

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02632 STORM DRAIN PIPE INSTALLATION

PART 1 – SCOPE

This work shall consist of the construction of storm drain pipe of the kinds and dimensions shown on the Plans, stipulated in the Contract Documents, or as directed by the Owner. The construction shall be accomplished in accordance with these Specifications and in conformity with the lines, grades, and details shown on the Plans or established by the Owner. The work shall include such labor, material, equipment, bedding, laying pipe, making joints, tunneling or jacking, encasement, foundation concrete, connection to other drainage structures, abandonment or removal of pipe, and all other items as may be necessary to complete the storm drains as shown on the Plans.

PART 2 – MATERIALS AND EQUIPMENT

2.01 MATERIAL

A. New Material.

All materials shall be subject to sampling, testing, and approval or rejection by the Owner. Unless otherwise specified all materials incorporated into the work shall be new and unused in previous construction. Used materials in acceptable condition may be used for trench bracing, forms, falsework, and similar uses.

B. Manufacturer's Qualifications.

The source of supply for each material to be supplied by the Contractor shall be subject to approval by the Owner before orders are placed. Storm drainage pipe shall be the standard product of a manufacturer of established good reputation in the industry and manufactured in a permanent plant adapted to meet the specified design requirements of the pipe.

C. Inspection and Testing.

1. Representative samples of materials intended for incorporation in the work shall be submitted for examination when so specified or requested. All materials to be used in the work shall be sampled, inspected, and tested in accordance with current ASTM specifications, or other specified standard specifications. The Contractor shall furnish the Owner with three copies of certified reports from a reputable testing laboratory showing the results of the tests carried out on representative samples of materials delivered and to be used in the project. The performance of all testing shall be done at no cost to the City.

2. The Contractor shall notify the Owner in advance of any deliveries of the materials and shall make whatever provisions are necessary, including the furnishing of such labor as may be required to aid the Owner in the examination, and culling of the materials on the site prior to installation in the work.

3. All materials not conforming to the requirements of these Specifications shall be considered as defective and rejected for use and shall be removed from the site of the work.

D. Storage.

The Contractor shall provide such storage facilities and exercise such measures as will insure the preservation of the specified quality and fitness of materials to be incorporated in the work.

E. Reinforced concrete Pipe.

1. All reinforced concrete pipe shall conform to the requirements of ASTM Standards for the specified diameter and strength class as follows:
 - a. Circular Pipe – ASTM C 76 – Wall B
 - b. Horizontal and Vertical Elliptical Pipe – ASTM C 507
 - c. Arch Pipe – ASTM C 506

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02632 STORM DRAIN PIPE INSTALLATION

2. Strength class or classes shall be as required by the Plans or Contract Documents but in no case shall pipe of less than strength Class III be used. The interior surfaces of the pipe shall be a smooth, true cylindrical surface free from undulations or corrugations. Bung holes for lifting drain pipe shall be eliminated with the exception of radius pipe, manhole sections and elliptical pipe. Lift holes are to be provided for radius and elliptical pipe and manhole sections only. Lifting holes when provided shall be cast in the wall of the pipe to receive a precast truncated conical concrete plug of such size as will allow 1/8 inch cementing material on the sides of the joining surfaces of the plug and will fill at least 50 percent of the lifting hole depth. Cement shall meet all the requirements of the Specifications for Portland Cement, ASTM C 150, Type II. Curved alignments shall be constructed with precast, beveled end concrete radius pipe which meet the same requirements as for straight pipe. Concrete radius pipe less than or equal to 36 inch diameter shall have a minimum centerline radius of 20 feet and all radius pipe greater than 36 inch diameter and less than 72 inch diameter shall have a minimum centerline radius of 30 feet.

3. Joints in reinforced concrete pipe shall conform to one of the following types:

- (A) Rubber Trapped "O" Ring Gasket type – ASTM C 443
- (B) Flexible Plastic Rope Gasket type – AASHTO M 198 – Type B
- (C) Flexible Butyl Rope Gasket type – AASHTO M 198 – Type A
- (D) Portland Cement Mortar Joint type

4. Type D, Portland Cement Mortar Joint, may only be used on radial, elliptical, and arch pipe. The shape, dimensions and tolerance of the bell and spigot or tongue and groove ends of the pipe shall be compatible with the type joint used and shall conform to the above referenced specifications.

F. Nonreinforced Concrete Pipe.

1. All nonreinforced concrete pipe shall conform to ASTM C 14 for the specified diameters and strength classes. Cut pipe for curved alignments shall be of uniform length along the same curve, and otherwise meet the requirements for straight pipe.

2. Joints in nonreinforced concrete pipe shall be the same as specified for reinforced concrete pipe.

G. Corrugated Steel Pipe

1. All corrugated steel pipe shall be zinc coated (galvanized) corrugated steel pipe conforming to AASHTO M 36 for Type I and Type II pipe. All special sections such as radii and flared end sections shall be the same sheet thickness and corrugation dimensions as adjoining pipe and shall conform to AASHTO M 36 unless specified otherwise on the Plans or Contract Documents. Type IA Pipe will not be permitted. When elongated pipe is called for by the contract, the pipe shall be shop formed to provide for a 5 percent vertical elongation. The zinc coated sheets used to manufacture the pipe and specials shall conform to AASHTO M 218. Corrugated steel pipe shall have one of the following protective coating systems:

- a. Pipe and specials described above when specified by the Owner, additional protective coating shall be provided conforming on the requirements of AASTO M-190 or M-245 as indicated on plans and specifications.

The pipe shall be furnished with lifting straps for handling. The lifting straps may be attached by welding. No burning of holes will be permitted.

2. Connections.

All connections shall conform to AASHTO M 36 with the following exceptions:

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02632 STORM DRAIN PIPE INSTALLATION

- a. Coupling bands shall have the same material and corrosion protection bondings and coatings as the pipe and specials which they connect.
- b. Connections shall be made by recorrugating the end of pipe, a full 12 inches and using an annular band and a 12 inch flat gasket.

3. Field Applied Coating.

Field applied bituminous coatings for filling joints between adjacent paved inverts and coating coupling bands and all touch-up work shall conform to AASHTO M 243.

4. Radius Pipe.

All corrugated steel pipe radii shall be shop fabricated to provide a smooth internal radius of not less than the following for various size pipes:

- a. Less than or equal to 36 inch diameter – 20 foot radii
- b. Greater than 36 inch diameter and less than or equal to 72 inch diameter – 30 foot radius

No elbows, tees, wyes, and similar specials shall be permitted, except where specified by Plans and Design Standards.

- 5. Corrugated metal pipe will not be used unless specified by the Owner on the plans.

H. Ductile Iron Culvert Pipe.

All ductile iron culvert pipe shall conform to the requirements of ASTM A 716 for the specified diameters and strength classes. All pipe shall be smooth and circular in cross section. All gray and ductile iron fittings shall conform to the requirements of ANSI A21.10 for the specified diameters. All joints shall be push-on type conforming to the requirements of ANSI A21.11 for the specified diameters.

I. Vitrified Clay Culvert Pipe.

All vitrified clay culvert pipe shall meet the requirements of ASTM C 700 for Extra Strength Clay Pipe. All joints shall be compression type meeting the requirements of ASTM C 425.

J. Portland Cement Concrete.

Portland Cement Concrete shall be of the class and dimensions as shown on the Plans, or as directed by the Owner. The classes of concrete for drainage facility construction are referred to as Class A and Class C. Class A concrete is intended principally for concrete structures designed for high strength. Class C concrete is intended principally for low strength concrete, used for foundation stabilization, pipe cradles and encasement and other general purpose uses. All portland cement, coarse aggregate, fine aggregate, water, air entraining agents and chemical admixtures; their proportioning, mixing, and delivery, shall be as specified in Division 3 of these specifications.

K. Crushed Limestone.

Crushed limestone shall be size No. 67 Coarse Aggregate meeting the requirements of the Tennessee DOT Standard Specifications for Road and Bridge Construction and the following gradation:

Size No.	Total Percent by Dry Weight Passing Each Sieve (U.S. Standard)				
	1"	¾"	3/8"	No. 4	No. 8
67	100	90-100	20-55	0-10	0-5

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02632 STORM DRAIN PIPE INSTALLATION

L. Mortar.

1. Mortar shall be composed of one part portland cement, two parts masonry sand, hydrated lime not to exceed 10 percent of the cement used, and 4 parts water. All ingredients shall be proportioned by measurement and not by estimation. All portland cement, sand, and water shall be as specified in Division 3 of this Specification. All hydrated lime shall be as specified by ASTM C 6.

2. The mortar shall be hand mixed or machine mixed. In the preparation of hand mixed mortar, the sand, cement and hydrated lime shall be thoroughly mixed together in a clean, tight, mortar box until the mixture is of uniform color, after which water shall be added. Machine mixed mortar shall be prepared in an approved mixer and shall be mixed not less than 1½ minutes. Mortar shall be used within 30 minutes after mixing.

3. Precast manhole sections, radius pipe and elliptical pipe lifting holes shall be filled with a non-shrinking grout from the outside and inside. Grout shall be set firmly before backfilling around structures.

M. Bracing Lumber.

Lumber for tunnel bracing shall be sound bridge oak placed to form a structurally sound timber tunnel lining properly braced. The timber tunnel lining shall remain in place after laying the pipe and backfilling. All timbers used in tunnels shall be of good quality reasonably straight grained and free from weakening knots and other defects.

2.02 EQUIPMENT.

A. The equipment provided by the Contractor shall include hoisting equipment capable of handling and placing the pipe in final position without damage to the pipe. Mechanical tamps shall also be provided.

B. All of the above equipment, as well as any additional equipment necessary for the satisfactory performance of this construction, shall be on the project and inspected by the Owner before work will be permitted to begin.

PART 3 – CONSTRUCTION REQUIREMENTS

3.01 MODIFICATION OF EXISTING STORM DRAIN.

A. Abandonment of Drainage Pipe.

1. Drainage pipe to be abandoned shall be sealed by mortaring (bricking) the end of the pipe for a distance of 18 inches minimum, or one-half the diameter of the pipe, whichever is larger. The pipe shall be sealed with solid concrete block or brick and acceptable cement grout to form a solid waterproof plug completely bonded to the pipe, unless otherwise specified.

2. The Contractor will be allowed to remove that portion of the pipe to be abandoned in lieu of filling and blocking. If the Contractor elects the removal method, all cost for backfilling the excavation and all costs for surface restoration, in addition to removing and properly disposing of the pipe, shall be included in the unit bid price for Abandonment.

B. Connection to Existing Structures.

1. The Contractor shall cut suitable openings as approved by the Owner into existing structures or remove existing pipe to accommodate the drain pipe if at the proper elevation,

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02632 STORM DRAIN PIPE INSTALLATION

location, and direction, as indicated on the Plans. The existing pipe shall be removed or a hole cut in the structure wall to permit inserting the drain pipe at the required flow line elevation, horizontal angle, and slope, and to allow 2 inches space around the pipe for bedding and filling solidly with mortar. Care shall be used to avoid unnecessary damage to the existing masonry.

2. All loose material shall be removed from the cut surfaces, which shall be completely coated with mortar before setting the pipe. If the structure wall is reinforced concrete, a cage of steel reinforcement shall be installed and the existing bars reshaped and tied to the cage around the entire pipe before mortar is placed in accordance with the Design Standard. Before inserting the pipe, a sufficient thickness of mortar shall be placed at the bottom and sides of the opening for proper bedding of the pipe. After setting, all spaces around the pipe shall be solidly filled with mortar and neatly pointed up on the inside to present a smooth joint, flush with the inner wall surface. Any necessary revisions in the existing invert shall be made to provide a smooth plastered surface for properly channeled drainage from the new connection. Particular care shall be given to insure that the earth subbase and bedding adjacent to the manhole will provide firm solid support to the pipe.

C. Removal of Drainage Pipe.

Existing pipes to be removed and their locations are shown on the Plans. The City reserves the right to retain or reject salvage of any materials encountered. All remaining materials become the property of the Contractor who will be responsible for properly disposing of same off-site. All pipe whose removal is required to facilitate the installation of the proposed drainage facilities shall be removed without separate measurement or payment. This work shall be included in the price of the new drainage facility.

3.02 STORM DRAIN PIPE INSTALLATION

A. General.

Drain pipe and bedding shall be constructed of the sizes, classes, dimensions, and materials and to the alignments and grades shown on the Plans.

B. Pipe Bedding.

Bedding for drainage pipe shall conform to the requirements given below for Class A, B, or C bedding, whichever is shown on the Plans. If the class of bedding is not shown, a minimum of Class C bedding shall be provided.

1. Class A – Concrete Cradle.

Class A bedding for drainage pipe shall consist of a continuous concrete cradle up to springline constructed in conformity with the details shown on the Plans or as directed by the Engineer.

2. Class B – Crushed Limestone.

Class B bedding shall be constructed by bedding the drainage pipe on a six inch thickness of crushed limestone and sufficient additional crushed limestone which is accurately shaped by a template to fit the lower part of the pipe exterior for at least 10 percent of its overall height. After pipe installation crushed limestone shall then be rammed under the haunches and tamped in layers not over 6 inches in loose thickness around the pipe to the springline. The remaining depth of trench shall then be backfilled and compacted as specified in Specification Section 02631. When bell and spigot pipe is to be placed, recesses shall be dug in the bedding material of sufficient width and depth to accommodate the bell without its resting on the bottom of the recess. The width of the recess shall not exceed the width of the bell by more than 2 inches

3. Class C – Natural Subgrade.

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02632 STORM DRAIN PIPE INSTALLATION

Class C bedding shall be constructed by bedding the drainage pipe on a natural earth subgrade shaped by a template to fit the lower part of the pipe exterior for at least 10 percent of its overall height. After pipe installation select earth material shall then be rammed and tamped in layers not over 6 inches in loose thickness around the pipe to the springline. The remaining depth of trench shall then be backfilled and compacted as specified in Specification Section 02631. When bell and spigot pipe is to be placed, recesses shall be dug in the subgrade of sufficient width and depth to accommodate the bell without its resting on the bottom of the recess. The width of the recess shall not exceed the width of the bell by more than 2 inches.

C. Pipe Laying.

1. Inspection Before Laying.

The Contractor shall inspect all pipe upon delivery and such pipe as does not conform to the requirements of these Specifications and which are not suitable for use shall be rejected and immediately removed from the work site.

2. Pipe Ends Cleaned and Lubricated Before Laying.

Preparatory to making pipe joints, all surfaces of the portions of the pipe to be jointed or of the factory made jointing materials shall be clean and dry. All necessary lubricants, primer, adhesives, etc., shall be used as recommended by the pipe or joint manufacturers specifications.

3. Care During Hoisting, Placing, and Shoving Home.

Equipment used to handle, lay and joint pipe shall be so equipped and used as to prevent damage to the pipe and its jointing materials. All pipe and fittings shall be carefully handled and lowered into the trench. Damaged pipe or jointing material will not be accepted and shall not be installed. All rejected material shall be removed from the job site.

4. Uniform Pipe Bearing.

a. Special care shall be taken to insure that the pipe is solidly and uniformly bedded, cradled, or encased in accordance with the type of bedding, cradle, or encasement required by the Plans. No pipe shall be brought into position for joining until the preceding length has been bedded, joined and secured in place.

b. Where a concrete cradle is required, the pipe shall be supported at not more than two places with masonry supports of minimum size sufficient to provide the required clearance and to prevent displacement during placing of concrete.

5. Direction of Work.

The laying of pipe in finished trenches shall be commenced at the lowest point. When installed the bell or grooved end shall be forward or upgrade. All pipe shall be laid with ends abutting and true to line and grade. They shall be carefully centered so that when laid they will form a drain with a uniform invert.

6. Alignment and Grade.

Each piece of pipe shall be checked for vertical and horizontal alignment immediately after being laid.

7. Bedding to Secure Pipe.

As soon as possible after the joint is made, sufficient material shall be placed alongside each side of the pipe to offset conditions that might tend to move the pipe off line and grade. Particular care shall be used to prevent disturbance or damage to the pipe and the joints during backfilling.

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02632 STORM DRAIN PIPE INSTALLATION

8. Flotation and Water in the Trench.

- a. The Contractor shall take all necessary precautions to prevent flotation of the pipe in the trench.
- b. Water shall not be allowed to rise in the trench until the joint materials and any concrete cradle or encasement is hardened and cannot be damaged by the water.

9. Open Ends.

Whenever pipe laying is stopped for any significant length of time, such as at the end of a workday, the unfinished end shall be protected from displacement, flotation, cave-in, in-wash of soil or debris, or other injuries. A suitable temporary tight fitting plug, stopper, or bulkhead shall be placed in the exposed ends of the pipe.

10. Curved Alignment.

Curved storm drain alignments shall be constructed with manufactured, beveled end radius pipe for circular pipe sizes of 21 inch diameter and larger. Curved storm drain alignments for noncircular pipe and circular pipe smaller than 21 inch diameter shall be constructed with a brick radius. Brick radius shall be constructed to the radius and dimensions shown on the Plans, but not less than 20 foot radius, and in accordance with Specification Section 02640 Paragraph 3.02.B. Curved storm drain alignments shall not be constructed by breaking joints of straight pipe sections. Curved alignments of corrugated metal storm drain shall be constructed of shop fabricated radii constructed to the radius specified.

D. Pipe Joint.

1. General.

- a. Jointing operations shall continue immediately following the laying of such pipe section. In no case shall any pipe section be left overnight which has not been completely jointed to the preceding pipe section in conformance with these Specifications.
- b. No composition or asphalt base joint material shall be used to seal pipe joints.
- c. The rubber trapped "O" ring gasket and flat rubber gasket shall be used on all drain pipe on City C.I.P. Projects. In sub-divisions the flexible butyl gasket joint may be used outside of the street right-of-way; the rubber gasket shall be used in the street right-of-way. The butyl gasket material may be placed on the end of the spigot only (not in the bell). See Specification Section 02632 Paragraph 3.04.

2. Concrete Pipe.

a. Rubber Trapped "O" Ring Gasket Joints:

(1) The two ends to be joined shall be thoroughly cleaned and a rubber gasket compatible with the type of pipe ends to be and a rubber gasket compatible with the type of pipe ends to be joined shall be placed on the tongue or spigot end of the pipe. Care shall be taken to assure even tensioning and uniform cross-section of the gasket around the full circumference of the pipe. When required, lubricant recommended by the joint material manufacturer shall be liberally applied to the gasket and both ends of the pipe immediately before pipe ends are joined. The upstream pipe shall be positioned such that the tongue or spigot may enter the groove or bell squarely.

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02632 STORM DRAIN PIPE INSTALLATION

(2) Suitable means shall be used to force the tongue or spigot end of the pipe into the groove or bell end without damage to the pipe and its jointing materials, and without disturbing the previously laid pipes and joints. Any pipe or gasket damaged during jointing operations shall be removed and pipe rejointed at the Contractor's expense.

b. Flexible Plastic or Butyl Gasket Joints.

(1) The two ends to be joined shall be thoroughly cleaned. If primers are recommended by the gasket material manufacturer, they shall be applied sufficiently in advance to allow primer to dry prior to placement of gasket material. Protective paper shall be removed from one side of gasket and gasket laid around joint surfaces near center of final gasket position desired. Gasket material may be placed on either the bell or spigot ends of the pipe as well as the tongue or groove ends of pipe. Gasket shall be placed and pressed firmly around the entire circumference of the joint and butted end to end forming a continuous gasket without stretching the gasket material. Care shall be exercised to ensure that the proper gasket size for the associated pipe joint is used.

(2) The upstream pipe shall be positioned and remaining protective paper removed. Suitable means shall be used to force the tongue or spigot end of the pipe into the groove or bell end without damage to the pipe and its jointing materials, and without disturbing the previously laid pipes and joints. Pipe shall be shoved home until gasket material is squeezed out of the joint. Squeeze out will be external if gasket material is placed on the tongue or spigot and internal if on the groove or bell ends of the pipe. All joints not fully filled with gasket material until "squeeze-out" occurs shall be rejointed with new gasket material at the Contractor's expense.

c. Portland Cement Mortar Joints for Radius, Elliptical and Arch Pipe.

(1) Bell and Spigot Pipe.

(a) When the bell and spigot type of joint is used, a closely twisted hemp or oakum gasket, of such diameter as required to support the spigot of the pipe at the proper grade and make truly concentric joints and in one piece of sufficient length to pass around the pipe and meet at the top, shall be thoroughly saturated in portland cement mortar. This gasket shall be laid in the bell for the lower third of the circumference of the joint and covered with mortar specified for pipe joining. The spigot of the pipe shall be thoroughly cleaned with a wet brush, inserted, and carefully driven home, after which a small amount of mortar shall be inserted in the annular space around the entire circumference of the pipe.

(b) The ends of the gasket shall then be wrapped around the pipe and solidly rammed into the joint with a caulking tool, the mortar previously placed being driven ahead of the gasket. The remainder of the joint shall then be completely filled with mortar and beveled off to an angle of 45 degrees with the outside of the pipe. The fresh mortar joint shall then be protected by wrapping with a strip of suitable tight woven cloth passed under the pipe, drawn up tight around the joint and tied at the top with a knot behind the bell. The bell hole under the pipe shall then be fully packed with cement mortar.

(c) On pipes of 24 inches or larger in diameter, the joints shall be pointed and smoothed from the inside and excess or wasted mortar removed from the inside of the pipe. On smaller pipes, the inside of the pipe shall be smoothed and wasted mortar removed.

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02632 STORM DRAIN PIPE INSTALLATION

(2) Tongue and Groove Pipe.

(a) When the tongue and groove type of joint is used, the groove end of the first pipe must be thoroughly cleaned with a wet brush and a layer of soft mortar applied to the lower half of the groove. The tongue end of the second pipe must be thoroughly cleaned with a wet brush and, while in a horizontal position, a layer of soft mortar applied to the upper half of the tongue. The tongue end of the second pipe is then inserted into the groove end of the first pipe until the mortar is squeezed out on the interior and exterior surface.

(b) The pipe is then to be partially bedded in place in the trench by tamping dirt on both sides leaving a gap or open space at the joints, special care being exercised so that no dirt gets into the joint. The annular space is then to be completely filled by calking mortar into the joint from the outside and on the inside around the entire perimeter of the pipe.

(c) A strip or band of cement mortar 1 inch thick and 3 inches wide shall then be built up around the entire outside perimeter of the pipe. The joint shall then be protected by wrapping with a strip of burlap, cotton cloth, or strong waterproof paper of suitable width. This strip of protective covering shall pass underneath the pipe, be drawn uptight around the joint and securely fastened at the top. The space under the pipe at the joint shall then be packed with mortar.

(d) In addition to the above outlined method of sealing pipe joints, the Contractor will be required to caulk the joints with mortar around the entire perimeter of the pipe on the inside, finally pointing up and brushing the joint to a smooth finish.

(3) Poured Mortar Joint.

(a) A continuous diaper shall be placed around the outside of each joint with a 12 inch gap at the top for pouring. Diapers shall consist of heavy cotton, burlap or approved synthetic fiber of such strength and texture that leakage and sagging under the weight of the grout will be prevented. Diapers shall be attached to the pipe with steel wires or bands of adequate strength to hold the loaded diaper without stretching or slipping. Diapers shall be filled with mortar. Consistency of the mortar shall be such that the diaper will be completely filled in one continuous pouring operation. The pouring space at the top of the joint shall be plastered with mortar. Diapers shall be left in place.

(b) Provision shall be made on the inside of the pipe to prevent loss of mortar through the joint. The Contractor shall then grout the joint around the entire perimeter of the pipe on the inside with stiff mortar, point and brush the joint to a smooth finish.

d. Jointing Tolerances.

(1) The maximum allowable joint width measured on the inside surface of concrete pipe shall not be more the $\frac{3}{4}$ inch for pipe sizes 15 inches through 21 inches in inside diameter; 1 inch for pipe sizes 24 inches through 45 inches in inside diameter; and $1\frac{1}{4}$ inch for pipe sizes 48 inches and larger in inside diameter.

(2) When the width of any joint exceeds the foregoing limits, the Owner will determine the acceptability of the joint, the requirements for acceptable repair, or will reject the joint to require relaying and rejointing.

3. Corrugated Steel Pipe.

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02632 STORM DRAIN PIPE INSTALLATION

a. Coupling Band.

(1) The two ends to be joined and the coupling band shall be thoroughly cleaned within the area to be covered by the coupling band and the inside of the coupling band. The coupling band and O-ring gasket shall be placed on the end of the pipe section to be lowered into the trench such that one-half the band width is exposed. Care shall be taken during the pipe positioning operations to prevent dirt or foreign matter from becoming lodged between the pipe ends and the coupling band. The upstream pipe shall be positioned such that the two pipe ends butt together squarely. Coupling bands shall be positioned such that the band corrugations and O-ring gaskets are aligned with the pipe corrugations and the coupling band laps on an equal portion of each pipe section. Fastening devices shall be located to facilitate ease of tightening. Fastening bolts shall be tightened uniformly to the required torque recommended by the pipe manufacturer but shall not be over tightened creating excessive stresses in the pipe.

(2) After coupling band installation the interior joint between asphalt pavements shall be completely filled with trowel grade mastic material as outlined in this Specification. The mastic shall be brought up flush with the asphalt pavement surfaces being joined. The entire exterior of each joint assembly, including bands, rods, lugs, bolts, and nuts shall be given one coat of mastic material of spraying or brushing consistency

b. Jointing Tolerances.

(1) The maximum allowable separation between adjoining sections of pipe when measured on the inside surface of corrugated steel pipe shall not be more than 1 inch. When the width of any joint exceeds the foregoing limits, the Owner will reject the joint and require relaying rejoining.

4. Ductile Iron Pipe.

a. The two ends to be joined shall be thoroughly cleaned and a rubber gasket compatible with the type of pipe ends to be joined shall be placed on the spigot end of the pipe. Lubricant recommended by the joint material manufacturer shall be liberally applied to the gasket and both ends of the pipe immediately before pipe ends are joined. The upstream pipe shall be positioned such that the spigot may enter the bell squarely.

b. Suitable means shall be used to force the spigot end of the pipe into the bell end without damage to the pipe and its jointing materials and without disturbing the previously laid pipes and joints.

5. Vitrified Clay Culvert Pipe.

a. The two ends to be joined shall be thoroughly cleaned and a compression gasket compatible with the type of pipe ends to be joined shall be placed on the spigot end of the pipe. Lubricant recommended by the joint material manufacturer shall be liberally applied to the gasket and both ends of the pipe immediately before pipe ends are joined. The upstream pipe shall be positioned such that the spigot may enter the bell squarely.

b. Suitable means shall be used to force the spigot end of the pipe into the bell end without damage to the pipe and its jointing materials and without disturbing the previously laid pipes and joints.

E. Cleaning and Inspection.

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02632 STORM DRAIN PIPE INSTALLATION

1. The interior of the pipe shall, as the work progresses, be cleared of all dirt, cement extruded joint materials, debris, and extraneous materials of every description. On small pipe where cleaning after laying may be difficult, a squeegee shall be kept in the pipe line and pulled forward past each joint immediately after its completion.
2. All work shall be in undamaged condition and constructed properly in accordance with the Plans and Contract Documents. All defects and leaks disclosed by tests shall be remedied. No piping shall be buried, covered, or concealed until it has been inspected, tested, and approved. To do otherwise will be grounds for rejection of the pipe by the Owner. All tests shall be performed by the Contractor under supervision of the Owner.
3. While the pipe is being laid between adjoining structures in each straight or working section of the drain, light from the finished or other end of the section 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 drain. The test shall be applied for each working section after the drain is complete in all respects before it is accepted
4. Pipe sizes greater than 36 inch diameter or equivalent diameter shall be entered and examined while smaller diameter or equivalent diameter pipe shall be visually inspected from each end of the pipe section. Pipe sections shall be visually inspected for debris and obstructions, structural cracks and defects, joint tolerances, joint workmanship, and satisfactory connection to drainage structures.

3.03 CONCRETE ENCASEMENT

- A. Concrete encasement for pipes is to be used at the locations shown on the Plans or as directed by the Owner. Concrete used for encasement shall be Class “C” Concrete.
- B. All pipe requiring encasement shall be blocked at each joint using masonry supports of a minimum size sufficient to provide the required clearance and to prevent displacement during placing concrete.
- C. All concrete shall be placed, cured and protected in accordance with Specification Section 03310, “Concrete Structures”. Concrete shall be placed on either side of the pipe in approximately equal amounts to prevent movement of the pipe. Pipe alignment shall be inspected immediately following concrete placement, and any misalignment caused by the placement of concrete shall be corrected prior to the concrete’s initial set. Concrete shall be protected against water flowing over the concrete until completely cured.
- D. Concrete encasement is to be rectangular in section with a minimum concrete thickness of 6 inches between the outside edge of pipe and the outside of encasement at the closest point unless shown otherwise on the Plans. Encasement around pipe joints shall extend a minimum of 2 feet either side of the joint as measured along the centerline of the pipe. Encasement shall be reinforced if specified on the Plans or in the Special Instructions.

3.04 TUNNELING AND JACKING

A. General

1. Storm drain shall be constructed by tunneling or jacking only at those locations and within limits shown on the Plans or directed by the Owner.
2. Where pipe is required to be installed under railroads, highways, streets, or other facilities by tunneling or jacking, construction shall be made in such a manner that will not interfere with the operation of the railroad, street, highway, or other facility, and shall not weaken or damage any embankment or structure.

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02632 STORM DRAIN PIPE INSTALLATION

3. If any storm drain, sewer, or utility above or adjacent to the tunnel is endangered or has been damaged because of the tunneling or jacking operations or movements of earth, the owner of same shall be notified immediately and shall be given access to the work for repair. The Contractor shall repair, at his expense, any storm drain or sewer damaged during the tunneling or jacking operation. If any public or private property is endangered, or has been damaged, it shall be repaired at the Contractor's expense. All cost and expense to the Contractor of carrying out the above requirements shall be incidental to the work.

4. The jacking pit shall be of sufficient size to provide ample working space for the jacking equipment, reaction blocks, bracing, liner plates, spoil removal and 1 or 2 sections of pipe. Provisions shall be made for the erection of guide rails in the bottom of the pit where applicable. If drainage is to be discharged from the jacking pit, a collection sump shall be provided. Wherever end trenches are cut in the sides of the embankment or beyond it, such work shall be sheeted securely and braced in a manner satisfactory to prevent earth caving.

5. The Contractor shall furnish and operate all necessary pumping equipment of ample capacity and make all necessary provisions to keep tunnels and shafts free of water during construction and to satisfactorily dispose of such water. During placing of concrete, drainage and pumping shall be so arranged that concrete is placed in the dry and that no water will flow over the concrete until it has set and will not be damaged and not sooner than two hours after initial set. The Contractor shall have on hand at all times sufficient equipment in good working order for all ordinary emergencies that are likely to arise.

B. Tunneling.

1. The Contractor shall carry out the work of tunneling and supporting the tunnel face, roof, walls, and floor so that there will be no fall or flow or caving or heaving of earth or other materials into the tunnel excavation. If there should be any fall or movement of earth into the tunnel at any time, the Contractor shall proceed with the work with all necessary precautions and in such a manner as will insure the safety of life and of all sewers, utilities and public and private property above and adjacent to the tunnel. The Contractor shall comply with all applicable OSHA regulations as stipulated in Part 11 – General Conditions during tunnel construction work.

2. The Contractor shall furnish, place, and maintain all sheeting, bracing, lining or casing required to support the tunnel floor, roof, sides, and face until the pipe and its bedding, jointing, encasement, and backfilling have been completed. All liners shall remain in place. Care shall be used in trimming the surfaces of the excavated section and in placing the liners or sheeting and bracing so that the required minimum clearance between the outside of the pipe and the final position of the liners, sheeting and bracing in the tunnel will be attained without any deviation in drain alignment. Sheeting or lining must be placed and held tightly against the trimmed earth surface of the excavated section so that will be no voids between the earth and the lining or sheeting placed against it. No part of the lining, bracing, or flanges of steel liner plates shall project closer to the outside of the pipe or pipe bells than the clearance limits shown on the Plans, or a minimum of two inches, if not shown on the Plans. If timber is used for lining and bracing instead of steel liner plates, invert struts shall be placed at the required intervals but in such manner that the pipe and its bedding will be supported entirely by the original earth floor of the tunnel and not on timber lining or bracing. All timbers, when placed for the support of the roof and sides of the tunnel, shall be properly fitted and wedged in place. Timber sets in tunnels shall be abutting. All void spaces in back of timbers shall be filled with blocking or other suitable material.

3. Timbering shall be so designed and placed that there will be no space or pockets that cannot be packed and filled. All excavated material not required for backfilling abandoned shafts shall be removed from the site and disposed of by the Contractor at his expense.

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02632 STORM DRAIN PIPE INSTALLATION

4. Shafts shall be constructed at the location shown on the Plans. Temporary construction shafts shall be of adequate size and properly constructed and equipped to meet all requirements of safety to personnel and to the work. All shafts shall be barricaded and properly guarded from the beginning of the excavation until the shaft is completely backfilled.
5. Provision shall be made at all shafts so that plumb lines suspended on the centerline of the drain at each end of the shaft will hang freely from the surface.
6. A substantially constructed ladder shall be provided in each shaft and shall be kept in safe good repair, clean, and clear of debris.
7. Cavities or spaces between the actual surfaces of excavation and the tunnel liner plates or sheeting, whether from avoidable or unavoidable causes, shall be completely filled with a uniform sand cement grout, consisting of 1 part portland cement and maximum 5 parts sand and the minimum amount of water necessary for proper placing, placed under pressure through grout-hold nipples in the steel liner plates or grout holes in sheeting. The grout holes shall be so located and the grout be placed in such sequence as to insure the complete filling of all cavities and spaces and of carrying loads uniformly from the undisturbed material to the tunnel lining or sheeting.
8. All pipe used in tunnels shall be reinforced concrete pipe with rubber O-ring gasket joints and shall be the strength class or classes required by the Plans.
9. After the tunnel section is excavated, lined, and braced, the pipe shall be placed on and supported by steel rails or other approved supports. The supporting system shall assure line and grade and shall allow space below the pipe for concrete grout. Care shall be used to avoid damage to the pipe or to the liner plates. Any such damage shall be replaced when so directed by the Owner.
10. The space between the pipe and the sides and roof of the tunnel shall be backfilled with a mixture of sand and portland cement, mixed in the proportions of 1 part cement to 7 parts sand by volume and a minimum amount of water necessary for proper placing whether placed under pressure or by hand. The cement grout shall be uniformly placed and compacted to fill all spaces between the outside of the pipe and inside surface of the sheeting or lining.
11. Temporary shafts shall be completely abandoned. Unless otherwise specified in the Plans or Contract Documents, all sheeting, bracing, and similar items may be removed or left in place at the Contractor's option. No payment will be made for such items left in place at the Contractor's option. If the Plans required leaving the sheeting, bracing, and similar materials, in place, payment will be made as provided in Specification Section 02631 Paragraph 5.02.

C. Jacking

1. Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided by the Contractor. In operating jacks, even pressure shall be applied to all jacks used. A suitable jacking head, usually of timber, and suitable bracing between jacks and jacking head shall be provided so that pressure will be applied to the pipe uniformly around the ring of the pipe. A suitable jacking frame or back stop capable of resisting the jacking forces shall be provided. The pipe to be jacked shall be set on guides, properly braced together to support the section of the pipe and to direct it in the proper line and grade. For pipes greater than 54 inch diameter or equivalent diameter the rails shall be set in a concrete slab. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe. If the Contractor desires, he may use a cutting edge of steel plate around the head end of the

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02632 STORM DRAIN PIPE INSTALLATION

pipe extending a short distance beyond the end of the pipe with inside angles or lugs to keep the cutting edge from slipping back onto pipe.

2. The Contractor shall furnish for the Owner's review, a plan showing his proposed method of handling, including the design for the jacking head, jacking support or back stop, arrangement and position of jacks, pipe guides, and similar items complete in assembled position. The review of this plan by the Owner will not relieve the Contractor from his responsibility to obtain the specified results.

3. Preferably, the pipe shall be jacked from the low or downstream end. Lateral or vertical variation in the final position of the pipe from the line and grade established by the Owner will be permitted only to the extent of 1 inch in 10 feet, provided that such variation shall be regular and only in one direction and that the final grade of flow line shall be in the direction indicated on the Plans. Manholes at the ends of a section of jacked pipe shall not be constructed until the jacked section is completed, in order to allow corrections for deviations in the line or grade of the jacked section.

4. All pipe used in jacking shall be tongue and groove type reinforced concrete pipe with rubber O-ring gasket joints and shall be the strength class or classes required by the Plans or Contract Documents. Any pipe damaged in jacking operations shall be removed and replaced by the Contractor at his own expense. A cushion material shall be placed between the butt ends of each pipe section adequate to uniformly distribute the jacking forces around the entire periphery of the pipe. Cushion material shall allow proper positioning of the O-ring gasket upon completion of the jacking operation.

5. Embankment material shall be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through the embankment with jacks, into the space thus provided. The excavation for the underside of the pipe, for at least one-third of the circumference of the pipe, shall conform to the contour and grade of the pipe. A clearance of not more than 2 inches may be provided for the upper half of the pipe. This clearance is to be tapered off to zero at the point where the excavation conforms to the contour of the pipe. The distance that the excavation shall extend beyond the end of the pipe depends on the character of the material, but it shall not exceed 2 feet in any case. This distance shall be decreased on instructions from the Owner if the character of the material being excavated makes it desirable to keep the advance excavation closer to the end of the pipe.

6. When jacking of pipe is begun, the operation shall be carried on without interruption, until completion, to prevent the pipe from becoming firmly set in the embankment.

7. The pits or trenches excavated to facilitate jacking operations shall be backfilled immediately after the jacking of the pipe has been completed in accordance with Specification Section 02631 Paragraph 3.04.

D. Pipe Drains In Jacked Liner.

1. When permitted as an alternate method of construction by the Plans or Contract Documents, or when permitted by the owner upon written request of the Contractor as an alternate to jacking without a liner or tunneling, a storm drain may be installed by jacking a pipe as a liner and inserting a carrier pipe of required size, type and class. When planning to use jacking for liners, the Contractor shall state in writing the kind, type and strength of liner, the type of joint proposed and the method of operation. Approval in writing by the Owner shall be obtained in advance of starting the work. In any case, the Contractor shall retain full responsibility for the adequacy of his jacking operation, equipment, and complete work.

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02632 STORM DRAIN PIPE INSTALLATION

PART 4 – MEASUREMENT

4.01 STORM DRAIN PIPE.

Storm drain pipe length will be measured per linear foot along the centerline of the pipe from inside face to inside face of drainage structures or to plain ends of pipe for the various sizes, types, classes, wall thicknesses, coatings or linings. Beveled end (radial) pipe length will be measured per linear foot along a centerline of the required radius and deflection angle. Storm drain pipe depth will be measured as the vertical depth between pipe flowline and natural ground surface along the pipe centerline for the various depth classifications specified in the Proposal. For depth measurement and classification purposes, the natural ground surface is defined as the subgrade template elevation for streets or other graded areas under which drains are placed or the actual natural ground surface, whichever is at the lower elevation.

4.02 PLAIN CONCRETE FOR PIPE BEDDING AND ENCASEMENT.

Plain concrete for pipe bedding and encasement at the locations shown on the Plans or directed by the Owner will be measured per cubic yard, complete in place.

4.03 REINFORCED CONCRETE FOR PIPE BEDDING AND ENCASEMENT.

Reinforced concrete for pipe bedding and encasement at the locations shown on the Plans or directed by the Owner will be measured per cubic yard, complete in place.

4.04 STORM DRAIN IN TUNNEL OR JACKED LINER.

Storm drain in tunnel or jacked liner will be measured per linear foot along the centerline length unless directed otherwise by the Owner in writing.

4.05 JACKED STORM DRAIN.

Jacked storm drain will be measured per linear foot along the centerline length unless directed otherwise by the Owner in writing.

4.06 REMOVAL OF EXISTING PIPE.

Removal of existing pipe will be measured per linear foot along the centerline of the pipe to be removed for various sizes or types. No measurement of existing pipe removal within the limits of excavation for new storm drain will be made.

PART 5 – PAYMENT

5.01 STORM DRAIN PIPE.

The accepted quantities of storm drain pipe will be paid for at the contract unit price per linear foot furnished and laid for the various sizes, types, classes, wall thicknesses, coatings, linings, and depths which price will be full compensation for materials and materials' testing, excavation, special protection, protection of existing utilities, specified bedding, laying, jointing, cleaning and inspection, fittings, connection to existing structures, removal and/or plugging of abandoned pipe within the limits of excavation and backfilling.

5.02 PLAIN CONCRETE FOR PIPE BEDDING AND ENCASEMENT.

The accepted quantities of plain concrete for pipe bedding and encasement will be paid for at the contract unit price per cubic yard, complete in place which price will be full compensation for materials and materials' testing, pipe support, formwork, removal of forms, and placement, curing and protection of concrete.

5.03 REINFORCED CONCRETE FOR PIPE BEDDING AND ENCASEMENT.

The accepted quantities of reinforced concrete for pipe bedding and encasement will be paid for at the contract unit price per cubic yard, complete in place which price will be full compensation for materials and materials' testing, pipe support, formwork, reinforcement, removal of forms, and placement, curing and protection of concrete.

5.04 STORM DRAIN IN TUNNEL OR JACKED LINER.

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02632 STORM DRAIN PIPE INSTALLATION

The accepted quantities of storm drain in tunnel or jacked liner will be paid for at the contract unit price per linear foot furnished and laid for the various sizes, which price will be full compensation for materials and materials' testing, pit excavation, sheathing, timber bracing, liner, excavation, temporary shafts, pumping, grouting, pipe, laying pipe, making pipe joints, cleaning and inspection, and backfilling of pits and shafts.

5.05 JACKED STORM DRAIN.

The accepted quantities of jacked storm drain will be paid for at the contract unit price per linear foot furnished and laid for the various sizes; which price will be full compensation for materials and materials' testing, pit excavation, jacking equipment, and concrete slab foundation, jacking back stop excavation, temporary shafts, pumping, pipe, laying pipe, making pipe joint cushions, cleaning and inspection, and backfilling of pits and shafts.

5.06 REMOVAL OF EXISTING PIPE.

The accepted quantities of existing pipe removal shall be paid for at the contract unit price per linear foot for various pipe sizes and types which price will be full compensation for excavation, special protection, protection of existing utilities, pipe removal, salvage or disposal, backfilling and site restoration.

5.07.1 PAYMENT WILL BE MADE UNDER:

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
02632-01	Storm Drain Pipe	Linear Foot
02632-01.01.____	__" Plain Concrete Pipe, Class III, __ Depth	Linear Foot
02632-01.02.____	__" Reinforced Concrete Pipe, Class III, __ Depth	Linear Foot
02632-01.03.____	__" Reinforced Concrete Pipe, Class IV, __ Depth	Linear Foot
02632-01.04.____	__" Reinforced Concrete Pipe, Class V, __ Depth	Linear Foot
02632-01.05.____	__" Reinforced Concrete Pipe (Radial) Class III __ Depth	Linear Foot
02632-01.06.____.____	__" x __" Horizontal Elliptical Reinforced Concrete Pipe, Class HE-III, __ Depth	Linear Foot
02632-01.07.____.____	__" x __" Horizontal Elliptical Reinforced Concrete Pipe, Class HE-IV, __ Depth	Linear Foot
02632-01.08.____.____	__" x __" Vertical Elliptical Reinforced Concrete Pipe, Class VE-III, __ Depth	Linear Foot
02632-01.09.____.____	__" x __" Vertical Elliptical Reinforced Concrete Pipe, Class VE-IV, __ Depth	Linear Foot
02632-01.11.____.____	__" x __" Arch Reinforced Concrete Pipe, Class A-III, __ Depth	Linear Foot
02632-01.12.____.____	__" x __" Arch Reinforced Concrete Pipe, Class A-IV, __ Depth	Linear Foot
02632-01.20.____	__" Corrugated Steel Pipe, .034" Thick, Coated And Paved, __ Depth	Linear Foot
02632-01.21.____	__" Corrugated Steel Pipe, .040" Thick, Coated And Paved, __ Depth	Linear Foot
02632-01.22.____	__" Corrugated Steel Pipe, .052" Thick, Coated And Paved, __ Depth	Linear Foot
02632-01.60.____	__" Ductile Iron Pipe, Class 50, __ Depth	Linear Foot
02632-01.65.____	__" Vitrified Clay Pipe, Extra Strength, __ Depth	Linear Foot
02632-02	Plain Concrete For Pipe Bedding And Encasement	Cubic Yard

**CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02632 STORM DRAIN PIPE INSTALLATION**

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
02632-03	Reinforced Concrete For Pipe Bedding And Encasement	Cubic Yard
02632-04 02632-04.____	Storm Drain In Tunnel Or Jacked Liner (Description)	Linear Foot
02632-05 02632-05.____	Jacked Storm Drain (Description)	Linear Foot
02632-06.____	Removal Of Existing ____” Pipe	Linear Foot

Examples of Pay Item Numbering System for Storm Drain Pipes

02632-01.02.12.01	Pay Item Number
02632	Section of Specification
-01	last digit(s) of applicable paragraphs for measurement and payment
.02	Type of Pipe; e.g., reinforced concrete pipe, Class II
.12	Size of Pipe; e.g., 12” diameter
.01	Depth of Pipe; e.g., 0’ – 6’ depth

END OF SECTION 02632