

Standard Specifications for

# Storm Sewer Construction

Section 200

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**Section 200**

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Storm Sewer Construction**

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## Section 200

# Standard Specifications for Storm Sewer Construction

### 1.0 GENERAL

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#### 1.1 SCOPE OF WORK

- 1.1.1 The Contractor shall furnish all the necessary labor, materials, equipment, tools and supplies that are necessary to install a complete storm sewer system, as shown on the plans and/or called for in these specifications or its addenda. It is the intent of these specifications to install a complete system or job.

#### 1.2 TERM OF WARRANTY

- 1.2.1 See Section 500 for warranty construction activity.

#### 1.3 PAYMENT

- 1.3.1 Payment to the Contractor shall be made in accordance with the General Conditions.

#### 1.4 ACCEPTANCE

- 1.4.1 Acceptance of the work shall be in accordance with the General Conditions.

#### 1.5 REFERENCES

- 1.5.1 South Dakota Department of Transportation Standard Specifications for Road and Bridges
- 1.5.2 American Society of Testing Materials, ASTM

## **2.0 MATERIALS**

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### **2.1 STORM SEWER PIPE**

#### **2.1.1 REINFORCED CONCRETE PIPE:**

- a. Reinforced concrete storm sewer pipe shall conform to the Standard Specifications for Road and Bridges produced by SDDOT and ASTM C-76.

#### **2.1.2 CORRUGATED METAL PIPE:**

- a. Corrugated metal pipe shall conform to the Standard Specifications for Road and Bridges produced by SDDOT and AASHTO M36 or M196. Corrugated metal pipe is only allowed in specified locations or rural roadway sections.

#### **2.1.3 POLYVINYL CHLORIDE (PVC) SEWER PIPE AND FITTINGS:**

- a. PVC pipe 15 inches in diameter or smaller shall meet the requirements of ASTM D 3034, Type PSM, SDR 35 minimum; PVC pipe 18 inches through 30 inches in diameter shall meet the requirements of ASTM F 679, minimum wall thickness T 1. The pipe shall be made of PVC plastic having a cell classification of 12454 B or 12454 C or 12364 C or 13364 B.
- b. Storm sewer pipes and bends installed at a depth of greater than 14 feet shall be SDR 26. All other bends shall be SDR 35 minimum.
- c. Polyvinyl chloride (PVC) is allowed only in specified locations.

#### **2.1.4 CORRUGATED POLYETHYLENE PIPE, SMOOTH WALL TYPE S:**

- a. Polyethylene pipe shall conform to requirements of the Standard Specifications for Road and Bridges produced by SDDOT, 12 inches to 30 inches diameter, and AASHTO M294.

### **2.2 PIPE JOINT MATERIALS**

#### **2.2.1 REINFORCED CONCRETE PIPE:**

- a. If concrete pipe tongue and groove joints are tight and true, as determined by the Engineer, they need not be grouted; but when such joints are open and/or skewed, they shall be mortared both inside and outside. The specified joints shall be jointed with cement mortar composed of one (1) part Portland cement and two (2) parts of sand and enough water to make a workable mixture, unless otherwise stipulated on the plans or by the Special Information. All lift holes in RCP Storm Sewer shall be plugged with a concrete mortar plug and sealant or with a flexible butyl lift hole patch. All RCP storm sewer pipe joints shall be sealed with mastic material or butyl rope.

## 2.2.2 CORRUGATED METAL PIPE:

- a. Corrugated metal pipe shall be jointed using either one or two-piece corrugated coupling bands of same diameter and gauge as the pipe unless otherwise shown on the plans or specified.

## 2.2.3 POLYETHYLENE PIPE, TYPE S:

- a. Polyethylene Pipe, Type S, shall have separate manufacturer coupling bands or the pipe will be manufactured with a bell and spigot joint system.

## 2.2.4 POLYVINYL CHLORIDE SEWER PIPE:

- a. PVC Sewer Pipe shall have a flexible elastomeric seal (O ring or rubber sealing joint), and conform to the latest revisions of ASTM D3212. Solvent cement joints shall not be allowed for pipe and fittings.
- b. Polyvinyl Chloride (PVC) Pipe, AWWA C905. PVC AWWA C905 Pipe joints shall conform to the same standards as PVC Sewer Pipe.

## 2.3 STRUCTURES

2.3.1 Curb-type drop inlets and junction boxes shall be constructed in accordance with the standard plates or as detailed on the construction drawings.

### 2.3.2 STRUCTURE ADJUSTING RINGS.

- a. Bricks and Blocks:
  1. Bricks, blocks, or shimming devices will not be allowed for use in adjusting manholes.
- b. Concrete adjusting rings:
  1. Concrete adjusting rings shall be in accordance with ASTM C478. The inside diameter of the ring shall be 24 inches.
- c. Sealant:
  1. Butyl Rubber Sealant in trowelable form shall be used. EZ STIK #3 as manufactured by Pre seal Gasket Corporation or approved equal. The material must meet or exceed the requirements of Federal Specification TT S 001657, ASTM C 990 and AASHTO M 198.
- d. Plastic Adjusting rings:
  1. The adjusting rings shall be injection molded HDPE as manufactured by Ladtech, Inc. or approved equal. The adjusting rings shall be manufactured

from polyethylene plastic as identified in ASTM D-1248 (Standard Specification for Polyethylene Plastic Molding and Extrusion Materials). Material properties shall be tested and qualified for usage in accordance with the ASTM Test Methods referenced in ASTM D 1248. The plastic adjusting rings shall be manufactured utilizing the injection molding process as defined by SPE (Society of Plastic Engineers). The adjusting rings shall be tested to assure compliance with impact and loading requirements in accordance with the AASHTO Standard Specification for Highway Bridges. The adjusting rings shall meet and exceed the static load requirements of AASHTO highway Bridge Specification HS 25 (21,280 lbs). The rings must withstand 1,000,000 plus full load cycles of 10 seconds or less duration. The rings must perform without failure to a minimum of 150 percent of these load values. The adjusting rings shall be sized to conform to the standard 24-inch manhole opening.

e. Mortar:

1. Mortar shall be Standard Portland Cement Type I, hydrated lime, and clean, sharp, well-graded sand, free from foreign materials. The minimum design compressive strength shall be no less than 4000 psi.

2.3.3 BEDDING MATERIAL

- a. Bedding material shall meet the requirements of the city's Standard Plates.
- b. On-site material may be used if approved by the Engineer.

2.3.4 SELECT BACKFILL MATERIAL

- a. Select backfill material shall meet the requirements of the city's Standard Plates.
- b. On-site material may be used if approved by the Engineer.

## **3.0 CONSTRUCTION REQUIREMENTS**

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### **3.1 ALIGNMENT AND GRADE**

- 3.1.1 The Engineer will furnish all the necessary line and grade stakes, benchmarks, or other necessary control. It is the responsibility of the Contractor to return all grade sheets prior to completion, final acceptance, and payment for the project. It is the responsibility of the Contractor to protect these stakes, and any replacement of stakes shall be at the expense of the Contractor. The Contractor shall carry line and grade into the trench by means of an approved laser beam system. At no time shall the Contractor or his employees change the grade without approval of the Engineer. If underground interference is encountered at the assigned grade, the Contractor shall notify the Engineer and wait until he has determined the revised grade for the sewer. The Contractor shall periodically check the grade from the grade stake to pipe invert.

### **3.2 UNDERGROUND INTERFERENCE**

- 3.2.1 The location of underground public or private utilities may be shown on the plans, as reported by the various utility companies and the City, but this does not relieve the Contractor of the responsibility of determining the accuracy or completeness of said locations. The Contractor shall determine the location of all underground ducts, conduits, pipes, cables, or structures which will be affected by the work, and shall take steps necessary to support and protect said structures by any means suitable to the owners of the structure involved and the Engineer. When necessary, the Contractor shall conduct operations as to permit access to the work site and provide time for utility work to be accomplished during the progress of the work.
- 3.2.2 Portions of utilities, which are found to interfere with the line and grade of the sewer, will be relocated, altered, or reconstructed by the owners, or the Engineer may order changes in the work to avoid interference. Such changes will be considered to be extra work and will be paid for through a change order. When the plans or specifications provide for the Contractor to alter, relocate, or reconstruct a utility, all costs for such work shall be included in the bid for the items of work necessitating such work unless a separate bid item is provided. Temporary or permanent relocation or alteration of utilities requested by the Contractor for the Contractor's convenience shall be the Contractor's responsibility, and the Contractor shall make all arrangements and bear all costs. In those instances where utility relocation or reconstruction is impractical, the Engineer may order a deviation from line and grade.
- 3.2.3 The Contractor shall be responsible for notifying the various utility companies if the Contractor's work will expose, affect, or endanger any existing utility. All cost of investigation and any necessary protection, support, removal, or relocation of said structures shall be included in the contract bid price for installing pipe or structures. The Contractor shall not begin construction until all utility companies have been contacted and their respective underground utilities have been located and marked.
- 3.2.4 The bid item "locating utilities" will be used to locate storm sewer connection services only if the service location marked exceeds the actual service location by 4 feet in either direction



and additional excavation is required. The bid item “verify utilities” will be used only when it is necessary to excavate down to the utility to determine if any vertical and/or horizontal conflicts exist between existing utilities and the proposed new sewer to be installed as shown on the plans. All costs of other exploratory investigation/excavation necessary for determining the location and depth of utilities shall be included in the contract bid price for installing pipe.

### **3.3 EXCAVATION AND TRENCHING**

3.3.1 Excavation shall be classed as either earth or rock excavation. Rock excavation shall consist of solid rock lying in its natural bed, which requires fracturing for its removal, and boulders of one yard or more in volume. All other material shall be classed as earth excavation.

#### **3.3.2 GENERAL**

- a. Excavation shall be classed as either earth or rock excavation. Rock excavation shall consist of solid rock lying in its natural bed which requires fracturing for its removal and boulders of 1 yard or more in volume. All other material shall be classed as earth excavation.

### **3.4 EARTH EXCAVATION**

3.4.1 All sewers shall be built in open cut, except that where conditions warrant, the Engineer may permit the use of short tunnels.

3.4.2 Unless specified in the Special Provisions, earth excavation costs are included in the cost of placing the pipe.

3.4.3 The width of the trench shall comply with city’s Standard Plates.

### **3.5 SHEETING AND BRACING**

3.5.1 If City, State, or Federal regulations dictate the necessity of sheeting, bracing, or pulling a trench box or shield, the cost of such sheeting, unless a special price is called for in the contract form, shall be included in the contract bid price for installing pipe.

### **3.6 EXCAVATION BELOW PIPE GRADE**

3.6.1 If required, trench excavation below pipe grade shall be backfilled with bedding material approved by the Engineer and thoroughly tamped to provide a uniform and continuous bearing and support for the pipe.

### **3.7 EXCAVATION IN UNSTABLE OR UNSUITABLE SOIL**

3.7.1 The Contractor shall notify the Engineer when material considered unstable for the pipe foundation is encountered and where additional support, stabilization and undercutting of the pipe trench are necessary. If the Contractor can not assure a product in accordance with the

specifications, the Contractor may request the use of trench stabilization material and/or geotextile fabric where the trench base is not structurally adequate or otherwise unstable to provide a uniform stable pipe foundation and requires additional undercutting for placement of trench stabilization material and/or geotextile fabric.

- 3.7.2 The undercutting and use of trench stabilization material and/or geotextile fabric shall only be approved for use in extreme conditions where it is obviously necessary. Approval for the limits of the payment lines for use of trench stabilization material and geotextile fabric must be obtained from the Engineer, prior to installation. If trench stabilization material and/or geotextile fabric is necessary to stabilize the trench foundation, they shall be installed by the Contractor at the unit bid prices for those respective items.
- 3.7.3 If geotextile fabric is used, it should be placed on the neutral soils and extended up the trench sidewalls to a level of at least the mid-point of the pipe. Placement of the fabric should then be followed by placement of the stabilization material.
- 3.7.4 The Contractor will be fully responsible for constructing the storm sewer on a stable base and any defects resulting from improperly preparing the pipe foundation shall be the Contractor's responsibility.
- 3.7.5 The Contractor will be required to furnish weigh tickets for trench stabilization material on a daily basis.
- 3.7.6 Pipe bedding material will always be required in addition to trench stabilization material where trench stabilization material is used.

### **3.8 ROCK EXCAVATION**

- 3.8.1 All rock excavation shall be under one classification. It shall include solid ledge rock in its natural location that requires systematic quarrying, drilling, and/or blasting for its removal and also boulders that exceed one-cubic yard in volume.
- 3.8.2 When rock is encountered in the trench, it shall be stripped of earth and the Engineer shall be notified by the Contractor and given ample time to make a profile before removal operation begins.
- 3.8.3 Rock excavation will be to the trench limits of these Standard Specifications, Section 4.3, for the specified pipe.
- 3.8.4 Procedures for rock removal operations shall be subject to the approval of the Engineer. The use of explosives shall be limited to the magnitude of the charge that will not cause damage to the adjoining property through shock vibrations or other stress loadings. Also, the Contractor shall provide adequate blanket protection to assure that there will not be fragments of rock or other debris flying through the air when discharging explosives. The Contractor shall employ personnel certified to execute blasting operations.

3.8.5 The entire rock removal operations shall be the responsibility of the Contractor, including payment, for any damages caused by his operations. Adequate insurance protection, in addition to the standard liability insurance required, shall be purchased by the Contractor for payment of any damages that may be caused by the use of explosives.

3.8.6 Explosive permits must be obtained from the city's Fire Department as per City Ordinance.

### **3.9 DEWATERING**

3.9.1 Pipe jointing shall be accomplished in a relatively dry trench condition. No joints may be connected under water. If ground water is encountered, the Contractor shall dewater the trench with suitable pumps and equipment. The cost of dewatering, unless a bid item is called for on the proposal, shall be absorbed in the contract bid price for installing pipe.

3.9.2 Water resulting from dewatering operation shall be disposed in a manner approved by the Engineer and South Dakota Department of Environmental and Natural Resources. It shall not be pumped onto private property without the property owner's approval. Any damage to property, either public or private, shall be rectified to the satisfaction of the owner and the City. All applicable permits must be obtained by the Contractor before the dewatering operation begins.

### **3.10 INSTALLATION OF PIPE**

3.10.1 Sewer pipe shall not be installed in frozen ground or in water, and no water will be allowed to run into or through the pipe until the joints have been sealed and structure bases are adequately hardened.

3.10.2 Pipe shall be carefully installed to line and grade in accordance with line and grade stakes set by the Engineer so that the finished sewer will present a uniform bore. Any noticeable variations from true alignment or grade will be cause for rejection of the work.

3.10.3 All pipe shall be installed upgrade with spigot ends pointing in the direction of flow. The bottom of the trench shall be freed of all rocks and stones and shall be hand shaped and bedded with bedding material as specified and the pipe shall be in firm contact with the bedding material or earthen surface for its entire length. At each joint of bell and spigot pipe, a hole shall be dug of sufficient size so that the weight of the pipe will rest on the barrel of the pipe and not on the bells, and the bell hole shall not be compacted. All pipe must be properly fitted together as no chipping of bell or spigot will be allowed. A suitable stopper shall be kept in the end of the pipe so as to prevent any dirt or water from entering during the progress of the work at all times. Any dirt, loose material, or cement mortar which may accumulate in the pipe shall be removed as the work progresses by means of a swab. The backfilling around the pipe shall be completed as per the city's Standard Plates. Whenever pipe is installed in rock trenches, it shall be bedded in select material of at least 12-inch depth.

### **3.11 PIPE JOINTS**

3.11.1 Sewer pipe installed on a curve shall adhere to the manufacturer's recommendations depending upon the curve radius.

3.11.2 RCP STORM SEWER PIPE.

- a. All RCP storm sewer pipe shall be sealed with mastic material or butyl rope. Seating of pipe shall conform to manufacturer's recommendations.

3.11.3 CORRUGATED METAL STORM SEWER PIPE.

- a. All bands attaching corrugated metal pipes shall be drawn firmly together with bolts and shall firmly clamp each pipe to prevent separation of the pipe, as per manufacturer's recommendations.

3.11.4 PVC STORM SEWER PIPE.

- a. All PVC Sewer Pipe shall be jointed utilizing elastomeric gaskets as referenced in ASTM D3034 and ASTM F679 and meeting the requirements of ASTM D3212. All pipe, fittings, and joints shall be installed in full compliance with the recommended practices of the pipe manufacturer and as specified in the latest revision of ASTM D2321. The joint surfaces (external and internal) shall be wiped free of all foreign materials, and the spigot end shall be centered on grade into the bell end and the joint shall be properly seated in accordance with the manufacturer's recommendations. Any pipe that is field cut shall have a square end with beveled edge equal to a factory cut and all field repairs shall be performed per manufacturer's recommendations.

3.11.5 CORRUGATED POLYETHYLENE PIPE, TYPE S.

- a. All bands attaching polyethylene pipes shall be drawn firmly together and clamped per manufacturer's specifications to prevent separation of the pipe. If a bell and spigot pipe is used, the pipe shall be drawn together and seated per manufacturer's specifications.

### **3.12 ADJUST STRUCTURE**

3.12.1 There shall be at least one two-inch adjusting ring, and a maximum of 14 inches of adjusting rings used on each junction box. Unless otherwise specified, the structure cover shall be set approximately 6 inches below the finished street elevation by the contractor, to be raised to finished grade elevation by the contractor prior to paving.

3.12.2 The installation for concrete adjusting rings shall be in accordance with the SDDOT Standard Specifications for Roads and Bridges unless otherwise specified. The structure frame and adjusting rings where concrete adjusting rings are used shall be set in a full bed of mortar to the elevation set by the Engineer as shown on the grade sheet. The mortar shall be tuck pointed between rings and shall not be applied to the inside diameter surface of the adjusting

rings. Smearing of mortar on the inside of the adjusting rings will be cause for rejection of the work.

- 3.12.3 Plastic adjusting rings may be used in lieu of concrete adjusting rings. The plastic adjusting rings shall be installed as recommended by the manufacturer. No shims or other leveling devices, other than leveling rings provided by the manufacturer, will be permitted with use of the plastic adjusting rings. The annular space between the adjusting rings shall be sealed using an approved butyl rubber sealant. The first plastic adjusting ring on existing manholes may require leveling with concrete mortar and therefore the first plastic ring may be set in mortar.

### **3.13 FRAME AND COVER**

- 3.13.1 Structure frame and covers shall be installed in accordance with the city's Standard Plates or as specified.

### **3.14 CONNECTIONS TO EXISTING SEWERS**

- 3.14.1 Wherever new storm sewers connect with existing storm sewers, the Contractor shall without extra compensation cut the necessary openings in the existing structures and make the connections thereto in a neat and workmanlike manner. The connections shall be made so as to make the joints around the entering storm sewers watertight.

- 3.14.2 The connection shall be constructed as not to obstruct the flow area of the main line storm sewer pipe.

### **3.15 STUBS FROM STRUCTURES FOR FUTURE EXTENSIONS**

- 3.15.1 Futures from a structure shall be installed to the staked elevation. The extension shall be plugged as specified.

### **3.16 BEDDING AND BACKFILL**

- 3.16.1 Bedding and backfill shall be performed as shown in the city's Standard Plates.

### **3.17 USE AND REPAIR OF STREET**

- 3.17.1 The Contractor shall carry on the work in such a manner as to interfere as little as possible with the use of the street for public travel, and as specified in the Special Provisions.
- 3.17.2 Wherever any paved gutters, pavements, graveled highways or street crossings or other improvements are interfered with or removed, they must be replaced by the Contractor or left in as good condition as previously existed. The Contractor shall also remove all surplus material leaving the streets clean and in good order.

3.17.3 No more than three hundred feet (300') of trench will be opened at any one time in advance of the complete construction of the sewers and the backfilling shall follow up the installation of the sewers.

3.17.4 All street repairs and cleaning shall be promptly performed as the work progresses. The Contractor shall not obstruct any street gutters but shall provide for the passage of surface water along the same at all times.

### **3.18 JACKING, BORING, AND TUNNELING**

3.18.1 It shall be the responsibility of the Contractor to maintain the alignment and grade specified. The jacking, boring, and tunneling specifications are available upon request from the City Engineer and shall be in accordance with the drawings and Special Provisions.

### **3.19 INSPECTION AND TESTING**

#### **3.19.1 GENERAL.**

- a. The Engineer shall have access at all times to all parts of the job and the Contractor must furnish such personnel, facilities, equipment, tools, and materials as are necessary to make whatever tests and inspection that are deemed necessary.

#### **3.19.2 VISUAL INSPECTION BY OWNER**

- a. The engineer may require inspections of pipe once constructed in place and prior to backfilling operations. Piping shall remain exposed for the engineer to visually inspect and record data for as-built plans. The Contractor shall notify the engineer when they are ready for an inspection.

#### **3.19.3 PIPE TESTING.**

- a. The Engineer may require a test of specimens not to exceed five (5) percent of the quantity of pipe to be furnished in order to prove the acceptability of the pipe. The manufacturer shall provide an approved testing stand near the site of the plant.

#### **3.19.4 PIPE INSPECTION.**

- a. Prior to being lowered into the trench, each pipe shall be carefully inspected by the Contractor and those not meeting the specified requirements shall be removed from the site immediately. Rejections may be made for any of the reasons as stated in the specifications for each specific type of pipe. Pipe having minor flaws not serious enough to cause rejection shall be installed so as to bring such flaws in the top half of the sewer. Pipe shall be protected during handling against impact, shocks, and free fall.

### 3.19.5 TELEVISION INSPECTION.

- a. The City will perform an inspection of the completed sewer line within the two (2) year warranty period through the use of a television camera. The expense of the initial television inspection and one additional reinspection will be borne entirely by the City. If defective workmanship of material or construction is noted, the deficiency shall be corrected by the Contractor at no expense to the City. The City will perform additional television inspections to review if the repairs were made properly and in accordance with the specifications. The expense of any additional television inspections beyond the initial inspection and one additional reinspection will be borne entirely by the Contractor.
- b. The Contractor shall be responsible for all related costs, including concrete or asphalt resurfacing if the street has been surfaced. The Contractor shall be required to repair all areas of deficiencies.

### 3.19.6 CLEANING.

- a. The Contractor shall be responsible for all work necessary to make the sewer acceptable for usage including removal of all mud, silt, rocks, or blockages that might hinder the flow and make said sewer unacceptable for final acceptance and usage. Also included is all work necessary in the structures and all cleanup work required prior to final acceptance. Structures will have all concrete forms removed prior to final acceptance.
- b. In the event that the line is not acceptable for televising, due to the Contractor's operations, the Contractor will be notified. It will be the Contractor's responsibility to make arrangements to clean the sewer and make it acceptable for the television work.

### 3.19.7 BACKFILL DENSITY TEST.

- a. The Contractor shall expose the compacted soil layers, as required by the Engineer, to enable the Engineer to perform density tests. The cost of exposing the soil layers for testing shall be incidental to the pipe and/or structure construction.
- b. A minimum of one density test and moisture content shall be made for every 500 lineal feet of trench per four (4) feet of depth. A minimum of one (1) standard density and optimum moisture determination shall be made for the project and one (1) additional test for each change in backfill.

### 3.19.8 QUALITY CONTROL AND SUBMITTALS

- a. Retesting of work required because of nonconformance to the specified requirements shall be performed by an independent firm based on the instructions of the Engineer. Payment for retesting performed during the contract

period and during the warranty period will be charged to and will be the responsibility of the Contractor.

- b. As required, shop drawings and data shall be submitted for, but not be limited to, the following items:
- c. Structures, pipe, pipe fittings, bedding material, stabilization material, granular material, and any other pertinent information concerning construction materials that the Engineer deems necessary for the review of the materials used on the project in accordance with the specifications and drawings.
- d. The Contractor shall submit three copies to the Engineer. The Contractor shall obtain shop drawing approval before any of the work related to that material is performed.

**3.20 PIPE DEFLECTION**

**3.20.1 PIPE DEFLECTION TEST, CORRUGATED POLYETHYLENE PIPE, TYPE S.**

- a. At the discretion of the Engineer, deflection testing will be performed by the Contractor. For pipe diameters through and including 24 inches in diameter, deflection testing is to be performed using a mandrel with at least five points approved by the Engineer. The diameter of the mandrel shall be as shown in the table below. The mandrel must be pulled through by hand without the use of excessive force. Pipe through which the mandrel does not pass shall be examined more closely to determine the reason for non-passage. For pipe diameters 30 inches and above, pipe diameters may be physically measured by a means approved by the Engineer. Deflection testing shall be performed no earlier than thirty days after installation or upon completion of construction of the roadway or the development area to the final grading elevation, whichever occurs first. Pipe that is determined to be over deflected shall be removed and reinstalled if the pipe is not damaged, or replaced with acceptable pipe. All pipe exceeding the 5 percent deflection within the two-year warranty period shall be reinstalled or replaced by the Contractor at no additional cost to the Owner.

<b>DEFLECTION TABLE</b>	
<b>Pipe Diameter (inches)</b>	<b>Mandrel Diameter (inches)</b>
12	11.01
15	13.77
18	16.52
24	22.02
30	27.53



### 3.20.2 POLYVINYL CHLORIDE (PVC) PIPE DEFLECTION TEST.

- a. At the discretion of the Engineer, deflection testing will be performed by the Contractor.
- b. Deflection tests shall be conducted after the final backfill has been in place at least 30 days. Deflection tests shall be made using a deflection gauge (mandrel) device or other approved method. The diameter of the deflection gauge device shall be 95 percent of the undeflected inside diameter of the flexible pipe. The Contractor shall be required to install the pipe in such a manner so that the diametric deflection of the pipe shall not exceed 5 percent. All pipe exceeding the 5 percent deflection within the two year warranty period shall be reinstalled or replaced by the Contractor at no additional cost to the Owner.

## **4.0 METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

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### **4.1 REMOVAL OF STORM SEWER PIPE**

- 4.1.1 The removal of sewer pipe shall be measured as lineal foot of pipe removed. The removal footage shall be rounded up to the nearest one-foot increment.
- 4.1.2 The removal of a sewer pipe shall be paid for at the contract unit price for each foot of sewer removed. Payment for removal of sewer pipe shall be full compensation for excavation, removal and disposal of the pipe and all appurtenances necessary for the proper removal of the pipe.

### **4.2 REMOVAL OF STORM SEWER STRUCTURE**

- 4.2.1 The removal of a structure shall be measured as a unit for each structure removed.
- 4.2.2 The removal of a structure shall be paid for at the contract unit price for each structure removed. Payment for removal of a structure shall be full compensation for removal and disposal of the structure, frame and covers, and all appurtenances necessary for the proper removal of the structure.

### **4.3 ROCK EXCAVATION**

- 4.3.1 The removal of rock shall be measured as cubic yards of rock removed. The cubic yards removed shall be rounded to the nearest 0.1 increment. All rock excavation shall be under one classification. The classification shall include solid ledge rock in its natural location that requires systematic quarrying, drilling, and /or blasting for its removal and also boulders that exceed one cubic yard in volume.
- 4.3.2 Pay lines for computing rock excavation shall be described as follows for trench widths:

<b>Pipe Size</b>	<b>Trench Width Pay Lines</b>
Pipe equal to or less than 24 inches in diameter	4 feet
Pipe greater than 24 inches in diameter	The outside pipe diameter plus 24 inches

- 4.3.3 Pay lines for computing depth of the rock excavation shall be described as the distance from top of rock to 12 inches below the pipe invert elevation. The top of the rock profile will be measured and determined by the Engineer and used to determine the rock quantities.

4.3.4 The accepted quantities of rock excavation shall be paid for at the contract unit price per cubic yard. Payment for rock excavation shall be full compensation for permits, excavation, blasting, removal and proper disposal of the rock offsite, and all appurtenances necessary for the proper removal of the rock. Furnishing and installing suitable fill material to replace the rock removed (except in locations where bedding material is required) will be paid for with the Granular Material bid item.

#### **4.4 SELECT BACKFILL MATERIAL**

4.4.1 Select backfill material shall be measured and paid by the lineal foot. Material shall be measured from pipe end to end with no deduction for length through the structure. The measured length shall be rounded up to the nearest one foot increment.

4.4.2 Payment for select material will be full compensation for furnishing and installing of the material and all appurtenances necessary for the proper installation of the select material.

#### **4.5 ADJUST STRUCTURE**

4.5.1 The furnishing and installing of structure adjustments shall be measured as a unit for the structure adjustment at each structure.

4.5.2 The furnishing and installing of adjusting rings shall be paid for at the contract unit price for each structure adjustment. Payment for adjust structure will be full compensation for furnishing and installing of the structure adjusting rings, sealant, mortar, and all appurtenances necessary for the proper installation of the structure adjusting rings. Structure adjustments will be paid for existing structures.

#### **4.6 STORM SEWER PIPE**

4.6.1 Storm sewer pipe shall be measured by the lineal foot of respective type, class, and size of pipe to the nearest foot.

#### **4.7 BEDDING MATERIAL**

4.7.1 Pipe bedding material shall be measured and paid by the lineal foot. Bedding material shall be measured from pipe end to end with no deduction for length through the structure. The measured length shall be rounded up to the nearest one-foot increment.

4.7.2 Payment for pipe bedding material will be full compensation for furnishing and installing of the pipe bedding material and all appurtenances necessary for the proper installation of the bedding material.

#### **4.8 STRUCTURES**

4.8.1 Structures shall be measured and paid for at the contract unit price of reinforcement steel, concrete, and castings.

#### **4.9 JACKING, BORING, AND TUNNELING, PVC AND POLYETHYLENE**

- 4.9.1 The basis of measurement shall be by the lineal foot for casing pipe, linear foot for carrier pipe, each for end seals, each for casing spacers, and each for boring obstructions. The measured length of carrier and casing pipe shall be rounded up to the nearest one-foot increment.
- 4.9.2 The furnishing and installing of casing pipe and carrier pipe shall be paid for at the contract unit price per lineal foot for the types, classes, and sizes furnished and accepted. The furnishing and installing of end seals and casing spacers shall be paid for at the contract unit price per each for the types and sizes furnished and accepted.
- 4.9.3 Payment for casing pipe will be full compensation for furnishing and installing of the casing pipe by boring, jacking or tunneling; excavation and backfilling of bore pits, welding, trench dewatering (unless otherwise specified) and all appurtenances necessary for the proper installation of the casing pipe.
- 4.9.4 Payment for carrier pipe will be full compensation for furnishing and installing of the carrier pipe, gaskets, grouting of the annular pipe space (unless otherwise specified) and all appurtenances necessary for the proper installation of the carrier pipe.
- 4.9.5 Payment for the end seals and casing spacers will be full compensation for furnishing and installing of the end seals and all appurtenances necessary for the proper installation of the end seals and casing spacers.
- 4.9.6 Payment for boring obstruction will be full compensation for the labor, equipment, and materials needed for removal of the obstruction. Payment for boring obstructions will be paid only for boring operations with mechanical equipment. If the project work is performed by a hand-mining operation, all such obstructions will be considered part of the normal operation and will not be paid for as a boring obstruction.
- 4.9.7 A boring obstruction shall be defined as any rock, boulder, etc., or similar material, which is encountered during the excavation that cannot be removed by the boring machine and requires shut-down of the equipment for removal. The Contractor shall be aware that all quantities are estimates and that there may be no obstructions or could be a large number of obstructions on the project. The Contractor will only be paid for obstructions encountered and reported to and verified by the Engineer. The bid item quantities are not guaranteed items.

#### **4.10 JACKING, BORING, & TUNNELING, REINFORCE CONCRETE PIPE**

- 4.10.1 The furnishing and installing pipe shall be measured and paid for at the contract unit price per lineal foot for the types, classes, and sizes furnished and accepted.
- 4.10.2 Payment for pipe will be full compensation for furnishing and installing of the pipe by boring, jacking or tunneling; excavation and backfilling of bore pits, welding, trench dewatering (unless otherwise specified) and all appurtenances necessary for the proper installation of the casing pipe.

- 4.10.3 Payment for boring obstruction will be full compensation for the labor, equipment, and materials needed for removal of the obstruction. Payment for boring obstructions will be paid only for boring operations with mechanical equipment. If the project work is performed by a hand-mining operation, all such obstructions will be considered part of the normal operation and will not be paid for as a boring obstruction.
- 4.10.4 A boring obstruction shall be defined as any rock, boulder, etc., or similar material, which is encountered during the excavation that cannot be removed by the boring machine and requires shut-down of the equipment for removal. The Contractor shall be aware that all quantities are estimates and that there may be no obstructions or could be a large number of obstructions on the project. The Contractor will only be paid for obstructions encountered and reported to and verified by the Engineer. The bid item quantities are not guaranteed items.