

CITY OF ABILENE**ITEM 464****REINFORCED CONCRETE PIPE****464.1 DESCRIPTION.**

This Item shall govern for furnishing and installing all concrete pipe and materials and for constructing precast concrete pipe culverts or precast concrete sewer mains, laterals, stubs and inlet leads. The pipes shall be of the sizes, strengths and dimensions shown on the Plans and shall include all connections to new or existing pipes, sewers, manholes, inlets, headwalls and other appurtenances and jointing materials as may be required to complete the work.

464.2 MATERIALS.

(1) General. Except as modified herein, precast reinforced concrete pipe shall conform to the design shown on the Plans and to ASTM C76 or C655 for circular pipe; ASTM C506 for arch pipe or ASTM C507 for horizontal elliptical pipe.

All present concrete pipes shall be machine made or cast by a process which will provide for uniform placement of the concrete in the form and compaction by mechanical devices which will assure a dense concrete. Concrete shall be mixed in a central batch Plant or other approved batching facility from which the quality and uniformity of the concrete can be assured. Transit mixed concrete will not be acceptable for use in precast concrete pipe.

Unless otherwise shown on the Plans, not more than two (2) holes may be placed in the top section of precast pipe for lifting and placing. The holes may be cast, cut, or drilled in the wall of the pipe. The holes shall not exceed three (3) inches in diameter at the inside surface of the pipe wall. Not more than one (1) longitudinal wire or two (2) circumferential wires may be cut per layer of reinforcing steel when locating lift holes in the pipe wall. After the pipe is in place, lift holes shall be filled with concrete or mortar or precast concrete plugs to the satisfaction of the Engineer.

The Contractor has the option of using Portland Cement or Portland Cement plus fly ash. When fly ash is used, then "cement" shall also be defined as "cement plus fly ash". "Cement plus fly ash" shall be composed of Portland Cement of the type specified and 20 to 35 percent fly ash by absolute volume. Type B fly ash shall not be used when Type II cement is shown on the Plans. When Portland Cement is partially replaced, blended or otherwise modified by a pozzolan, the pozzolan is defined and limited to fly ash conforming to TxDOT Departmental Materials Specification D-9-8900, "Fly Ash".

Copies of TxDOT Departmental Materials Specifications are available from the TxDOT, Division of Materials and Tests, 125 East 11th St., Austin, Texas 78701-2483.

(2) Design. Circular pipe shall be of the class of D-load shown on the Plans. Regardless of the design shown, the Contractor may furnish pipe to either ASTM C76 or ASTM C655 specifications.

Table C outlines the class and D-load equivalents. For concrete pipe arch or elliptical pipe, the minimum design shall conform to Table A or B.

Table A * Arch Pipe				Table B * Horizontal Elliptical Pipe			
{PRIVATE }Design Size	Equiv. Dia. In.	Rise In.	Span In.	{PRIVATE }Design Size	Equiv. Dia. In.	Rise In.	Span In.
1	18	13 1/2	22	1	18	14	23
2	21	15 1/2	26	2	24	19	30
3	24	18	28 1/2	3	27	22	34
4	30	22 1/2	36 1/4	4	30	24	38
5	36	26 5/8	43 3/4	5	33	27	42
6	42	31 5/6	51 1/8	6	36	29*	45
7	48	36	58 1/2	7	39	32	49
8	54	40	65	8	42	34	53
9	60	45	73	9	48	38	60
10	72	54	88	10	54	43	68

*Minimum height of cover required is one (1) foot.
 *Maximum height of cover is eight (8) feet.

TABLE C
CIRCULAR PIPE
(CLASS, D-LOAD EQUIVALENTS)

{PRIVATE }C76	C655
Class III	800D-LOAD
Class IV Class I	1000D-LOAD
Class II	1350D-LOAD
	2000D-LOAD
Class V	3000D-LOAD

Reinforced concrete pipe for jacking, boring or tunneling shall meet the requirements of the pertinent ASTM specification with the following additional requirements.

The pipe shall have circular reinforcement and for 30 inch and larger diameters shall have an additional layer of Class III reinforcement, 12 inches long, extending into both the tongue and groove of the joint to within three-fourths (3/4) inch of the end of the tongue and the groove. The minimum wall thickness shall be wall "B" for the diameter specified, unless special designs are required. The minimum concrete compressive strength for jacking and boring pipe shall be 5000 psi. Variations in the laying length of opposite sides shall not exceed three-eighths (3/8) inch for pipe diameters 24 inches through 60 inches and one-half (1/2) inch for pipe diameters 66 inches and larger. The maximum joint taper shall be 7° degrees for tongue and groove pipe and 2° degrees for O-ring gasket pipe. Pipe manufactured to these additional requirements shall be marked to identify pipe for jacking and boring.

The Plans will provide a summary indicating the locations and length for all pipe. In addition, the diameter, required D-load and/or class for full circle pipe, and/or the design size for pipe arch or elliptical pipe will also be shown.

(3) Physical Test Requirements. The acceptability of the pipe shall be determined by the results of the physical tests outlined herein; by appropriate material tests required in ASTM C76, C506, C507, OR C655; by absorption tests on selected samples from the wall of the pipe; and by inspection of the finished pipe to determine its conformance with the required design and its freedom from defects. Three (3) Edge Bearing tests shall be performed on one (1) pipe for each 100 pipe or fraction thereof of each design or shape, size, class or D-load for the load to produce a 0.01 inch crack and, at the discretion of the Engineer, the pipe may be tested to ultimate load.

As an alternate to the Three-Edge Bearing test, concrete pipe 60 inches in diameter and larger may be accepted on the basis of compressive strength of cores cut from the wall of the pipe. The manufacturer shall furnish facilities and personnel for taking the cores and determining the compressive strength of the samples. Three-Edge Bearing tests and core tests shall be in accordance with ASTM C497.

The manufacturer shall plug and seal core holes in the pipe wall, after testing, in a manner satisfactory to the Engineer.

(4) Marking. The following information shall be clearly marked on each section of pipe:

- (a) The class or D-load of pipe.
- (b) The date of manufacture.
- (c) The name or trademark of the manufacturer.
- (d) One end of each section of pipe with elliptical reinforcement shall be clearly marked during the process of manufacture or immediately thereafter on the inside and the outside of opposite walls to show the location of the "top" or "bottom" of the pipe as it should be installed, unless the external shape of the pipe is such that the correct position of the top and bottom is obvious. Marking shall be indented on the pipe section or painted thereon with waterproof paint.
- (e) Pipe for jacking and boring shall be identified for the intended use.

(5) Inspection. The quality of materials, the process of manufacture, and the finished pipe shall be subject to inspection and approval by the Engineer at the pipe manufacturing Plant. In addition, the finished pipe shall be subject to further inspection by the Engineer at the project site prior to and during installation.

(6) Causes for Rejection. Pipe shall be subject to rejection for failure to conform to any of the specification requirements. Individual sections of pipe may be rejected because of any of the following:

- (a) Fractures or cracks passing through the shell, except for a single end crack that does not exceed the depth of the joint.
- (b) Defects that indicate imperfect proportioning, mixing and molding.
- (c) Surface defects indicating honeycombed or open texture.
- (d) Damaged ends, where such damage would prevent making a satisfactory joint.

- (e) Any continuous crack having a surface width of 0.01 inch or more and extending for a length of 12 inches or more, regardless of position in the wall of the pipe.

(7) Repairs. Pipe may be repaired if necessary, because of occasional imperfections in manufacture of accidental injury during handling and will be acceptable if, in the opinion of the Engineer, the repairs are sound, properly finished and cured, and the repaired pipe conforms to the requirements of the specifications.

(8) Rejections. All rejected pipe will be plainly marked by the Engineer by painting colored spots over the Division of Materials and Tests monogram on the inside wall of the pipe and on the top outside wall of the pipe. The painted spots shall be sufficient to identify the rejected pipe but no larger than four (4) inches in diameter. Rejected pipe shall not be defaced in any other manner. The contractor shall remove the rejected pipe from the project and replace with pipe meeting the requirements of this Item.

(9) Jointing Materials. Unless otherwise specified on the Plans the Contractor shall have the option of making the joints using any of the materials described herein. For all jointing materials except mortar, the Contractor shall furnish the Engineer the Manufacturer's Certificate of Compliance.

- (a) **Mortar.** Mortar for joints shall be in accordance with the section, "Jointing", of this Item.

- (b) **Cold Applied, Plastic Asphalt Sewer Joint Compound.** This material shall consist of natural and/or processed asphalt base, suitable volatile solvents and inert filler. The consistency is to be such that the ends of the pipe can be coated with a layer of the compound up to one-half (1/2) inch thick by means of a trowel. The joint compound shall cure to a firm, stiff plastic condition after application. The material shall be of a uniform mixture and any small separation occurring in the container shall be stirred to a uniform mix before use.

The material shall meet the following requirements when tested in accordance with Test Method Tex-526-C:

Asphalt Base, 100% - % Volatiles - % Ash, % by weight	28-45
Volatiles, 212 F Evaporation, 24 h, % by weight	10-26
Mineral Matter, determined as Ash, % by weight	30-55
Consistency, Cone Penetration, 150 q, 5 sec, 77 F	150-275

- (c) **Rubber Gaskets.** These gaskets shall conform to ASTM C361 or C443. The design of the joints and permissible variations in dimensions shall be in accordance with ASTM C443. The Contractor shall furnish the Engineer the Manufacturer's Certificate of Analysis.

- (d) **Cold Applied Preformed Plastic Gaskets.** Preformed plastic gaskets shall be suitable for sealing joints of tongue and groove concrete pipe. The gasket sealing the joint shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler and shall contain no solvents, irritating fumes or obnoxious odors. The gasket joint sealer shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength, and shall be supplied in extruded rope-form of suitable cross-section. The size of the plastic gasket joint sealer shall not be in accordance with the manufacturer's recommendations and be of sufficient size to properly seal the joint. The plastic gasket joint sealer shall be so constructed as to provide evidence of proper installation either by means of "squeeze-out" of the gasket material on the inside or outside around the complete pipe joint circumference or by means of tabs, projections or other such indicators placed at established intervals around the circumference of the pipe joint. Plastic gasket joint sealers shall be Type 1 or 2. Type 1 gaskets

shall meet the “squeeze-out” requirements and Type 2 gaskets shall meet the requirements for tabs, projections or other indicators. The gasket joint sealer shall be protected by a suitable wrapper designed that when removed, the jointing material maintains integrity.

The chemical composition of the gasket joint sealing compound for Type 1 and 2, as shipped, shall meet the following requirements:

COMPOSITION	TEST METHOD	ANALYSIS
Bitumen, Petroleum Plastic Content, % by weight	ASTM D4	50-70
Ash-Inert Mineral Matter, % by weight	Tex-526-C	30-50
Volatile Matter, 325 F, % by weight	Tex-506-C	2.0 max.

The gasket joint sealing compound when immersed for 30-days at ambient room temperature separately in five (5) percent solution of caustic potash; a five(5) percent solution of hydrochloric acid; a five (5) percent solution of sulfuric acid; and a saturated H₂S solution, shall show no visible deterioration.

The physical properties of the gasket joint sealing compound as shipped shall meet the following requirements:

{PRIVATE }PROPERTY	TEST METHOD	REQUIREMENT Type 1	REQUIREMENT Type 2
Ductility @ 77 F (cm), min.	Tex-503-C	5.0	5.0
Softening Point, F	Tex-505-C	275	275
Penetration			
32F (300g) 60 sec., min	Tex-502-C	--	65
77F (150g) 5 sec.	Tex-502-C	50-100	50-100

464.3 CONSTRUCTION METHODS.

The location of private driveway and side road pipe shall be constructed at locations shown on the Plans or as directed by the Engineer.

Reinforced concrete pipe culverts and sewers shall be constructed in accordance with the Plans and requirements of this Item.

(1) Excavation. All excavation shall be in accordance with the requirements of Item 400, “Excavation and Backfill for Structures”, except where tunneling or jacking methods are shown on the Plans or permitted by the Engineer.

(2) Shaping and Bedding. Shaping and bedding shall be in accordance with Item 400, “Excavation and Backfill for Structures”.

(3) Laying Pipe. Unless otherwise authorized by the Engineer, the laying of pipe on the bedding shall be started at the outlet end with the spigot or tongue end point downstream and shall proceed toward the inlet end with the abutting sections properly matched, true to the established lines and grades. Where bell and spigot pipe are used, cross trenches shall be cut in the foundation to allow the

barrel of the pipe to rest firmly upon the bedding. These cross trenches shall be not more than two (2) inches larger than the bell ends of the pipe. Proper equipment shall be provided for hoisting and lowering the sections of pipe into the trench without disturbing the bedding and the sides of the trench. The ends of the pipe shall be carefully cleaned before the pipe is placed. As each length of pipe is laid, the mouth of the pipe shall be protected to prevent the entrance of earth or bedding material. The pipe shall be fitted and matched so that when laid in the bed the pipe shall form a smooth uniform conduit. When elliptical pipe with circular reinforcing or circular pipe with elliptical reinforcing is used, the pipe shall be laid in the trench in such position that the markings "Top" or "Bottom", shall not be more than five(5) degrees from the vertical plane through the longitudinal axis of the pipe.

Multiple installations of reinforced concrete pipe shall be laid with the centerlines of individual barrels parallel. Unless otherwise shown on the Plans, the following clear distances between outer surfaces of adjacent pipes shall be used.

Diameter 18"	24"	30"	36"	42"	48"	54"	60 to 84"
Clear 0'-9" Distance between Pipes	0'-11"	1' -1"	1'-3"	1'-5"	1'-7"	1'-11"	2'-0"

(4) Jointing.

(a) Joints sealed with Portland Cement mortar shall be made as follows:

Mortar shall consist of one part cement, two (2) parts sand and sufficient water to make a plastic mix. The pipe ends shall be cleaned and wetted before making the joint. The lower half of the bell or groove and the upper half of the tongue or spigot shall be plastered with mortar. After the pipes are tightly jointed, mortar shall be packed into the joint from both inside and outside the pipe. The inside shall be finished smooth and flush with adjacent joints of pipe. Over the joint outside the pipe, a bead shall be formed at least one (1) inch on either side of the joint and of semicircular cross section for tongue and groove joints, but for bell and spigot joints, the mortar shall form a 45° fillet between the outer edge of the bell and the spigot. Mortar joints shall be cured by keeping the joints wet for at least 48 hours or until the backfill has been completed, whichever comes first. No jointing shall be done when the atmospheric temperature is at or below 40° F. Mortared joints shall be protected against freezing by backfilling or other approved methods for at least 24 hours.

No mortar banding on the outside of pipe will be required for driveway culverts.

At the Contractor's option, and with the approval of the Engineer, pipes which are large enough for a man to enter may be furnished with the groove not less than one-half (1/2) of an inch and not more than three-fourths (3/4) of an inch longer than the tongue. Such pipe may be laid and backfilled without mortar joints. Care shall be exercised to avoid displacing the joints during the backfilling operations. After the backfilling has been completed, the space between the end of the tongue and the groove on the interior of the pipe shall be cleaned of all foreign material, thoroughly wetted and filled with mortar around the entire circumference of the pipe and finished flush.

The contractor shall make available for the use of the Engineer an appropriate rolling device similar to an automobile mechanic's "Creeper" for conveyance through small size pipe structures.

Mortar joints will be required for irrigation wells, vents and similar vertical structures.

- (b) Joints using Cold Applied Plastic Asphalt Sewer Joint Compound shall be made as follows:

Both ends of the pipes shall be clean and dry. A one-half (1/2) inch thick layer of the compound shall be troweled or otherwise placed in the groove end of the pipe covering not less than two-thirds (2/3) of the joint face around the entire circumference. Next, the tongue end of the next pipe shall be shoved home with sufficient pressure to make a tight joint. After the joint is made any excess mastic projecting into the pipe shall be removed. Backfilling of pipe laid with asphalt mastic joints may proceed as soon as the joint has been inspected and approved by the Engineer. Special precautions shall be taken in placing and compacting backfill to avoid damage to the joints.

- (c) Joints using Rubber Gaskets shall be made as follows:

Where rubber gasket pipe joints are required by the Plans the joint assembly shall be made according to the recommendations of the gasket manufacturer. Watertight joints will be required when using rubber gaskets. Backfilling may begin when approved by the Engineer.

- (d) Joints using Cold Applied Preformed Plastic Gaskets shall be made as follows:

Before laying the pipe in the trench, the plastic gasket shall be attached around the tongue or groove near the shoulder or hub of each joint in accordance with the gasket manufacturer's recommendations. The protective wrapper shall be removed and the gasket pressed firmly to the clean, dry surface of the pipe, as recommended by the manufacturer. The joint sealer must be placed in such a manner that no dirt or other deleterious materials will come in contact with the joint sealing material.

After the tongue is correctly aligned with the flare of the groove, the wrapper or wrappers on the gasket shall be removed and the pipe shall be pulled or pushed home with sufficient force to properly seal the joint. Any joint material pushed out into the interior of the pipe that would tend to obstruct the flow shall be removed. (Pipe shall be pulled home in a straight line with all parts of the pipe on line and grade at all times.) Backfilling of pipe laid with plastic gasket joints may proceed as soon as the joint has been inspected and approved by the Engineer. Special precautions shall be taken in placing and compacting backfill to avoid damage to the joints.

When the atmospheric temperature is below 60° F, plastic joint seal gaskets shall either be stored in an area warmed to above 70° F, or artificially warmed to this temperature in a manner satisfactory to the Engineer. Gaskets shall then be applied to pipe joints immediately prior to placing pipe in trench, followed by connection to previously laid pipe.

- (5) **Connections and Stub Ends.** Connections of concrete pipe to existing pipes, pipe sewers or sewer appurtenances shall be as shown on the Plan.

The bottom of existing structures shall be mortared or concreted if necessary to eliminate any drainage pockets created by the connections. Any damage to the existing structure resulting from making the connection shall be repaired by the Contractor, to the satisfaction of the Engineer, at the Contractor's expense.

When concrete pipe is to be joined with existing aluminum pipe, portions of the aluminum pipe that are to be in contact with the concrete pipe, shall be insulated with a coating of bituminous material meeting the requirements of Article 460.7. The coating shall extend to a minimum distance of one (1) foot beyond the area of contact.

Unless otherwise shown in the Plans, connections between concrete pipe and corrugated metal pipe shall be made with a suitable concrete collar having minimum thickness of four (4) inches.

Stub ends, for connections to future work not shown on the Plans, shall be finished by installing watertight plugs into the free end of the pipe.

(6) Backfilling. After the pipe has been placed, bedded and jointed as specified, filling and/or backfilling shall be done in accordance with the applicable requirements of Item 400, "Excavation and Backfill for Structures". When mortar joints are specified, no fill or backfill shall be placed until the jointing material has been cured for at least six (6) hours. Special precautions shall be taken in placing and compacting the backfill to avoid any movement of the pipe or damage to the joints. For all pipe structures where joints consist of materials other than mortar, immediate backfilling will be permitted.

(7) Reuse of Appurtenances. When existing appurtenances are specified on the Plans for reuse, the portion to be reused shall be severed from the culvert and moved to the new position previously prepared by hoisting with a crane, rolling, or other approved methods. Connections shall conform to the requirements for joining sections of pipes, as designated herein or as shown on the Plans. Any portion of the headwalls or pipe attached to the appurtenance damaged during the moving operations by the Contractor shall be restored to its original condition at the Contractor's expense. The Contractor may remove and dispose of the existing appurtenances and construct new appurtenances at his expense in accordance with the pertinent specifications and design shown on the Plans or as furnished by the Engineer.

(8) Protection of Pipe. Unless otherwise shown on the Plans or permitted in writing by the Engineer, no heavy earth moving equipment will be permitted to haul over the structure until a minimum of four (4) feet of permanent or temporary, compacted fill has been placed thereon. Pipe damaged by the Contractor's equipment shall be removed and replaced by the Contractor at the Contractor's expense.

464.4 MEASUREMENT.

This Item will be measured by the linear foot. Such measurement will be made between the ends of the pipe barrel along the flow line, exclusive of safety end treatments. Safety end treatments shall be measured in accordance with TxDOT Item 467, "Safety End Treatment". Where spurs or branches, or connections to existing pipe lines are involved, measurement of the spur or new connecting pipe will be made from the intersection of the flow line with the outside surface of the pipe into which it connects. Where inlets, headwalls, catch basins, manholes, junction chambers, or other structures are included in lines of pipe, that length of pipe tying into the structure wall will be included for measurement but no other portion of the structure length or width will be so included.

For multiple pipes, the measured length will be the sum of the lengths of the barrels measured as prescribed above.

This is a Plans quantity measurement Item and the quantity to be paid for will be that quantity shown in the proposal and on the "Estimate and Quantity" sheet of the contract Plans, except as may be modified by General Conditions of Contract Documents. If no adjustment of quantities is required, additional measurements or calculations will not be required.

464.5 PAYMENT.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Reinforced Concrete Pipe" and "Reinforced Concrete Pipe (Sewers)" of the size and D-Load or class specified; and "Reinforced Concrete Pipe (Arch)", "Reinforced Concrete Pipe (Elliptical)", "Reinforced Concrete Pipe (Arch) (Sewer)", and "Reinforced Concrete Pipe (Elliptical) (Sewer)" of the design specified. This price shall be full compensation for furnishing, hauling, placing and joining of pipes; for cutting of skews or slopes, for all connections to new or existing structures; for moving and reusing appurtenances where required; for removing and disposing of portions of existing structures as required; and for all labor, tools, equipment, and incidentals necessary to complete the work.

Excavation, bedding and backfill will be paid for in accordance with Item 400, "Excavation and Backfill for Structures".