintain all crossing until project completion.

24. PAYMENT AND MEASUREMENT OF QUANTITIES

- A. Pipe, Ductile Iron, In Open Cut (does not include pipe in casings): Paid for at the unit price per linear foot of pipe in place in open cut trenches or open cut excavations, measured along the top centerline of the pipe between intersecting centerlines or ends of pipe, and through fittings and valves.
- B. Pipe, Ductile Iron, Bored, (does not include pipe in pipe casings): Paid for at the unit price per linear foot of pipe in place within bored, jacked, or tunneled holes more than 5 feet long, without pipe casings, measured along the top centerline of the pipe for the full length of the bored, jacked, or tunneled hole. NOTE: Pipe in bored, jacked, or tunneled holes that are 5 feet or less in length will be classified as and paid for as PIPE, IN OPEN CUT.
- C. Ductile Iron and Cast Iron Fittings: Paid for at the unit price per pound of fittings in place, as established by the invoice weight of the fittings on the basis of ASNI/AWWA C110 published body of bolts, nuts, glands, gaskets or cement linings, does not include tapping sleeves.
- D. Valves and Boxes: Paid for at the unit price for each valve and its box in place; does not include tapping type valves and their boxes, which will be paid for as described under "Pressure Connections".
- E. Hydrants: Paid for at the unit price for each hydrant in place, complete with base supports, drainage gravel, anchorage, and painting, based upon standard 3 foot bury hydrants.
- F. Hydrant Extensions: Paid for at the unit price per linear foot of hydrant extensions, in place. No payment will be made for unauthorized hydrant extensions (See SETTING OF HYDRANTS).
- G. Hydrant Leads: Paid for as PIPE. IN OPEN CUT.
- H. Single Service Unit: Paid for at the unit price for each complete single service unit in place, including corporation stop, tapping or fittings required to attach

corporation stop to water main, one service pipe tee, two meter stops, meter couplings, service pipe couplings and fittings, adapter's excavation, and backfill, but does not include service pipe which will be paid for separately.

- I. Duplex Service Unit: Paid for at the unit price for each completed duplex service unit in place, including corporation stop, tapping of fittings required to attach corporation stop to water main, one service pipe tee, two meter stops, meter couplings, service pipe couplings and fittings, adapter's excavation, and backfill, but does not include service pipe which will be paid for separately.
- J. Service Pipe, In Open Cut: Paid for at the unit price per linear foot of service pipe in place in open cut trenches and open cut excavations.
- K. Service Pipe, Bored: Paid for at the unit price per linear foot of service pipe in place within bored, jacked, or tunneled holes more than 5 feet long, without pipe casings, measured for the full length of the bored, jacked, or tunneled hole. NOTE: Service pipe is bored, jacked, or tunneled holes that are 5 feet or less in length will be classified as and paid for as SERVICE PIPE, IN OPEN CUT.
- L. Non-Pressure Connections: No separate payment, unless specifically otherwise indicated; included in the various unit prices. However, pipe and fittings involved in the non-pressure connections will be paid for as specified hereinbefore.
- M. Connections to Existing Plugged Valves: No separate payment, included in the unit price per linear foot of pipe in place.
- N. Pressure Connections: Paid for at the unit price for each completed tapping sleeve type connection made to existing mains, while the main is in service and under pressure. This included the tapping sleeve, tapping valve, and tapping valve box, in place, and the hole cut in existing main. For payment purposes, the size of the tapping valve shall determine the size of the pressure connections, as shown in the PROPOSAL.
- O. Pipe, in Casing, Mains and Service Pipes: Paid for at the unit price per linear foot of pipe in place in pipe casings: Includes pipe and casing; no payments will be made for any pipe in casing in excess of the lengths indicated or authorized.
- P. Granular Pipe Bedding Material and Granular Backfill Material: Paid for at the unit price per ton of granular material in place, as evidenced by delivery tickets signed by the City.
- Q. Placement of Road Gravel: Paid for at the unit price per cubic yard of compacted road gravel in place, as computed by actual measurements of surface area covered with a 6" thick compacted layer. No payment will be made for any road gravel placed without authorization, or for any road gravel placed outside of the specified payment limits. Includes base courses under pavement and under special surface repairs.

- R. Replacement of Paving and Special Surfaces: Paid for at the unit price for square yard or each type of pavement or special surface in place, as computed by actual measurements of the areas repaired, except that no payment will be made outside of the specified pavement limits. Does not include gravel base courses, which will be paid for separately as noted herein.
- S. Gaskets, Bolts, Nuts, Mechanical Joint Glands, and other Joint Materials, Excavation, and Backfill; Boring, Jacking, Tunneling; Removal of Existing Paving; Anchorage; Testing and Sterilizing; and Removing and Replacing Sod, Fences, Etc.: No separate payment unless specifically otherwise indicated; included in the various unit prices for pipe, fittings, valves, and other related items.
- T. Extra Depth Excavation: The MINIMUM cover pipes shall be 30" from mains and 18" for service pipes, as specified hereinbefore: No extra payment will be made for any extra depth excavation that may be required to permit piping to pass under obstructions, whether they are indicated on the drawings or not.
- U. Other Miscellaneous Items: No separate payment, unless specifically otherwise indicated; included in the various unit prices.
- V. Quantities and Payments, General: Payments will be made to the nearest complete unit as listed in the PROPOSAL. Quantities submitted for payment shall be rounded off to the nearest linear foot, pound, cubic yard, or other applicable unit.

END

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