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SECTION 5 – SANITARY SEWER SYSTEM CONSTRUCTION

5.1 GENERAL

5.1.1 Description - This work shall consist of the construction of sanitary sewer trunk, laterals, and services using plant fabricated pipe and other appurtenant materials, installed for conveyance of sewage. The work includes construction of manholes, sanitary sewer pipe, services, and other related items as specified.

All work must be performed in accordance to these specifications, the Blaine Standard Detail Plates, the plans and applicable MNDOT Standard Plates.

5.1.2 References - All general pipe installation requirements and materials shall be in accordance with Section 2 "Pipeline Installation Requirements" of these specifications.

5.1.3 Applicable MnDOT Standard Plates - The following are MnDOT Standard Plates that apply to specific items as shown on the plans or referenced in the specifications. Though listed, each Plate may not be used on every project, and some projects may identify another Plate or modify an existing Plate.

4005L MANHOLE

4007C PRECAST MECHANICAL JOINT SEWER MANHOLE

4010H ADJUSTING RING

4180J MANHOLE OR CATCH BASIN STEP

5.1.4 Extra Materials – See Section 2.1.2 of these specifications for extra materials requirements.

5.2 PRODUCTS

5.2.1 Polyvinyl-Chloride Pipe and Fittings

A. Non-Pressure Pipe

1. Pipe for non-pressure gravity sewers shall meet the requirements of ASTM D3034 for sizes 8-inch through 15-inch, and ASTM F679 for sizes 18-inch through 27-inch for SDR 35.
 - a. Pipe class SDR 35 – less than 20 feet depth
 - b. Pipe class SDR 26 – greater than 20 feet of depth but less than 28 feet of depth
 - c. Pipe class for greater than 28 feet of depth shall be determined by the designer and submitted to the City for verification.
2. Joints - Joints shall be push-on with molded rubber gaskets meeting the requirements of ASTM D3212 except for service lateral pipe connections to pipes, tees, wyes, and fittings which shall be solvent-cemented joints meeting the requirements of ASTM D2855 and ASTM D3212.
3. Fittings - Fittings shall meet the requirements of ASTM D3034. End plugs for service laterals shall be solvent weld.

All pipe fittings shall have the certification of compliance by Underwriters Laboratories, Inc., or by an independent testing laboratory acceptable to the Engineer.

Saddle connections to existing mains shall be made with a "TSPK-46 Tap Saddle Pressure Kit" as manufactured by Fernco, Inc.

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4. Service Pipe – Pipe for sanitary sewer services shall meet the requirements of ASTM D2665 for Schedule 40.

B. Pressure Pipe

1. Pipe for pressure forcemains shall meet the requirements of AWWA C-900, table 2, for pipe with cast iron outside dimensions. The pipe, fittings, and accessories shall have a minimum dimension ratio (DR) of 14, corresponding to a working pressure of 200 psi for PVC type 1120 pipe.
2. Joints shall be push-on gasket bell type with molded rubber gaskets.

5.2.2 Ductile Iron Pipe and Fittings

- A. Ductile Iron Pipe - All pipe shall be ductile iron class 52 for pipe less than 12 inches in diameter, Class 50 for pipe 12 inches and larger in diameter and shall conform to the requirements of AWWA 151 (ANSI A21.51).
- B. Fittings - Forcemain fittings for sizes up to and including 16 inch diameter shall be mechanical joint ductile iron fittings meeting the requirements of AWWA C110 (ANSI A21.10) and AWWA C111 (ANSI 421.11) for a working pressure rating of 350 pounds per-square-inch.

Forcemain fittings for sizes 18 inch diameter and larger shall be mechanical joint gray or ductile iron fittings meeting the requirements of AWWA C110 (ANSI A21.10) and AWWA C111 (ANSI A21.11) for a working pressure rating of 250 pounds per-square-inch.
- C. Lining and Coating - All pipe and fittings shall be furnished with cement mortar lining meeting the requirements of AWWA C104 (ANSI A21.4) for standard thickness lining. All interior and exterior surfaces of the fittings shall have an epoxy coating meeting the requirements of AWWA C116. Spotting or thin coating, or poor coating adhesion, shall be cause for rejection.
- D. Joints - Pipe three inches and larger in diameter shall have slip on joints. Fittings shall have mechanical joints. The rubber gasket for both type joints shall conform to AWWA C111 (ANSI A21.11).
- E. Retainer Glands - All joints requiring thrust restraint must be provided with a Mechanical Joint Restraint Device. The device shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1 and shall be manufactured by "EBBA Iron, Inc., MEGALUG"; American Cast Iron Pipe Company; or approved equal.
- F. Electrical Conductivity - Copper straps shall be welded or otherwise permanently affixed to each pipe or appurtenance to provide a positive means of conveying electricity from pipe or fitting, to pipe or fitting. Conductive pipe gaskets may be used on pipe-to-pipe connections if approved by the Engineer. Size and method of affixing strap shall be subject to the approval of the Engineer and shall be sufficient to meet or exceed the criteria for conductivity testing set forth in this specification.

5.2.3 Valves - All valves shall meet the requirements of Section 4.2.3 of these Specifications.

5.2.4 Insulation - Pipe wrapped insulation shall be two (2) inches of DOW Styrofoam FB brand plastic foam, or approved equal, wrapped around the entire pipe, pipe joints and bends for those areas designated on the plans. The insulation shall be installed with bands as per the manufacturer's specification.

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Sheet insulation shall be three inch thick, four feet wide foam waterproof insulation in accordance with MNDOT Specification 3760. Sheets shall be centered on the pipe and installed above or below the pipe in accordance with Blaine typical detail plates.

5.2.5 Sanitary Manhole

- A. All sanitary sewer manholes shall have monolithic base wall sections and be in accordance with MNDOT Standard Plate 4007 unless the manhole is to be constructed over an existing like or otherwise constrained as to require separate sections or block construction. Changes in manhole type construction must be approved by the Engineer.
- B. Castings shall be Neenah R-1733 with "Platen" lids meeting the requirements of MNDOT Standard Plate 4110, casting no. 716, or as specified on the plans. Lids shall be marked "SANITARY SEWER". Castings shall be set 0.02 foot below finish grade. On development projects with an interim surface course, manholes shall be adjusted to the interim grade within one week of paving in accordance to Blaine Detail Plates.
- C. Drop Connections – Inside drops shall be "Reliner" inside drop systems as manufactured by Duran Inc. or approved equal. If more than one inside drop is installed into a manhole, the manhole size must be increased 6" in diameter for each drop. Outside drops shall be per Blaine Standard Details. Connections to manholes must be cast at time of manufacturing or core-drilled. All connections into manholes shall have watertight seals per MnDOT Standard Plate 4007C.

5.2.6 Reinforced Concrete Pipe - Pipe for non-pressure gravity sewers shall meet the requirements of ASTM C76-83 with pipe joints per ASTM C361-92 (confined round-rubber 'O' ring gasket type) except as modified or supplemented herein.

- A. All sanitary sewer reinforced concrete pipe will be of the size and class shown on the plans.
- B. Pipe Liner – Liner shall be Ameron T-Lock as manufactured by Ameron Protective Line Products or approved equal.
- C. Joint Coating and Sealing - All joints shall be inspected by the manufacturer, repaired, smoothed and cleaned in preparation for coating. The entire joint surface (pipe ends and mating surfaces) of both the bell and spigot shall be coated with an epoxy ester designed for use on concrete in sanitary sewer applications. Application shall be in accordance with the manufacturer's recommendations to produce a smooth, continuously coated joint mating surface and cover pipe ends.
- D. Plant Testing – 12-inch through 36-inch pipe manufactured for this project will be vacuum tested to a minimum of 3.5 psi pressure differential and a leakage rate not to exceed 0.0017 CFM per square foot of internal pipe surface area. Detailed testing procedures shall be submitted to the Engineer prior to in-plant testing. Copies of test results will be forwarded to the Engineer.
- E. Certification - For all pipe manufactured for this project, it shall be certified in writing to the Engineer that it meets all the requirements specified herein.

5.3 **EXECUTION**

All Sanitary Sewer items shall be installed in accordance with Section 2 "Pipeline Installation Requirements" of these specifications except as modified or supplemented herein.

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5.3.1 Gravity Sewer Installation - The following section applies to construction of PVC gravity sewers only.

- A. Connection and Assembly of Joints - All pipe and fitting joints shall fit tightly and be fully closed. Spigot ends shall be marked as necessary to indicate the point of complete closure. All joints shall be watertight.

All pipe and fitting ends left open for future connection shall be closed off with prefabricated plugs or caps.

Prefabricated plugs and caps shall be of the same material as the pipe material, or an approved alternate material, and shall be watertight.

Sanitary sewer lines connecting into an existing manhole, unless specified otherwise, shall be made by installing the pipe at or slightly above the elevation of the bench. A concrete invert one half the depth of the sewer pipe shall be formed on the bench from the sewer pipe to the edge of the existing invert through the manhole.

If specified, sanitary sewer line connection into an existing manhole shall be made by removing a portion of the existing manhole invert and reconstructing to provide smooth flow of all pipelines through the manhole.

Inside or outside drop manholes shall be constructed in accordance with the detail plates.

RCP shall be installer per PVC liner manufacture recommendation.

5.3.2 Sewer Service Installations - Main sewer service connections and service sewer pipe shall be installed where indicated on the plans, and/or where staked in the field. The sewer service connections and pipelines shall be installed in conformance with all applicable requirements of the main sewer installation and as more specifically provided for herein.

The Contractor shall keep accurate records of all service installations as to type, size, location, elevation, point of connection and termination, etc. This service record shall be maintained jointly by the Contractor and Inspector. The service installations shall not be backfilled until visually inspected and all required information has been obtained and recorded.

The main sewer service connection shall consist of installing a Branch Tee or Wye section in the main sewer line at designated locations or of providing an insert type Saddle Tee in a pipe cutout where the sewer main is existing. Orientation of service connection fitting is shown in the detail plates.

Where the depth of the sewer invert is 16 feet or greater, the service connection shall be extended upward by means of a Service Riser Section in accordance with the detail plate.

Unless otherwise specified, service pipe shall be installed at right angles to the main sewer and at a straight-line grade to the property line. Minimum pipe grade is 1.0%.

Service trenches shall be restored and compacted as specified for pipelines.

Unless otherwise indicated, service pipe installation shall terminate at the property line, at which point the Contractor shall furnish a prefabricated plug, and set a 2 by 2-inch wooden stake to mark the exact end of pipe. This stake or post shall be set vertically and shall extend from the service pipe to the ground surface. If the service is in a separate trench, the Contractor shall install a 6-foot-2-inch by 2-inch wood post next to the 2 by 2 marker. If the service is to a vacant lot, a 6-foot steel fence post shall be used in place of the 2-inch by 2-inch wood post.

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Service line connections to existing sewer mains are to be made by the open cutout method in the absence of a built-in Tee or Wye fitting. The connection shall be made by using an approved type of Saddle Tee fitting. The new service pipe may not protrude into the main. The pipe cutout shall be made with an approved type coring machine as required for proper fit. The cutout discs shall be retrieved and shall not be allowed to remain within the main sewer pipe. The Saddle Tee shall be securely fastened to the main sewer pipe by means of epoxy resin or other approved adhesive and the fitting shall be encased with a minimum of 6" concrete. The fitting shall be encased in concrete.

Sewer service lines connecting to a manhole shall be made 3 to 4 inches above the elevation of the concrete bench. A concrete invert one half the depth of the service pipe shall be formed on the manhole bench from the service pipe to the edge of the existing invert formed through the manhole.

All pipe and fitting openings at temporary terminal points shall be fitted with suitable plugs or shall be bulkheaded as required for the main sewer pipe.

If the distance from the sanitary sewer main to the proposed structure is greater than 100 feet, a cleanout is required to be installed at 100-foot intervals. The clean out shall be constructed per Blaine Detail Plates.

5.3.3 Forcemain Installation - The following sections apply to construction of Ductile Iron Pipe and Polyvinyl Chloride Pipe Forcemains only.

A. Duct Iron Pipe Joints

1. Push-On Joints - The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the bell socket. A thin film of approved gasket lubricant shall be applied to either the inside surface of the gasket or the outside surface of the spigot end, or to both. Care shall be taken while inserting the spigot end to prevent introduction of contaminants. The joint shall be completed by forcing the spigot end to the bottom of the socket by the use of suitable pry bar or jack-type equipment. Spigot ends that do not have depth marks shall be marked before assembly to insure full insertion. Field cut pipe shall be filed or ground at the spigot edge to resemble the manufacturer's fabricated detailing. The use of the bucket on the excavation equipment shall not be used to force pipe into socket.
2. Mechanical Joints - The last eight inches of the outside spigot surface and the inside bell surface of each pipe and appurtenance joint shall be painted with a soap solution, after being thoroughly cleaned. The cast iron gland shall then be slipped on the spigot end with the lip extension toward the socket or bell end. The rubber gasket shall be painted with soap solution and be placed on the spigot end with the thick edge toward the gland. An approved lubricant provided by the pipe manufacturer may be used in lieu of the soap solution.

After the spigot end is inserted into the socket to full depth and centered, the gasket shall be pressed into place within the bell evenly around the entire joint. After the gland is positioned behind the gasket, all bolts shall be installed and the nuts tightened alternately to the specified torque, such as to produce equal pressure on all parts of the gland.

Unless otherwise specified, the bolts shall be tightened by means of a suitable torque-limiting wrench to within a foot-pound range of: 40 to 60 for 5/8-inch bolts; 60 to 90 for 3/4-inch bolts; 70 to 100 for 1-inch bolts; and 90 to 120 for 1 1/4-inch bolts. After tightening, all exposed parts of the bolts and nuts shall be completely coated with an approved bituminous

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rust preventive material such as automotive undercoating, unless nickel cadmium plated bolts and nuts are used.

3. Retainer Glands - Retain glands and other mechanical restraint devices shall be installed in accordance to the manufacturer's instructions for the device.

- B. Polyvinyl Chloride Pipe Installation - Installation shall be in accordance with AWWA Manual No. M23 and supplemented as follows in this section.

1. Relocation Wire - A relocation wire shall be installed above the pipe prior to backfilling. The wire shall be 8-gauge plastic jacket type TW or THW, with a first class solder joint when splicing is required. Splicing shall not be more frequent than 1 per 250 feet of piping.

At each appurtenance such as an air relief manhole or valve box the wire shall be securely fastened to the metal box or fastened inside the manhole on an approved standoff.

The wiring shall be connected to the appurtenance in such a way that a low voltage circuit can be completed without excavation of the structure.

- C. Aligning and Fitting of Pipe - The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe and leave a smooth square-cut end. Ductile iron pipe shall be cut with approved mechanical cutters. The electric-arc cutting method, using carbon or steel rod, will be approved for use on the larger size pipe where mechanical cutters are not available. Flame cutting will not be allowed under any conditions. All rough edges shall be removed from the cut ends of pipe and, where rubber gasket joints are used, the outer edge shall be rounded or beveled by grinding or filing to produce a smooth fit.

Wherever it is necessary to deflect the pipe from a straight line either in the vertical or horizontal plane, to avoid obstructions, plumb stems, or produce a long radius curve when permitted, the amount of deflection allowed at each joint shall not exceed the allowable limits for maintaining satisfactory joint seal as given in AWWA C600 (DIP Pipe only) for mechanical joints and push-on joints, or as otherwise allowed by the pipe manufacturer.

The following table is reproduced from AWWA C600 for convenience. The Contractor shall check to ascertain if this is the most current data and complies with the pipe manufacturer's recommendation.

Ductile Iron Pipe

Maximum Deflection Full Length Pipe

- Push-on Type Joint -

| <i>Pipe Diameter (inch)</i> | <i>Deflection Angle (degrees)</i> | <i>Approx. Radius of Curb Produced</i> | | | |
|---------------------------------|---------------------------------------|--|---------------------|--|---------------------|
| | | <i>Maximum Deflection (18' Length)</i> | <i>(20' Length)</i> | <i>by Succession of Joints (feet) (18' Length)</i> | <i>(20' Length)</i> |
| 6 | 5 | 19 | 21 | 205 | 230 |
| 8 | 5 | 19 | 21 | 205 | 230 |
| 10 | 5 | 19 | 21 | 205 | 230 |
| 12 | 5 | 19 | 21 | 205 | 230 |
| 14 | 3 | 11 | 12 | 340 | 380 |
| 16 | 3 | 11 | 12 | 340 | 380 |

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| | | | | | |
|----|---|----|----|-----|-----|
| 18 | 3 | 11 | 12 | 340 | 380 |
| 20 | 3 | 11 | 12 | 340 | 380 |
| 24 | 3 | 11 | 12 | 340 | 380 |

- D. Retaining of Pipe and Appurtenances - All plugs, caps, tees, bends, and other thrust points shall be provided with restraining devices.

All necessary fittings, bands, nuts, and washers, and all labor and excavation required for installation of reaction restraints shall be furnished as a part of the associated work item.

- E. Polyethylene Encasement of Pipeline - Wherever so required by the Plans or Special Provisions, the pipeline, including valves, fittings, and appurtenances, shall be fully encased in polyethylene film of 8 mil nominal thickness. The film shall be furnished in tube form for installation on pipe and all pipe-shaped appurtenances such as bends, reducers, offsets, etc. Sheet film shall be provided and used for encasing all odd-shaped appurtenances such as valves, tees, crosses, etc.

Installation shall be in accordance with AWWA C105.

- 5.3.4 Testing and Acceptance - Prior to final acceptance of each section of pipe, and each manhole, the Contractor shall clean and test the line as described herein.

The line shall be cleaned by flushing a rubber ball, the full diameter of the sewer, through the pipe. All dirt and debris shall be prevented from entering the existing sewer system by means of watertight plugs or other suitable methods approved by the Engineer.

Sanitary sewer pipes shall be straight and uniform in alignment and grade. Manholes shall be free from dirt, mortar, and other debris.

If any test indicates that a section of the sanitary sewer system, including pipe, manholes, service lines and appurtenances, does not meet the allowable criteria established herein, then the necessary repairs and corrective measures shall be undertaken to bring the section in to compliance with the testing levels. All rework and materials used must be approved by the Engineer. For the purposes of the tests, the line between adjoining manholes will be considered a section and will be tested as such. Manholes and service lines will be included in all testing.

The Contractor shall furnish all materials, labor, and equipment necessary to perform the tests, including, but not limited to plugs, weirs, cleaning balls, air compressors, gauges, and hoses. The City's Project Representative must be present for all testing.

Each test described herein will apply as defined in each section. In the absence of specific direction as to how to test a pipe, the Engineer will have the final decision as to which method or methods to use.

- A. Air Testing PVC Gravity Sanitary Sewer - All PVC gravity sanitary sewer lines, mains, stubs, and services shall be substantially watertight. A low-pressure air test shall be performed on all lines, mains, stubs, and services to verify watertightness. Air test shall be conducted after the sewer has been backfilled to finished grade and has been in place for 30 days and ground water has returned to normal elevation. Unless otherwise indicated on the bid proposal, this testing shall be incidental to the cost of pipe installation.

The section of sewer pipe shall be clean, and the pipe may be wetted. Pneumatic balls shall be used to plug each end of the test section at a manhole. The testing gauge shall be located at ground level, out of the manhole, and have dial increments of 0.1 psi or less.

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Low-pressure air shall be introduced into the line until the gauge pressure reaches the initial pressure plus 0.5 psig. At least two minutes shall be allowed for the air temperature to stabilize before readings are taken and the timing started.

The initial pressure on the pipe due to the average height of ground water above the pipe shall be determined by dividing the average height by 2.31 and then adding this value to 5.0 psig. The following table summarizes the initial pressure for heights of 1-10 feet.

| <i>Average Height of Ground Water Table Above Pipe</i> | <i>Initial Pressure</i> |
|--|-------------------------|
| <i>0 foot</i> | <i>5.00 psig</i> |
| <i>1 foot</i> | <i>5.43 psig</i> |
| <i>2 feet</i> | <i>5.86 psig</i> |
| <i>3 feet</i> | <i>6.29 psig</i> |
| <i>4 feet</i> | <i>6.72 psig</i> |
| <i>5 feet</i> | <i>7.16 psig</i> |
| <i>6 feet</i> | <i>7.59 psig</i> |
| <i>7 feet</i> | <i>8.01 psig</i> |
| <i>8 feet</i> | <i>8.44 psig</i> |
| <i>9 feet</i> | <i>8.87 psig</i> |
| <i>10 feet</i> | <i>9.30 psig</i> |

The portion being tested shall pass if it does not lose air within 15 minutes.

In the event of test failure on any test section, testing shall be continued until all leakage has been detected and corrected to meet the requirements. All repair work shall be subject to approval of the Engineer. Introduction of sealant substances by means of the test water will not be permitted. Unsatisfactory repairs or test results may result in an order to remove and replace pipe as the Engineer considers necessary for test conformance. All repair and replacement work shall be at the Contractor's expense.

- B. Deflection Testing PVC Gravity Sewer - Deflection tests shall be performed on all flexible pipe installed for gravity sanitary sewer. The test shall be conducted after the sewer has been backfilled to finished grade and has been in place for 30 days and ground water has returned to normal elevation. Unless otherwise indicated on the bid proposal, this testing shall be incidental to the cost of pipe installation.

No pipe shall exceed a deflection of 5%.

If the deflection test is to be run using a rigid ball or mandrel, it shall have a diameter equal to 95% of the inside diameter of the pipe. The ball or mandrel shall be clearly stamped with the diameter. The test shall be performed without mechanical pulling devices.

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ASTM 3034-81 Nominal Pipe (inches)

| <u>Diameter</u> | <u>*Base ID</u> | <u>Mandrel Diameter</u> |
|-----------------|-----------------|-------------------------|
| 8 | 7.67 | 7.29 |
| 10 | 9.56 | 9.08 |
| 12 | 11.36 | 10.79 |
| 15 | 13.90 | 13.21 |
| 18 | 16.98 | 16.13 |
| 21 | 20.00 | 19.00 |
| 24 | 22.48 | 21.36 |

**From Unibell Handbook, Table 69.*

- C. Infiltration Testing Gravity Sanitary Sewer - All reinforced concrete pipe gravity sanitary services shall be tested for infiltration. If approved by the Engineer, PVC gravity sanitary sewers that are installed below groundwater may be tested for infiltration.

The maximum amount of infiltration leakage allowed in any pipe section is 100 gallons per day per inch diameter of pipe per mile of pipe in the section.

Tests shall be conducted using a 90 degree V-notch weir in manholes located as directed by the Engineer.

The Contractor shall provide for an independent testing company that is acceptable to the Engineer to perform the infiltration testing. The testing company shall provide a written report documenting the work performed and the results obtained. The report must be certified by a Registered Professional Engineer testifying as to its accuracy.

The tests shall be performed in accordance to ASTM 969 except as modified herein.

Unless otherwise indicated on the bid proposal, this testing shall be incidental to the cost of pipe installations.

- D. Televising Gravity Sanitary Sewer - All gravity sanitary sewer mains shall be televised in accordance to 2.3.8 and 2.4.4 of Section 2 of these specifications "Pipeline Installation Requirements".

- E. Hydrostatic Testing of Forcemains - Forcemains shall be subjected to a pressure test prior to acceptance. Testing shall be for a one-hour duration with valves closed. The Contractor shall furnish the pump, pipe connections, temporary plugs, gauges, and measuring equipment, and shall perform the testing in the presence of the Engineer. The pressure gauge for the test shall be an Ashcroft Model 1082 with a 4½-inch dial face and 1 psi increments. Where permanent air vents are provided, the Contractor shall provide and install corporation cocks at the high points as needed for release of air as the line is filled with water.

If concrete reaction blocking is approved by the Engineer, the force main shall not be subjected to hydrostatic pressure until at least 5 days have elapsed after the concrete casting, with the exception that this period may be reduced to 2 days where high early strength concrete is used.

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Any defective joints, pipe, fittings, or valves revealed during the testing or before final acceptance of the work shall be satisfactorily corrected and the test repeated until the specified requirements have been met.

1. Pressure Test - The section being tested shall be slowly filled with water and the specified test pressure shall be applied after all air has been expelled from the pipe. A hydrostatic pressure of two times the maximum design pressure, or a minimum of 70 pounds per square inch, gauge pressure, measured at the lowest point of elevation, shall be applied by means of a pump connected to the pipe in a satisfactory manner.

The gauge pressure shall be checked after a minimum duration of one hour. A pressure drop of 1 psi or less will be cause to accept the test section.

- F. Electrical Conductivity Test - The Contractor shall perform a conductivity test within one week after completion of pressure testing of the main on all ductile iron pipe force mains to establish that electrical thawing may be carried out in the future. The Engineer or Owner may require the Contractor to test the first section of pipe installed to demonstrate the Contractor's ability to install the pipe in an acceptable manner.

The system (pipeline, valves and fittings) shall be tested for electrical continuity and current capacity. The electrical test shall be made after the hydrostatic pressure test and while the line is at normal operating pressure. Backfilling shall have been completed. The line may be tested in sections of convenient length as approved by the Engineer.

Direct current of 350 amperes plus or minus 10% shall be passed through the pipeline for 5 minutes. Current flow through the pipe shall be measured continuously on a suitable ammeter and shall remain steady without interruption or fluctuation throughout the 5-minute test period. For a PVC water main, all sections must be located with an electronic testing device. The Contractor shall provide a certified testing company to supply the device and perform the test.

The current control should be set at minimum before starting. After starting the machine, advance the control until the current indicated on the ammeter is at the desired test value.

Insufficient current or intermittent current or arcing, indicated by large fluctuation of the ammeter needle, shall be evidence of defective contact in the pipeline. The cause shall be isolated and corrected. Thereafter, the section in which the defective test occurred shall be retested as a unit and shall meet the requirements.

Sources of D.C. for these tests may be motor generators, arc welding machines, or other approved sources. All such equipment shall be furnished by the Contractor and subject to the approval of the Engineer.

Cables from the power source to the section of system under test should be of sufficient size to carry the test current without overheating or excessive voltage drop.

Connections for the test can be made at valves. Where valves are not available, connections will be made to straps welded directly to the pipe.

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5.4 **METHOD OF MEASUREMENT AND PAYMENT**

Measurement and payment for each item shall be in accordance to MNDOT Standard Specifications for Construction, 2016, and current supplements, unless modified or supplemented herein. The specification numbering references used herein shall refer to MNDOT Specifications.

Payment shall be at the Contract Bid price for each item shown on the bid form. The bid price shall include furnishing, installing, and removal as specified. All bid items shall include labor and materials for a complete job.

Principal components are listed in each description and do not necessarily include all component parts required. All component parts required by the plans, specifications and detail plates shall be considered included in the contract Bid Price. Payment for the items shown on the bid form shall be payment in full for a complete job as specified.

Work required by this contract and obviously necessary for the timely and successful completion of the project but not specifically provided for in the bid proposal, shall be included in the bid prices of the associated construction items.

- 5.4.1 Connect To Existing Manhole - Measurement and payment shall be per each connection made to an existing manhole and shall include excavating, dewatering, materials, labor, equipment, and backfilling as necessary to break into existing structure and insert, reconstruct and grout structure as needed.
- 5.4.2 Connect To Existing Pipe - Measurement and payment shall be per each connection made to an existing pipe and includes excavation, dewatering, removal of existing plug, cleaning of existing pipe, connection of new pipe and backfilling.
- 5.4.3 Sanitary Sewer Pipe - Measurement and payment shall be per linear foot of each size and depth of pipe installed and shall include excavation, dewatering, delivery, handling, laying, inspection, grade control, gaskets, backfilling, deflection testing, televising and pressure testing. Measurement shall be the actual overall length measured along the axis of the pipe without regard to intervening manholes or fittings. All lengths will be measured in a horizontal plane unless the grade of the pipe exceeds fifteen percent. If provided for in the bid proposal, the depth of pay cut for the sanitary sewer pipe shall be based on the difference from the proposed street centerline subgrade elevation to the pipe invert, to the nearest tenth of one foot. If the pipe is located in a boulevard or ditch section, the depth of pay cut shall be based from the existing elevation over the proposed pipe.
- 5.4.4 Service Laterals - Measurement and payment shall be per linear foot of each size of lateral installed and shall include excavation, dewatering, delivery, handling, laying, inspection, grade control, joints, backfilling and pressure testing. Measurement shall be the actual pipe installed measured from the center of the mainline pipe to the end of service lateral.
- 5.4.5 Service Wye - Measurement and payment shall be per each size of wye installed and includes furnishing and installing the wye.
- 5.4.6 Drop Connection - Measurement and payment shall be per each size and depth of each type of drop connection made and includes excavating, dewatering, furnishing materials, installing and connecting fittings, waterproofing, core drilling into existing manhole, connecting to new or existing manhole, and backfilling.
- 5.4.7 Sanitary Sewer Manhole - Measurement and payment shall be in accordance to MNDOT 2506.502 for each manhole installed. A standard manhole shall be up to 10 feet in depth

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as measured from the top of casting to invert of pipe going out. The cost of furnishing and installing the frame and ring casting is included with the cost of sanitary sewer manhole.

- 5.4.8 Extra Depth Sanitary Manhole - Measurement and payment shall be per linear foot of manhole constructed to depth greater than ten feet. Measured as from the top of casting to the invert minus ten feet to the nearest 0.10 foot. This item is incidental unless provided for on the bid proposal.
- 5.4.9 Forcemain - Measurement and payment shall be on a lineal foot basis for each size of force main installed and includes the furnishing of the pipe, rubber gaskets, joints, delivery of materials, handling, laying, excavation, dewatering, backfilling, testing, shop inspection, grade control and all other materials and work necessary to install the pipe complete in place as shown on the plans. Measurement shall be the actual overall length measured along the axis of the pipe without regard to intervening valves or fittings. Measurement of branches will be measured from the centers of connecting pipes to the centers of the valve or fittings. All lengths will be measured in a horizontal plane unless the grade of the pipe exceeds fifteen percent.