

CITY OF ODESSA
STANDARD SPECIFICATIONS

ITEM 306
REINFORCED CONCRETE PIPE
FOR STORM SEWERS, CULVERTS AND DRAINS

306.1 DESCRIPTION

These specifications shall govern for the furnishing and placing of reinforced concrete pipe. The pipe shall be installed in accordance with the requirements of these specifications, to the line and grades shown on the plans, and shall be of the classes, sizes and dimensions shown thereon. The installation of pipe shall include all joints or connections to new or existing pipes, manholes, catch basins, headwalls, etc., as may be required to complete the work.

306.2 MATERIALS

A. General

Materials, manufacture and design of pipes shall be as prescribed in the standard specifications for “Reinforced Concrete Culvert Pipe”, A.S.T.M., Designation C-76, or “Reinforced Concrete Sewer Pipe”, A.S.T.M., Designation C-75, whichever is indicated by the plans and/or proposal form; and the additional provisions contained herein. All pipe 60" in diameter and under shall be machine made. Pipe over 60" in diameter shall preferably be machine made by other approved processes. The manufacturing equipment used shall provide uniform and continuous placement of the concrete in the forms. During placement the concrete shall be consolidated by mechanical devices, other than hand tamping, which will provide a dense concrete without disturbing or displacing the steel reinforcement. Culvert pipe shall be of two classed known respectively as “Standard Reinforced Concrete Pipe” and “Extra Strength Reinforced Concrete Pipe”. All pipe to be installed by jacking shall be tongue and groove pipe.

B. Physical Test Requirements

The acceptability of the pipe shall be determined by the results of the strength and absorption tests specified herein and by inspection to determine whether the pipe conforms to the specifications in design and freedom from defects. The requirements for tests and the methods of testing shall be as prescribed in the standard specifications for reinforced concrete culvert pipe, A.S.T.M., Designation C-76, and in the standard specifications for concrete sewer pipe, A.S.T.M., Designation C-75.

C. Sizes, Dimensions and Permissible Variations

Pipe of the internal diameters listed in Tables I and II, A.S.T.M., Designation C-76, and Table I, A.S.T.M., Designation C-75, shall be the standard sizes for this type of construction. Elliptical pipe the inside diameter of the minor axis shall be equal to the diameter of the corresponding size of circular pipe. Variations of the internal diameters shall not exceed one (1) percent for pipe of 36" or less size and shall not exceed 0.75 per cent for larger pipe. The shell thickness shall not be less than that intended in the design by more than five (5) per cent at any point. Variations of the position of the reinforcement shall not exceed one-half (½) inch for larger pipe; but the cover on the reinforcement shall not be less than three-fourths (¾) inch at any point.

D. Workmanship and Finish

Pipe shall be substantially free from fractures, large or deep cracks, laminations and surface roughness. The planes of the ends of pipe shall be perpendicular to the longitudinal axis. The ends of the pipe shall be of such design that when laid, the pipe sections will form a continuous conduit with a smooth and uniform interior surface.

E. Marking

The following shall be clearly stenciled on the pipe:

1. The pipe class (by an "S-C" for standard pipe and by an "X-C" for extra strength pipe when more than one class);
2. The date of manufacture;
3. The name or trademark of the manufacturer;
4. Elliptical pipe with circular reinforcing and circular pipe with elliptical reinforcing shall have the work "top" and "bottom" placed on the inside of the pipe at the correct place to indicate the proper position when laid;
5. Inspector's identification mark.

F. Minimum Age for Shipment

Pipe shall be considered ready for shipment they conform to the requirements, as indicated by the specified test.

G. Inspection

All materials, processes of manufacture and finished pipe shall be subject to inspection by the Engineer at the factory and/or trench or other point of delivery. The purposes of the inspection shall be to cull and reject pipes which fail to conform to the requirements

of the specifications. The manufacturer, when directed by the Engineer, shall have holes cut in such sections of the finished pipe (not exceeding one hole in every fifty sections delivered) as desired so that a proper inspection may be made of the quantity and placement of the reinforcement. In testing pipes for strength or absorption, inspection of the reinforcement shall be made on the pipe sections used for those tests and in no case shall the total number of pipes cut open for inspection exceed the number to which the Engineer is entitled under the provisions of Paragraph (B), Section 306.2 of these specifications.

H. Causes for Rejection

Pipe shall be subject to rejection on account of failure to meet any of the specification requirements or on account of any of the following:

1. Fractures or cracks passing through the shell, except that a single end-crack that does not exceed the depth of the joint shall not be cause for rejection. If a single end-crack that does not exceed the depth of the joint exists in more than ten (10) per cent of the pipe, however, the defective pipe shall be rejected.
2. Defects which indicate imperfect placing, mixing, and curing of the concrete.
3. Spalls deeper than one-half ($\frac{1}{2}$) the depth of the joint or extending more than four (4) inches around the circumference. If spalls not deeper than one-half ($\frac{1}{2}$) of the depth of the joint or extending not more than four (4) inches around the circumference existing in more than ten (10) per cent of the pipe, however, the defective pipe shall be rejected.
4. Exposure of the reinforcement when such exposure would indicated that the reinforcement is misplaced.
5. The complete absence of distinct web-like markings which in indicative of a possible deficiency of water in the concrete mix from the external surface of the pipe made by any process in which the forms are removed immediately after the concrete has been placed.

All rejected pipe shall be plainly marked by the Engineer and shall be replaced by the Contractor with pipes which meet the requirements of these specifications. such rejected pipes shall be immediately removed from the site of the work.

I. Jointing Materials

Mortar for joints shall be composed of sand, cement, and water conforming to the requirements for these materials as specified in the pertinent specifications for concrete construction included in the contract, except that the sand shall be properly graded for the required work.

306.3 CONSTRUCTION METHODS

Reinforced concrete pipe culverts and storm sewers shall be constructed from the specified materials in accordance with the following method and procedure.

A. Excavation

All excavation shall be in accordance with the requirements of Item 100 except where tunneling or jacking methods are shown on the plans or permitted by the Engineer. When pipes are laid in a trench, the trench when completed and shaped to receive the pipe, shall be of sufficient width to provide free working space for satisfactory bedding and jointing and thorough tamping of the backfill and bedding material under and around the pipe. The Contractor shall make such temporary provision as may be necessary to insure adequate drainage of the trench and bedding during the construction operation.

B. Laying Pipe

Unless otherwise authorized by the Engineer the laying of pipes on the prepared foundation shall be started at the outlet end with the spigot or tongue ends pointing in the direction of flow and shall proceed toward the inlet end with the abutting sections property matched, true to the established lines and grades. Where bell, or hub and spigot pipes are used cross trenches shall be cut in the foundation to allow the barrel of the pipe to rest firmly upon the prepared bed. The cross trenches shall be not more than two (2) inches larger than the bell or hub ends of the pipes. Proper facilities shall be provided for hoisting and lowering the sections of pipe into the trench without disturbing the prepared foundation and sides of the trench. The ends of the pipes shall be carefully cleaned before the pipes are 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 pipes shall be fitted and matched so that when laid in the bed they 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 manner that the markings "top" or "bottom" as prescribed in Paragraph (E), Section 306.2, will be in correct position.

Multiple installations of reinforced concrete pipe shall be laid with the center lines of individual barrels parallel. When not otherwise indicated on plans, the following clear distances between outer surfaces of adjacent pipes shall be maintained:

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

All pipe so designated on the plans shall be installed by jacking.

If the grade of the pipe at the jacking end is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking operations and for placing end joints of the pipe. Wherever end trenches are cut in a manner satisfactory to the Engineer to prevent caving in. When jacking pipe under railway embankment all work shall be conducted so as not to interfere with the railway traffic and to prevent any caving of the railway embankment.

Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided. 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 ring of the pipe. A suitable jacking frame or back stop 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. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe. In general, embankment material shall be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through embankment with jacks, into the space thus provided.

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

The excavation for the underside of the pipe for at least 1/3 of the circumference of the pipe shall conform to the contour and grade of the pipe. A clearance of not more than two (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 excavation shall extend beyond the end of the pipe depends on character of the material, but it shall not exceed two (2) feet in any case. This distance shall be decreased on instructions from the Engineer. If the character of the material being excavated makes it desirable to keep the advance excavation closer to the end of the pipe.

The pipe shall preferably be jacked from the low or downstream end. Lateral or vertical variation in final position of the pipe from the line and grade established by the Engineer will be permitted only to the extent of one (1) inch in ten (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 by the plans.

To reduce the likelihood of breakage due to concentrated pressure, a suitable cushioning material may be used between the joints. A one-half (1/2) inch manilla rope stuck to the pipe with asphaltic cement may be used for this purpose and the joints grouted or filled with an approved asphaltic cement after the pipe is in final position.

If the Contractor desire, he may use a cutting edge of steel plate around the head end of the pipe and extending a short distance beyond end of pipe with inside angles or lugs to keep cutting band from slipping back onto the pipe.

When jacking of pipe is once begun the operation shall be carried on without interruption, insofar as practicable, to prevent the pipe becoming firmly set in the embankment.

Any pipe damaged in jacking operations shall be removed and replaced by the Contractor at his entire expense.

The pits or trenches excavated to facilitate jacking operations shall be backfilled immediately after the jacking of the pipe has been completed.

The Contractor shall not place materials, equipment, or framework closer than eight (8) feet six (6) inches to the center line of the railroad tracks. During construction operations on the railroad right-of-way, barricades and flares to safeguard trainmen and pedestrians shall be furnished and maintained as directed by the Engineer, until such time as the backfill has been completed and shall then be removed from the site.

C. Jointing

All pipe shall be closely jointed and sealed with stiff mortar, composed of one part Portland cement and two parts sand, so placed as to form a durable watertight joint. The ends of the pipe shall be thoroughly cleaned and wetted before making the joint. After any section of pipe is laid and before any succeeding section is laid, the lower half of the bell of the pipe last laid shall be thoroughly plastered by troweling on an even layer of mortar. The spigot end of the next section of pipe shall then be inserted holding it as high as possible until it is fully inserted and then lowering it gently on the mortar. After the section is laid and uniformly matched and the sections have been fitted as close as the construction of the pipe will permit the lower half of the inner circumference of the joints of pipes over eighteen (18) inches in diameter shall be sealed and packed with mortar and finished smooth and even with the adjacent sections of pipe. Before this mortar has attained initial set additional mortar shall then be applied from the outside and forced into the unfilled portion of the bell or groove to fill completely the annular space around the spigot or tongue. For bell and spigot pipe, a bead shall be formed on the outside by troweling on mortar downward at an angle of 45E from the outer edge of the bell to the spigot of the last laid section. For tongue and groove pipe, a bead shall be formed extending at least one (1) inch on either side of the joint and of approximately semicircular or triangular cross section. If the triangular cross section is used, it shall be formed by placing the mortar at approximately 45E outward from the extreme edges of the bead. For pipes too small to permit finish of the inside surface of the joint, a tight stopper of burlap or otherwise equivalent material shall be dragged through the pipe past the new joint to remove any fins of mortar. Special care shall be exercised in placing adjacent pipe sections to avoid movement of the pipe in place and the beading of the mortar bond at completed joints. After the initial set, the mortar on the outside shall be protected from air and sun with a thoroughly wetted earth of burlap cover or acceptable equivalent which shall be kept wet for a minimum of forty-eight (48) hours or until the backfill has been completed. No jointing shall be done when the atmospheric

temperature is at or below 40E F. and when necessary because of a sudden drop in temperature, joints shall be protected against freezing for a least twenty-four (24) hours. After placing any pipe which is not in true alignment or which shown any undue settlement after laying or is damaged shall be taken up and relaid or replaced without extra compensation.

Curves or slight turns in vertical and/or horizontal alignment, where required, shall be made by partially withdrawing the tongue from the groove on the outside of curve or turn. In no case shall the change in direction from one joint of pipe to the other be so great that the tongue fails to enter at least partially into the grooved.

The joints of pipe shall be both grouted and banded with a Portland cement mortar composed of one part of cement to two parts of sand by volume. All joints shall be grouted both inside and outside. Each joint shall be carefully wiped on the inside so that a smooth joint is secured free from mortar fins or other obstructions. After grouting, the joints shall be banded on the outside with a band of mortar from ½ to 1 inch thick from 3 to 4 inches wide. The workmanship shall be first class throughout.

D. Backfilling

Backfilling shall be in accordance with the provisions of Item 100 with the additional requirement that, except as hereinafter provided, no backfill shall be placed until the jointing has been cured for at least twenty-four (24) hours. In those instances where the proper protection of traffic necessitates that backfill be placed on the same day that mortar joints are installed, the curing period for joints may be reduced to a minimum of six (6) hours, provided that special precautions are taken in placing and compacting the backfill to avoid any damages to the joints.

E. End Finish and Connections

The upstream ends of culverts or sewers shall be formed to a smooth rounded lip entrance by filling the recess in the bell with joint mortar which shall be placed and cured in accordance with the provisions for jointing in these specifications. Where new culverts or sewers are constructed as extensions to culverts or sewers in place the construction shall include all work necessary to provide a proper connection between the new structure and the old as indicated on the plans.

306.4 METHOD OF MEASUREMENT

Reinforced concrete pipe shall be measured by the linear foot of pipe complete in place in accordance with these specifications. Such measurement shall be made between the ends of the pipe barrel along the central axis as installed. Where spurs or branches or connections to existing pipe lines are involved, measurement of the spur or new connecting pipe shall be made from the intersection of its central axis with the outside surface of the pipe into which it connects. Where inlets, catch basins, manholes, junctions, chambers, or other structures are included in lines of pipe that length of pipe provided for tie into the structure wall shall be included for measurement but no other portion of the structure length or width shall be so included.

Payment for concrete pipe measured as prescribed above will be made at the contract unit price bid for the various sizes of the items of "Standard Reinforced Concrete Culvert Pipe" and "Extra Strength Reinforced Concrete Culvert Pipe" and "Reinforced Concrete Sewer Pipe", which payment shall be full compensation for furnishing and transporting the pipe; the excavation, hauling, and placing of select material where required for bedding pipe in rock excavation; the preparation and shaping of beds; hauling, placing, and jointing of pipes; for end finish; for all connections to existing structures and for all other items of materials, labor, equipment, tools, and incidentals necessary to complete the culvert, storm sewer, or drain in accordance with the plans and these specifications including all labor, tools, equipment, and incidentals involved in designated jacking operations. Where pipes are laid on a skew full compensation for cutting the ends parallel with faces of structures shall be considered as included in the price paid per linear foot for the designated item of pipe and no additional allowance will be made thereof.