

**SPECIAL PROVISION**  
**SANITARY SEWER INSTALLATION**

This special provision has applicability for installation of sanitary sewer pipe, structures, and equipment.

**Description**

**1.1 General Description of Work.** This purpose of this work is to install       (X-inch "type")       sewer line. The CONTRACTOR shall be responsible for supplying and installing the new sewer main piping and appurtenances in accordance with the sewer plans and specifications or as ordered by the ENGINEER.

**1.1.1**       ("CONTRACTOR'S NAME")       or its Designated Agent, hereinafter called the CONTRACTOR, together with the ENGINEER and the OWNER, will inspect, accept, and reject work related to the sanitary sewer installation herein specified.

**1.1.2** The CONTRACTOR shall furnish all materials, labor, tools, and equipment and perform all operations, testing, and incidentals necessary for a complete sewer installation as shown on the plans and specified herein.

**1.2 Sequence/Maintenance of Service.** The CONTRACTOR shall provide a bypass pumping system as necessary to maintain continuous sewer service. The CONTRACTOR shall be responsible for providing whatever is necessary to allow for the continuation of sewage flow from locations upstream of and adjacent to the construction of the replacement sewer. The flow shall be maintained in whatever manner the CONTRACTOR chooses; however, the method chosen must provide for round-the-clock fail-safe sewer service which shall not result in any spills. Should pumps be employed by the CONTRACTOR to maintain flow, the pumps shall be electrically driven and powered by electrical drops from power companies during non-working hours. The CONTRACTOR shall submit the proposed plan to maintain sewage flow to the OWNER for review and approval a minimum of 10 days prior to start-up of the bypass system.

**1.3 Reference Drawings and Information.** The plans indicate, in general, the alignment and finished grade elevation and underground utility and piping invert grades. The ENGINEER may make such adjustments in grade and alignment, as are necessary, in order to avoid interference and to adapt the piping to other special conditions encountered. All locations of existing pipes, utilities, etc., shall be verified by the CONTRACTOR with the proper authority. The OWNER does not guarantee the accuracy or completeness of the existing conditions shown on the construction plans. Cover over pipes shall conform to requirements of the New Hampshire Department of Environmental Services (NHDES).

**1.3.1** Sufficient investigations shall be made by the CONTRACTOR so that the CONTRACTOR is knowledgeable about existing conditions prior to tendering a bid.

**Materials**

**2.1 Materials.** The CONTRACTOR shall provide the following material for the installation of the sewer mains, manholes services, and appurtenances.

**2.1.1 Common Backfill.** Common backfill shall be granular material consisting of hard sand and gravel so graded that, of the material passing the No. 4 (4.75 mm) sieve, not more than 35 percent shall pass the No. 200 (0.075 mm) sieve. Common backfill shall be free of organic matter, trash, roots or other deleterious material and shall contain no stone measuring greater in any dimension than two-thirds of the loose lift thickness, or 6 inches (200 mm), whichever is smaller. Common backfill material shall be capable of forming a firm, stable base when spread and compacted in accordance with this specification. In addition, common backfill shall be non-plastic (plasticity index zero, defined as liquid limit minus plastic limit). Common backfill materials may be obtained from either on-site excavations or from off-site sources. Any materials excavated from the trench and not conforming

to this specification shall be disposed of as specified and replaced with approved material, as required, at no additional cost to the OWNER.

**2.1.2 Sand Blanket Material.** Sand blanket material required for installation of the sewer mains, services, and appurtenances shall meet the following gradation requirements, 100 percent passing the ½-inch (12.5 mm) sieve and, of the material passing the #4 (4.75) sieve, no more than 15 percent passing the #200 (0.075 mm sieve).

**2.1.3 Gravel Fill.** Gravel fill shall consist of hard, durable gravel free from trash, organic matter, clay, surface coatings, and other deleterious materials. Gravel fill shall have a maximum stone size of two-thirds of the loose lift thickness, or 6 inches (150 mm), whichever is smaller. That portion passing the 4-inch (100 mm) sieve shall meet the following gradation requirements, as determined by ASTM C 136 and ASTM C 117:

<u>U.S. Sieve Size</u>	<u>Percent Passing</u>
6-inch (150 mm)	100
No. 4 (4.75 mm)	25-70
No. 200 (0.075 mm) *	0-12

\* Based on fraction passing the No. 4 (4.75 mm) sieve.

**2.1.4 Crushed Gravel.** Crushed gravel shall consist of hard durable sand and gravel, free from trash, organic matter, clay, surface coatings, and other deleterious materials. Crushed gravel material shall meet the following gradation requirements, as determined by ASTM C 136 and ASTM C 117:

<u>U.S. Sieve Size</u>	<u>Percent Passing</u>
3-inch (75 mm)	100
2-inch (50 mm)	95-100
1-inch (25 mm)	55-85
No. 4 (4.75 mm)	27-52
No. 200 (0.075 mm)*	0-12

\* Based on fraction passing the No. 4 (0.075 mm) sieve.

**2.1.5 Bedding.**

**2.1.5.1 Gravity Sewer Bedding.** Gravity sewer bedding shall be crushed stone conforming to ASTM C 33 stone size No. 67 gradation requirements.

**2.1.5.2 Force Main Bedding.** Force main bedding shall be sand conforming to NHDOT Item 304.1 Sand gradation requirements.

**2.2 Sanitary Sewer.** All products and materials shall conform to the latest ASTM, ANSI or other appropriate standard and as otherwise specified herein.

**2.2.1 Gravity Polyvinyl Chloride Pipe.** Gravity polyvinyl chloride pipe shall be SDR-35 with integral bell and spigot joints, conforming to ASTM D 3034, unless otherwise noted. Pipe shall have manufacturer name clearly marked on it.

**2.2.1.1** Each length of pipe shall have an integral bell and shall be supplied in 14-foot (4.27 m) lengths.

**2.2.1.2** Furnish fittings of approved equal to the pipe and have bell and spigot configuration identical to that of the pipe. Fittings shall comply with ASTM D 3034. Fittings shall have manufacturer name clearly marked on it.

**2.2.1.3** Joint shall be push-on type using elastomeric gasket designed to prevent slipping during jointing. Joints shall comply with ASTM D 3212. The gaskets shall be factory installed and secured in place prior to delivery to the job site. Gaskets shall conform to ASTM F 477.

**2.2.1.4** All pipe, fittings, gasket material and lubricant shall be supplied by the same manufacturer. Petroleum base lubricants shall not be used.

**2.2.1.5** Physical and chemical properties of pipe couplings shall be equal to those properties of the pipe.

**2.2.2 Mechanical Joint Ductile Iron Pipe.** Mechanical joint ductile iron pipe for use on bridge crossings shall conform to ANSI A21.51/AWWA C 151 Class 52. Pipe shall be double cement lined and seal coated inside and outside in accordance with ANSI A21.4/AWWA C 104. All pipe shall be conspicuously marked on the exterior with the pressure, class and weight. All mechanical joint ductile iron pipe shall be furnished with "Mega-Lug" type retainer glands.

**2.2.2.1** Each length of pipe shall be furnished in even lengths, either 18 feet or 20 feet.

**2.2.2.2** Mechanical joint fittings shall be ductile iron conforming to ANSI A21.10/AWWA C 110 and of the same class as the pipe unless otherwise shown on the drawings. Pipe and fitting joint shall meet ANSI A21.11/AWWA C 111 standards and shall include plain rubber gaskets. Fittings shall be double cement lined and seal coated inside and outside in accordance with ANSI A21.4/AWWA C 104. All fittings shall be furnished with ductile iron retainer glands.

**2.2.3 Push-On Type Ductile Iron Pipe.** Push-on type ductile iron pipe shall be ductile iron complying with ANSI A21.51/AWWA C 151, Class 52. Pipe shall be double cement-lined  $\frac{1}{8}$ -inch (3 mm) thick and seal coated inside and out in accordance with ANSI A21.4 and AWWA C 104. All pipe shall be conspicuously marked on the exterior with the pressure, class and weight. All pipe shall be furnished with ductile iron retainer glands.

**2.2.3.1** Each length of pipe shall be furnished in even lengths, either 18 feet or 20 feet.

**2.2.3.2** Joints shall be rubber gasket, push-on type in accordance with ANSI A21.11/AWWA C 111. Use only lubricant that is specified by the pipe manufacturer.

**2.2.4 Forcemain Polyvinyl Chloride Pipe.** Forcemain polyvinyl chloride pipe shall be SDR-21 with integral bell and spigot joints, conforming to ASTM D 2241. Pipe shall have manufacturer name clearly marked on it.

**2.2.4.1** Each length of pipe shall have an integral bell and shall be supplied in 20 feet (6.09 m).

**2.2.4.2** Furnish fitting of approved equal to the pipe and have bell and spigot configuration identical to that of the pipe. Fittings shall comply with ASTM D 2241. Fittings shall have manufacturer name clearly marked on it.

**2.2.4.3** Joint shall be push-on type using elastomeric gasket designed to prevent slipping during jointing. Joints shall comply with ASTM D 3139. The gaskets shall be factory installed and secured in place prior to delivery to the job site. Gaskets shall conform to ASTM F 477.

**2.2.4.4** All pipe, fittings, gasket material and lubricant shall be supplied by the same manufacturer. Petroleum base lubricants shall not be used.

**2.2.4.5** Physical and chemical properties of pipe couplings shall be equal to those properties of the pipe.

**2.2.5 Flexible Couplings and Transition Couplings.** Fittings shall be gasketed slip-style. Flexible/FERNCO style fittings are not permitted. Glued fittings are not permitted.

**2.2.6 Couplings.** Couplings used to join plain ends of PVC pipes shall be PVC double bell couplings which shall conform to ASTM D 3034 for materials and ASTM D 3212 for joints.

**2.2.7 Identification.** Each pipe length and fitting shall be clearly marked with:

**2.2.7.1** Manufacturer's name and trademark.

**2.2.7.2** Nominal pipe size with sidewall dimension ratio.

2.2.7.3 Material designation.

### 2.3 Pipe Insulation (Expansion Piping).

**2.3.1 Materials.** Materials shall be polystyrene insulation with a minimum density of 2.05 lbs/cf and have a minimum R value of 5.3 per inch at 180 days at a mean temperature of 75 degrees F.

**2.3.2** Insulation shall be 2 layers of 2-inch thick insulation board (4-inch total thickness) with staggered joints.

**2.3.3** Apply with adhesive as specified and recommended by manufacturer.

**2.3.4** Provide manufacturer approved sealant to cover exposed edge.

**2.3.5** Pipe Jacket shall be a 0.032 inch corrugated aluminum jacket around the insulation.

**2.3.5.1** Jacket shall be secured in place by ¾-inch stainless steel bands.

### 2.4 Joints.

#### 2.4.1 Expansion Joints.

**2.4.1.1 Materials.** Materials shall be capable of withstanding the temperature, pressure, and type of material in the pipeline.

**2.4.1.2** Shall be the filled arch type that will prevent sediment build up for all sludge, sewage, and other lines with similar service.

**2.4.1.3** Supplied with control rods to restrict elongation and compression.

**2.4.1.4** Metal retaining rings shall be split and beveled galvanized steel for placement against the flange of the expansion joint.

**2.4.1.5** Acceptable Manufacturers: EBAA Iron Sales, Inc. or approved equivalent.

#### 2.4.2 Deflection Joints.

**2.4.2.1 Materials.** Materials shall be designed to permit a nominal maximum deflection of 15 degrees in all directions from the axis of the adjacent pipe length, will prevent pulling apart, and will remain watertight at any angle of deflection under 15 degrees.

**2.4.2.2 Materials.** Materials shall be manufactured from a composition material suitable for exposure to the liquid, pressure, and temperature to be contained within the pipe.

**2.4.2.3** Supplied with control rods as required.

### 2.5 Precast Concrete Manholes.

**2.5.1 Materials.** Materials shall be in conformance with NHDOT Standard Specification Item 604.31 and NHDES Env-Wq 704.12 and Env-Wq 704.13.

**2.5.2 Precast Manhole Sections.** Precast manhole sections shall be in conformance with NHDOT Standard Specification Item 604.31 and NHDES Env-Wq 704.12 and Env-Wq 704.13.

**2.5.2.1** All precast sections and bases shall have the date of manufacture and name or trademark of the manufacturer impressed or indelibly marked on the inside wall.

### **2.5.3 Manhole Joints and Pipe Seals.**

**2.5.3.1** Horizontal joints between precast manhole sections shall be tongue and groove as shown on the Drawings and shall have a double row of a mastic-like sealant or a butyl rubber joint gasket (O-ring) conforming to ASTM C 443. All horizontal joints shall be watertight in accordance with the testing requirements of this Section.

**2.5.3.2** Pipe to manhole joints shall be an embedded flexible rubber boot or as shown on the Drawings. Nonshrinking mortar or grout is not acceptable. Pipe to manhole connections and joints shall be watertight in accordance with the testing requirements of this Section.

### **2.5.4 Waterproofing.**

**2.5.4.1** All manholes shall be waterproofed, at the factory, with two seal coats of bituminous waterproofing material, applied to the exterior of the manhole in accordance with the seal coating manufacturer's recommendations. The coating shall be applied after the manholes have cured adequately.

**2.5.4.2** Exterior of all joints shall be filled with hydraulic cement and then coated with waterproofing after setting.

### **2.5.5 Brick Masonry.** Brick masonry for Inverts and Grade Adjustment: ASTM C 32, Grade SS.

**2.5.5.1** Brick masonry inverts shall be constructed as a smooth semicircular shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with smooth curves with radius as large as permitted by the size of the manhole. Invert channels should be formed as shown on the drawings.

**2.5.5.2** Grade adjustment for manhole frames and covers shall whenever possible use solid precast concrete riser rings. No more than one layer of brick shall be permitted.

### **2.5.6 Mortar.**

**2.5.6.1** Masonry Cement: ASTM C 150 (Type II).

**2.5.6.2** Aggregate for Masonry Mortar: ASTM C 144.

**2.5.6.3** Hydrated Lime for Masonry Purposes: ASTM C 207.

**2.5.6.4** Mortar for Unit Masonry: ASTM C 270, Type S.

**2.5.6.5** Premixed Materials: ASTM C 387.

### **2.5.7 Drop Manholes.**

**2.5.7.1** No free drop shall be permitted within the manhole.

**2.5.7.2** Where vertical distance between inlet and outlet pipe exceeds 12 inches, construct a drop manhole as shown on the drawings.

## **2.6 Sewer Manhole Frames and Covers.**

### **2.6.1 General.**

**2.6.1.1** The castings shall be of good quality, strong, tough, even-grained cast iron, smooth, free from scale, lumps, blisters, sand holes and defects of every nature which would render them unfit for the service for which they are intended. Contact surfaces of covers and frame seats shall be machined at the foundry, before shipment to prevent rocking of covers in any orientation.

**2.6.1.2** All castings shall be thoroughly cleaned and subject to a careful hammer inspection.

**2.6.1.3** Castings shall be at least Class 30 conforming to the ASTM A 48.

**2.6.1.4** All castings shall be heavy duty suitable for H-20 loadings.

**2.6.2 Manhole frames and Covers.** Manhole frames and covers shall provide 30-inch (750 mm) diameter clear opening. The cover shall have the word "SEWER" in 3-inch (75 mm) letters cast into a diamond design top surface.

**2.6.2.1** Approved models for castings shall be Neenah R-1743-W frame and R1743 cover or approved equal. In areas prone to flooding, castings shall be Neenah R-1916-H1 gasketed bolted frame and lid, or approved equal.

**2.7 Casing pipe** for highway crossing (and other uses) shall be galvanized steel pipe, A53 grade, schedule 40 standard weight pipe suitable for welding and not intended for flanging.

**2.7.1 Casing Pipe:**

<u>Carrier Pipe</u>	<u>Casing Pipe Diameter (min)</u>
4-inch Class 52 D.I.	10-inch
6-inch Class 52 D.I.	12-inch
8-inch Class 52 D.I.	16-inch
10-inch Class 52 D.I.	20-inch
12-inch Class 52 D.I.	24-inch

**2.7.2 Tolerance.** Out-of-round tolerance shall not exceed 0.50 inches (12.5 mm ).

**2.7.3 Pipe Spacers.** Pipe spacers shall be a two-piece 14-gauge T-304 stainless steel assembly with stainless steel bolts. Assembly shall be the restrained positioning type. The runners shall be a ultra high molecular weight polymer with a maximum coefficient of friction 0.12. The assembly shell liner shall be 0.090-inch (2.3 mm) ribbed PVC with 85-90 durometer. Spacer assembly shall be as manufactured by Cascade Waterworks MFG. Co. or approved equal.

**2.7.4 Carrier Pipe.** Carrier pipe shall be mechanical joint ductile iron per paragraph 2.2.2.

**2.7.5 Bulkhead Materials.** Bulkhead materials shall be one of the following:

**2.7.5.1 Brick and Mortar.** Brick for bulkheads shall be sound, uniformly burned and shall comply with ASTM C 32, Grade SA. Mortar shall consist of one part cement, one-quarter part lime, and two parts sand. Sand shall comply with ASTM C 144; lime shall comply with ASTM C 207, Type S; cement shall comply with ASTM C 150, Type II.

**2.7.5.2 Rubber Seal.** Rubber shall have one adhesive side for initial attachment to the pipe. Bonding agent shall seal the two ends of the rubber. Three-quarter-inch stainless steel bands shall secure the rubber seal to the casing and carrier pipes. Rubber seal shall be Model CCES as manufactured by Cascade Waterworks MFG or approved equal.

**Construction Requirements**

**3.1 General.** The CONTRACTOR shall furnish all sanitary sewer pipe, fittings, services and related material and appurtenances, labor, tools and equipment, granular material, and concrete; and perform all operations and incidentals necessary for complete excavation, installation, backfill and testing, as outlined herein and on the plans; and maintaining service at all times.

**3.1.1** The CONTRACTOR shall be responsible for the layout of the work. The OWNER will provide control points as described in Section 105.08. The sanitary sewer and appurtenances shall be built at the locations indicated on the plan to facilitate reconstruction of other facilities within this area of the project.

**3.1.2** The CONTRACTOR shall be responsible to field locate all existing sewer service laterals for the purpose of connecting them to the proposed sewer. This may involve exploratory test pits of which payment will be made under Item 206.19.

**3.1.3** Consequential damages resulting from the CONTRACTOR not locating the facilities as shown on the plan are the responsibility of the CONTRACTOR.

**3.1.4** Location of new sewer services for all lots throughout the project area as part of the new sewer line will be as determined by the OWNER and ENGINEER.

**3.1.5** The CONTRACTOR, at the completion of each part of the work, shall furnish the as-built locations of the sewer main, and appurtenances referenced to the OWNER'S Construction Base Line and Bench Marks. The as-built locations shall be to an accuracy of plus or minus 0.10 feet (0.03 m) in plan and elevation.

**3.1.6** Any deviations from the locations shown on the plans require the OWNER 's and ENGINEER's approval. Any discrepancies with locations shown on the plans will be brought to the ENGINEER's attention and subsequently resolved between the OWNER, the ENGINEER and the CONTRACTOR.

## **3.2 Trench Excavation.**

**3.2.1 General.** Excavation, dewatering, sheeting, and bracing shall be carried out in such a manner as to eliminate any possibility of undermining or disturbing the foundations of any existing structure, utilities or any work previously completed under this contract.

**3.2.1.1** All lawns, paved surfaces, roadways, and structures which have been damaged or disturbed by the CONTRACTOR 's operations outside of the project work areas shall be restored to a condition at least equal to that in which they were found immediately prior to the beginning of operations or as specified on the drawings.

**3.2.1.2** On paved surfaces that will not be resurfaced under this contract, the CONTRACTOR shall not use or operate tractors, bulldozers, or other power-operated equipment with treads or wheels which are so shaped as to cut or otherwise damage such surfaces during excavation or other phases of the work.

**3.2.2 Execution.** The CONTRACTOR shall provide trench shoring and dewatering, if necessary, to provide a stable and dry trench at all times. The pipe trench must be dewatered to 1-foot 6 inches (0.5 m) below the invert of the new sewer pipe. Trench width shall be 2 feet (0.6 m) plus the diameter of the pipe or a minimum of 3 feet (1 m), whichever is greater. Cover on the gravity sewer pipe shall be a minimum of 6 feet (1.8 m) or as shown on the contract drawings. Trench depth shall extend to 6 inches (150 mm) below the invert of the main.

**3.2.2.1** As the excavation approaches pipes, conduits, or other underground structures, digging by conventional trenching machine methods shall be discontinued. Only manual methods of excavating shall be employed around buried utilities.

**3.2.2.2** Prior to doing any work outside the right-of-way line on private property or disturbing private property, the CONTRACTOR shall advise the property owner of the work and/or disturbance of the person's property that will be done, and the restoration thereof.

**3.2.2.3** The CONTRACTOR shall maintain utilities, utility services and sewers encountered in the excavation, and repair or replace them to their owner's satisfaction and be responsible for consequential damages thereof.

**3.2.2.4** The CONTRACTOR shall not be compensated for any additional work required in working in close proximity to a utility line, sewer, water or underground structure in the trench line above or below the sewer pipe.

**3.2.2.5** Where sheeting is placed alongside the pipe and extends below mid-diameter, the sheeting shall be cut off and left in place to an elevation not less than one foot above the top of the pipe and at least 3 feet below finished grade.

**3.2.2.6** Excavations shall be kept dry until the pipes and appurtenances to be built therein have been completed to such extent that they will not be damaged.

**3.2.2.6.1** Provide, operate and maintain any dewatering system required to lower and control groundwater levels and groundwater hydrostatic pressure during the construction of the Work as required by this Section and the Contract Documents. The CONTRACTOR shall assume full responsibility and expense for the adequacy of the dewatering system with no additional time for performance.

**3.2.2.6.2** The dewatering system shall be capable of developing an excavated subgrade relieved of any hydrostatic pressure that could cause a decrease in the stability of the excavated subgrade and which will provide the necessary groundwater control for the proper performance required for completion of the Work.

**3.2.2.6.3** Dispose of subsurface water collected in a manner which conforms to all applicable local and state ordinances, statutes and laws. Obtain all permits required for operation of the dewatering system.

**3.2.2.6.4** Maintain continual and complete effectiveness of the dewatering system operation to provide a firm, stable, excavated subgrade at all times as required for proper performance of the Work.

**3.2.2.6.5** Provide dewatering necessary to maintain the groundwater table 18 inches (450 mm) below the base of the proposed structure and/or pipe at all times.

**3.2.2.6.6 Erosion Control.** Provide adequate protection from erosion from any of the dewatering operations utilized during the course of the construction. Any damage, disruption or interference to newly constructed work or existing properties, buildings, structures, utilities and/or other work resulting directly or indirectly from dewatering operations conducted under this Contract shall be remedied by the CONTRACTOR, at no cost to the OWNER.

**3.2.2.6.7 Treatment of Dewatering Operations Discharges.** Provide such additional treatment devices as may be required to meet the provisions of the Contract. This may include the construction of sumps and/or settling basins, stone rip-rap, silt fences or other requirements. The treatment devices shall be later removed and/or filled in with acceptable backfill material, and restored to original conditions once they are no longer needed, at no additional cost to the OWNER.

**3.2.3 Over-Excavation.** If, in the opinion of the ENGINEER together with the OWNER, the material at or below the depth of the trench is unsuitable for foundation, it shall be removed to such depths as directed by the OWNER and shall be replaced with Granular Backfill (Sand) and placed as provided in 209.3.

**3.2.3.1** Where the bottom of the excavation shall, by error of the CONTRACTOR, have been taken to a depth greater than the depth shown on the drawings, or as directed, said condition shall be corrected by refilling to the proper grade with compacted Granular Backfill (Sand) and placed as provided in 209.3. All costs shall be borne by the CONTRACTOR.

**3.2.4 Rock and Boulder Excavation.** Rock and boulder excavation shall be in accordance with "Section 206, Structure Excavation for Pipes and Other Minor Structures."

**3.2.5 Excess and Unsuitable Excavation.** Excess excavation that will not be used for backfill, and unsuitable excavation shall be removed from the site and disposed of by the CONTRACTOR in accordance with local, state or federal regulations.

### **3.3 Trench Backfill.**

**3.3.1 General.** After the pipe has been placed and has been inspected by the OWNER together with the ENGINEER, backfilling shall be performed without delay.



### **3.3.2 Bedding.**

**3.3.2.1 Gravity Sewer Bedding.** Gravity sewer bedding shall be crushed stone and shall extend 6 inches (150 mm) below the pipe invert, to the trench walls, to springline (horizontal centerline) of pipe. Placement and compaction of bedding to 95 percent Modified Proctor in accordance with ASTM D 157 and ASTM D 2922 shall be done prior to placement of the pipe and blanket.

**3.3.2.2 Forcemain Sewer Bedding.** Forcemain sewer bedding shall be sand and shall extend 6 inches (150mm) below the pipe invert, to the trench walls, to springline (horizontal centerline) of pipe. Placement and compaction of bedding to 95 percent Modified Proctor in accordance with ASTM D 157 and ASTM D2922 shall be done prior to placement of the pipe and blanket.

**3.3.3 Blanket.** From the springline of the pipe to a minimum of 12 inches (300 mm ) above the pipe crown, the trench shall be backfilled by placing and compacting the sand in lifts of 6 inches (150 mm) or less to 95 percent Modified Proctor in accordance with ASTM D 157 and ASTM D 2922. The filling shall be carried up evenly on both sides of the pipe, care being taken not to raise or otherwise dislodge the pipe. Backfill to this depth shall be thoroughly compacted with approved hand-operated devices.

**3.3.4 Backfill.** Backfill material from 12 inches (300 mm) above the pipe crown to the underside of the pavement select material profile, or to the underside of gravel and loam areas, shall be backfilled with common backfill described herein and as approved by the ENGINEER.

**3.3.4.1** Backfill shall be placed and compacted in layers of 6 inches (150 mm) or less. Compaction shall be by hand-operated compactors.

**3.3.4.2** Tamping of trenches with excavating machines is prohibited.

**3.3.4.3** Trench areas improperly backfilled or having excessive settlement, as determined by the ENGINEER, shall be reopened to the required grade and repaved as necessary. The CONTRACTOR shall receive no additional compensation for repair of trenches constructed under this Contract.

**3.3.4.4** Soil compaction for pipe backfill shall be 95 percent Modified Proctor in accordance with ASTM D 157 and ASTM D 2922.

**3.3.5 Temporary Trench Pavement Patch.** All pavement patching of sewer pipe-related trenches shall be in accordance with Section 401.3.

### **3.4 Sewer Installation.**

#### **3.4.1 General.**

**3.4.1.1** Pipe and fittings shall be handled with care to ensure that the pipe and fittings are in sound, undamaged condition. Particular care shall be taken to prevent damage to pipe coating and lining (if any).

**3.4.1.2** The CONTRACTOR shall furnish slings, straps and/or other approved devices to support the pipe when it is lifted. Pipe and fittings shall not be dropped from trucks onto the ground or into the trench. Transporting pipe and fittings from storage areas shall be restricted to operations which will not cause damage to the pipe or lining (if any).

**3.4.1.3** All pipe and fittings shall be examined before laying, and no pipe or fittings shall be installed which are found to be defective. Damaged pipe coatings and/or lining (if any) shall be repaired as approved or directed by the ENGINEER at no additional cost to the OWNER.

**3.4.1.4** Any pipe showing a distinct crack with no evidence of incipient fracture beyond the limits of the visible crack, if approved, may have the cracked portion cut off by, and at the expense of, the CONTRACTOR before the pipe is laid so that the pipe used is sound. The cut shall be made in the sound portion of the barrel at least 12 inches (300 mm) from the visible limit of the crack.

**3.4.1.5** If any defective pipe is discovered after it has been laid, the CONTRACTOR shall remove the defective pipe and replace it with sound pipe at no additional cost to the OWNER.

**3.4.1.6** In general, gravity pipe laying shall proceed upgrade with spigot ends pointing in the direction of the flow.

**3.4.1.7** Flow from existing service connections and main lines shall be maintained at all times by pumping or other methods approved by the ENGINEER. Under no circumstances will the dumping of raw sewage on private property, in municipal streets or into waterways, be allowed.

### **3.4.2 Control of Alignment and Grade.**

**3.4.2.1** Easement and property and other control lines necessary for locating the Work, as well as elevations and bench marks used in the design of the Work, are shown on the Drawings. The CONTRACTOR shall use this information to set line and use a level or transit to set grade.

**3.4.2.2** The CONTRACTOR shall use laser equipment to assist in setting the pipe and casing and must demonstrate satisfactory skill in its use.

**3.4.2.3** The use of string levels, hand levels, carpenter's levels or other similar devices for transferring grade or setting pipe are not to be permitted.

**3.4.2.4** During construction provide the OWNER, upon request, all reasonable and necessary materials, opportunities, and assistance for setting stakes and making measurements, including the furnishing of one (1) or two (2) rodmen as needed at intermittent times.

**3.4.2.5** CONTRACTOR shall not proceed until he has made timely request of the ENGINEER for, and has received, such controls and instructions as may be necessary as Work progresses. The Work shall be done in strict conformity with such controls and instructions.

**3.4.2.6** The CONTRACTOR shall carefully preserve bench marks, reference points and stakes, and in case of willful, careless, or accidental destruction by his own workers, he will be responsible for the resulting expense to re-establish such destroyed control data and shall be responsible for any mistakes or delay that may be caused by the loss or disturbance of such control data.

**3.4.2.7** Maintain good alignment in laying pipe. The deflection at joints shall not exceed the manufacturer's recommended limit. Provide fittings, if required, in addition to those shown on the Drawings when pipe crosses utilities encountered when excavating the trench. Use solid sleeves only where shown on the plans unless otherwise approved by ENGINEER.

### **3.4.3 Installing Pipe and Fittings.**

**3.4.3.1** The CONTRACTOR shall have on the job site with each pipe laying crew, all the proper tools to handle and cut the pipe.

**3.4.3.2** All pipe and fittings shall be thoroughly cleaned before laying, and shall be kept clean until installed.

**3.4.3.3** Pipe shall be laid in the dry trench conditions. At no time shall water in the trench be permitted to flow into the pipe. At any time that Work is not in progress, or the trench is unattended, the end of the pipe in the trench shall be suitably closed to prevent the entry of animals, earth, water, etc. using watertight expandable plugs.

**3.4.3.4** Lay PVC pipe and fittings in accordance with the requirements of AWWA C 900, except as provided herein. PVC pipe shall not be installed when temperatures are below 32 ° F (0 ° C) unless approved by the ENGINEER.

**3.4.3.5** Lay ductile iron pipe and fittings in accordance with the requirements of AWWA C 600, except as provided herein.

**3.4.3.6** Excavation shall conform to the Trenching Section shown on the drawings.

**3.4.3.7** As soon as excavation has been completed to the proper depth the pipe bed shall be prepared as follows:

**3.4.3.7.1** Pipe Laid on Bedding Material: Place and compact bedding materials, as specified in the Trenching Section, to the elevation necessary to bring the pipe to grade. The compacted material shall be shaped so that the bottom quadrant of the pipe rests firmly on the bedding for the entire length of pipe barrels. Suitable holes shall be dug for bells or couplings to provide ample space for jointing pipe.

**3.4.3.8** Each pipe section shall be placed into position on the pipe bed in such a manner and by such means required to avoid injury to persons, any property or the pipe.

**3.4.3.9** Permanent blocking under the pipe is not permitted except where a concrete cradle is required, in which case precast concrete blocks shall be used.

**3.4.3.10** Jointing shall conform to the manufacturer's instructions and appropriate ASTM Standards.

**3.4.3.11** Any debris, tools etc. shall be removed from the pipe.

**3.4.3.12** After placing the pipe on the bedding, the bedding material shall be placed and compacted to the spring line (horizontal centerline) of the pipe.

**3.4.3.13** Following placement of the bedding material, the blanket material shall be placed and compacted from the spring line to 12 inches (300 mm) above the crown of the pipe.

**3.4.3.14** After placement of the blanket material the pipe shall be checked for alignment and grade. If the pipe has been properly installed, the CONTRACTOR may refill or backfill the remainder of the trench in conformance with the Trenching Section, and details shown on the Drawings.

**3.4.3.15** At the end of each day's work, or more frequently, the ENGINEER will view the pipe installation with the CONTRACTOR. Unsatisfactory work shall be dug up and reinstalled to meet the requirements of the Contract Documents with no additional time allowed for completion of the Work and at no additional cost to the OWNER.

**3.4.3.16** When cutting of pipe is required, the cutting shall be done by machine (power cutter) without damage to the pipe or cement lining (if any). Cut ends shall be smooth and at right angles to the long axis of the pipe. Pipe ends to be used with a rubber gasket joint shall be beveled and filed or ground smoothly to conform to a manufactured spigot.

#### **3.4.4 Service Connections.**

**3.4.4.1** House service lines shall be laid from the wye connection on the main line sewer to the property line, as directed by the ENGINEER.

**3.4.4.2** All new service connections shall be 8-inch (200 mm) PVC.

**3.4.4.3** New services shall terminate as shown on the Drawings, be capped with a watertight cap, and the end shall be marked with a ferrous metal rod or pipe terminating at finish grade.

**3.4.4.4** At the time of service connection to the property, a cleanout shall be installed at the property line. The cleanout shall be 6-inch to the surface and intersect the service via a 8" x 8" x 6" wye. The top of this cleanout shall have a removeable screw-cap and be covered with a cast iron frame/cover meeting ASTM A 48 CL35B set

at finished grade. When the cleanout is located in a landscaped area, the frame shall be set in 2 foot square by 4-inch thick concrete collar with 4-inch by 4-inch welded wire fabric at mid-depth.

**3.4.5 Testing.**

**3.4.5.1 General.**

**3.4.5.1.1** Leakage tests under the direction of the Engineer shall be conducted on all pipes installed under this section of the Work. Deflection tests shall be conducted on PVC pipe as ordered by the ENGINEER. The ENGINEER shall witness all tests. The CONTRACTOR shall supply all plugs, pumps, weirs, gauges, water, water trucks, mandrels, etc., necessary to conduct the tests. Should the Work fail the leakage or deflection tests, corrective action shall be taken by the CONTRACTOR in a manner approved by the ENGINEER and, if directed by the ENGINEER, the CONTRACTOR shall dig up and relay the failed section with no additional time allowed for completion of the Work and at no additional cost to the OWNER.

**3.4.5.1.2** The use of sealants, applied from the inside of the pipe, is not acceptable.

**3.4.5.1.3** Flush all piping systems with water prior to testing.

**3.4.5.1.4** Testing forms which indicate all testing information and results shall be submitted to the ENGINEER.

**3.4.5.2 Sanitary Sewer Pipe Testing With All Service Connections Capped.**

**3.4.5.2.1** Air Test: Leakage testing shall be by means of low-pressure air in accordance with the procedures described in UNI-B-6. The maximum allowable pressure drop from the test pressure shall be 1.0 psig (6.89 kPa) during the minimum holding time.

Test pressure psi (kPa) shall be calculated using the following equation:

ENGLISH

$$P = 8.5 + \left( \frac{H}{2.31} \right)$$

*P = Test Pressure (Max = 9 psf)*

*H = Height of Groundwater Above Invert (feet)*

METRIC

$$P = 24.1 + \left( \frac{H}{0.102} \right)$$

*P = Test Pressure (Max = 62.0 kPa)*

*H = Height of Groundwater Above Invert (meters)*

Minimum holding time required for a 1.0 psig (6.89 kPa) maximum pressure drop shall be calculated using the following chart.

## MINIMUM HOLD TIME FOR SEWER PRESSURE TEST

### ENGLISH UNITS

Pipe Diameter (in)	Minimum Time (mm:ss)	Length For Minimum Time (ft)	Time for Longer Length (s)	Time (mm:ss) for Length (L) Shown					
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft
				4	3:46	597	0.380 L	3:46	3:46
6	5:40	398	0.854 L	5:40	5:40	5:40	5:40	5:40	5:40
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29

### METRIC UNITS

Pipe Diameter (mm)	Minimum Time (mm:ss)	Length For Minimum Time (m)	Time for Longer Length (s)	Time (mm:ss) for Length (L) Shown					
				30 m	45 m	60 m	75 m	90 m	105 m
				100	3:46	597	0.380 L	3:46	3:46
150	5:40	398	0.854 L	5:40	5:40	5:40	5:40	5:40	5:40
200	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52
250	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51
300	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56
375	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09
450	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52
525	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00
600	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46
675	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57
750	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38
825	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43
900	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29

**3.4.5.3** Deflection Test for Flexible Pipe: Optional devices for testing include calibrated television, photography, properly sized "GO-NO-GO" mandrel, sewer ball or deflectometer. Maximum allowable pipe deflection shall be five percent. The deflection test shall be performed no sooner than thirty (30) days after installation.

**3.4.5.4** Force Main Testing: Force mains shall be tested for pressure and leakage in accordance with AWWA C 600, except as amended or added below:

**3.4.5.4.1** Water to be furnished by CONTRACTOR.

**3.4.5.4.2** Test Duration: Two (2) hours.

**3.4.5.4.3** Test Pressure: One hundred and fifty percent of maximum operating pressure, or 100 psi (690 kPa), or the greater of the two, as determined by the ENGINEER.

**3.4.5.4.4** Allowable Pressure Loss: Pressure shall not vary more than ± 5 psi (34 kPa) for the duration of the pressure test.

**3.4.5.4.5** Allowable Leakage: Allowable leakage shall be determined by the following formula:

$$L = \frac{(S)(D)(P)^{0.8}}{188,200}$$

$$L = \frac{(S)(D)(P)^{0.8}}{715,817}$$

*L = Allowable Leakage (gallons per hour)*

*L = Allowable Leakage (gallons per hour)*

*S = Length of Pipe Tested (feet)*

*S = Length of Pipe Tested (meters)*

*D = Nominal Pipe Diameter (inches)*

*D = Nominal Pipe Diameter (mm)*

*P = Average Test Pressure (psig)*

*P = Average Test Pressure (kPa)*

**3.4.5.4.6** Allowable leakage, in gallons (liters) per hour, per 1,000 feet (100 m) of pipe line can be determined from the following chart.

## ALLOWABLE LEAKAGE PER HOUR, PER 1,000 FEET (100 M) OF PIPE

### ENGLISH UNITS

Average Test Pressure (psig)	Nominal Pipe Diameter (inches)										
	3	4	6	8	10	12	14	16	18	20	24
450	0.48	0.64	0.95	1.27	1.59	1.91	2.23	2.55	2.87	3.18	3.82
400	0.45	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.60
350	0.42	0.56	0.84	1.12	1.40	1.69	1.97	2.25	2.53	2.81	3.37
300	0.39	0.52	0.78	1.04	1.30	1.56	1.82	2.08	2.34	2.60	3.12
275	0.37	0.50	0.75	1.00	1.24	1.49	1.74	1.99	2.24	2.49	2.99
250	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14	2.37	2.85
225	0.34	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25	2.70
200	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12	2.55
175	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	1.98	2.38
150	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84	2.21
125	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68	2.01
100	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.80

### METRIC UNITS

Average Test Pressure (kPa)	Nominal Pipe Diameter (mm)										
	75	100	150	200	250	300	350	400	450	500	600
3100	0.60	0.79	1.18	1.58	1.97	2.37	2.77	3.17	3.56	3.95	4.74
2750	0.56	0.75	1.12	1.49	1.86	2.24	2.61	2.98	3.35	3.73	4.47
2400	0.52	0.70	1.04	1.39	1.74	2.10	2.45	2.79	3.14	3.49	4.19
2050	0.48	0.65	0.97	1.29	1.61	1.94	2.26	2.58	2.91	3.23	3.87
1900	0.46	0.62	0.93	1.24	1.53	1.85	2.16	2.47	2.78	3.09	3.71
1700	0.45	0.58	0.88	1.18	1.48	1.76	2.06	2.36	2.66	2.94	3.54
1550	0.42	0.56	0.84	1.12	1.40	1.68	1.96	2.24	2.52	2.79	3.35
1400	0.40	0.53	0.79	1.06	1.32	1.59	1.83	2.11	2.37	2.63	3.17
1200	0.37	0.50	0.73	0.99	1.23	1.48	1.73	1.97	2.22	2.46	2.96
1050	0.35	0.46	0.68	0.92	1.14	1.37	1.60	1.83	2.06	2.28	2.75
850	0.31	0.42	0.62	0.83	1.04	1.25	1.47	1.66	1.88	2.09	2.50
700	0.29	0.37	0.56	0.74	0.93	1.18	1.30	1.49	1.68	1.86	2.24

### 3.4.6 Protection of Water Supplies.

**3.4.6.1** There shall be no physical connection between a public or private potable water supply system and a sewer, or sewer appurtenance, which would permit the passage of any sewage or polluted water into the potable supply. No water pipe shall pass through or come in contact with any part of a sewer manhole.

**3.4.6.2** Sewers shall be located outside a 400 feet (125 m) radius centered at a municipal well; 200 feet (60 m) radius centered at a small public well, and 75 feet (25 m) radius centered at a private well.

**3.4.6.3** Sewers shall be located during design, at least 10 feet (3 m) horizontally from any existing or proposed water main, except that a deviation from this separation to avoid subsurface structures, including telecommunication chambers, interference of building foundations shall be allowed, provided that the sewer is constructed as follows:

**3.4.6.3.1** Sewer pipe shall be class 52 ductile iron for a maximum distance of 75 feet (25 m) each side of the obstruction.

**3.4.6.3.2** Joints shall be mechanical type water pressure rated with zero leakage when tested at 25 psi (172 kPa) for gravity sewers and 1-1/2 times working pressure for force mains.

**3.4.6.4** Whenever sewers must cross water mains, the sewer shall be constructed as follows:

**3.4.6.4.1** Sewer pipe shall be SDR-21 for a minimum distance of 9 feet (2.75 m) each side of the crossing.

**3.4.6.4.2** Joints shall be water pressure rated with zero leakage when tested at 25 psi (172 kPa) for gravity sewers and 1-1/2 times working pressure for force mains and joints shall not be located within 6 feet (1.83 m) horizontally of the crossing.

**3.4.6.4.3** Vertical separation of the sewer and water main shall not be less than 18" (450 mm) with water over sewer, unless otherwise approved by NHDES.

### **3.4.7 Casing Installation.**

**3.4.7.1** Casing pipe shall be installed by open cut, with bedding and cover material as shown on the drawings.

**3.4.7.2** Casing pipe ends shall be beveled with a single V-groove for field welding. Pipe joints shall be butt welded and shall be a full penetration on the outside circumference of the pipe. The single V-groove butt weld shall conform to the latest AWS Welding Code. All joints of the casing pipe shall be butt welded by a welder certified by the State of New Hampshire for the specific application.

**3.4.8 Carrier Pipe Installation.** After casing pipe has been installed and cleaned of dirt and debris, pipe spacers shall be attached to carrier pipe as shown on the Drawings. As carrier pipe is jointed, it shall be pushed into position inside the casing pipe.

**3.4.8.1** After the carrier pipe has been tested for leakage, bulkheads shall be constructed at each end of the casing pipe. On brick bulkheads, a "one brick" opening shall be left in the bulkhead at the top of the casing pipe at each end and covered with polyethylene to prevent entry of backfilling materials. The portion of the carrier pipe passing through the brick bulkhead shall be wrapped with three layers of fifteen pound asphalt-impregnated felt before the bulkhead is constructed.

## **3.5 Manhole Installation.**

### **3.5.1 Installation of Manhole Bases and Sections.**

**3.5.1.1** Precast bases shall be placed on a 1-foot (0.3 m) layer of compacted bedding material. The excavation shall be properly dewatered to allow placing of bedding material and setting the manhole base on completely drained subgrade.

**3.5.1.2** Inlet and outlet stubs shall be connected and sealed in accordance with the manufacturer's recommended procedure, and as shown on the Drawings.



**3.5.1.3** Barrel sections and cones of the appropriate combination of heights shall then be placed, using manufacturer's recommended procedure for sealing the horizontal joints.

**3.5.1.4** A leakage test shall then be made as described below in this section.

**3.5.1.5** Upon successful completion of the leakage test all joints shall be pointed.

**3.5.1.6** The exterior waterproofing coat shall be touched up after installation and shall be applied to the exterior of all joints in accordance with manufacturer's recommendations.

**3.5.1.7** The inverts and the shelf shall be constructed of brick.

**3.5.1.8** The frame and cover shall be placed on the top of the manhole or some other approved means shall be provided to prevent accidental entry by unauthorized persons, children, animals, etc., until the Contractor is ready to make final adjustment to grade.

### **3.5.2 Mixing Mortar.**

**3.5.2.1** Mortar shall be mixed in accordance with ASTM C 270 or the recommendations of the manufacturer.

### **3.5.3 Brick Masonry.**

**3.5.3.1** Only clean bricks shall be used in brickwork for grade adjustment and manhole inverts. The bricks shall be moistened by suitable means, until they are in a surface dry, saturated condition.

**3.5.3.2** Each brick shall be laid in full bed and joint of mortar without requiring subsequent grouting, flushing, or filling, and shall be thoroughly bonded.

**3.5.3.3** Brick masonry shall be protected from too rapid drying. Use an approved cover and protect from the weather and frost.

**3.5.3.4** All masonry joints which are exposed to view shall be examined to locate cracks, pointed up and filled with mortar. Where necessary, in the opinion of the Engineer, the joints shall be cut out and repointed with mortar.

**3.5.3.5** All brick masonry inverts shall allow unimpeded flow. Steps or puddles will be basis for rejection.

### **3.5.4 Setting Frames and Covers.**

**3.5.4.1** Frames shall be set with the tops conforming accurately to the grade of the pavement or finished ground surface or as indicated on the Drawings. Frames shall be set concentric with the top of the masonry and in a full bed of mortar so that the space between the top of the manhole masonry and the bottom flange of the frame shall be completely filled and made watertight. A thick ring of mortar extending to the outer edge of the masonry shall be placed all around and on the top of the bottom flange. The mortar shall be smoothly finished and have a slight slope to shed water away from the frame.

**3.5.4.2** Manhole covers shall be left in place in the frames on completion of other work at the manholes.

### **3.5.5 Leakage Tests for Sewer Manholes.**

**3.5.5.1** Leakage tests shall be made and observed by the ENGINEER on each manhole. The test shall be a vacuum test made as described below.

#### **3.5.5.2 Vacuum Test.**

**3.5.5.2.1** The vacuum test may be performed on manholes, completely constructed, with inlet and outlet pipes in place. Test shall be conducted before any backfilling begins. Any material around the base section shall

be removed to expose the entire side of the manhole. Plug pinholes and horizontal seams with a non-shrinking mortar.

**3.5.5.2.2** Brace the inlet and outlet pipes/plugs to prevent movement during the test. Use air inflated plugs in good condition.

**3.5.5.2.3** The vacuum test shall be performed using equipment approved by the ENGINEER. The equipment shall be in good operating condition. No gauges are to have any broken glass or other visible abnormalities. The test shall be performed by trained personnel familiar with the equipment and the test.

**3.5.5.2.4** The test shall have a minimum duration of two minutes. The vacuum shall be pumped down to 10 inches (250 mm) of mercury on an approved gauge, and held. At the time the removal of air is stopped, the test time shall begin.

**3.5.5.2.5** Any manhole that has a vacuum drop to nine inches (225 mm) of mercury or less, within the following time intervals, shall have failed the test.

<u>Depth to Base of Manhole</u>	<u>Time Interval</u>
0 – 10 feet (0 – 3.0 meters)	Less than 2 minutes
10 – 15 feet (3.0 – 4.5 meters)	Less than 2 ½ minutes
15 – 20 feet (4.5 – 6.0 meters)	Less than 3 minutes
More than 20 feet (6.0 meters)	Less than <b>T</b> (see calculation below)

Calculations for manholes deeper than 20 feet (6.0 m).

ENGLISH

$$T = 0.085 \left( \frac{(D)(K)}{Q} \right)$$

*T = Time of Pressure Drop (seconds)*

*K = (0.000419)(D)(L), but not less than 1.0*

*Q = 0.0015  $\left( \frac{ft^3}{min} / ft^2 \right)$  of area*

*D = Nominal Manhole Diameter (inches)*

*L = Depth of Manhole (feet)*

METRIC

$$T = 0.085 \left( \frac{(D)(K)}{Q} \right)$$

*T = Time of Pressure Drop (seconds)*

*K = (0.008244)(D)(L), but not less than 1.0*

*Q = 0.00046  $\left( \frac{m^3}{min} / m^2 \right)$  of area*

*D = Nominal Manhole Diameter (mm)*

*L = Depth of Manhole (m)*

**Method of Measurement**

**4.1** Sanitary gravity sewer and sewer services of the kind, type and size specified will be measured by the linear foot (linear meter) to the nearest 0.1-foot (meter) to the inside face of manholes.

**4.2** Sewer casing including carrier pipe of the kind, type and size specified will be measured by the linear foot (linear meter) to the nearest 0.1-foot (meter).

**4.3** Sewer service wyes will be measured as each wye furnished and installed.

**4.4** Sewer manholes will be measured in accordance with NHDOT Standard Specification 604.31.

**4.5** No separate measurement will be made for any removal of existing sewer manholes or sewer pipe or bypass system or plugging of abandoned sewers.

**4.6** The ENGINEER must be involved in and approve the measurement of any pay item.

## **Basis of Payment**

**5.1** The accepted quantity of sanitary gravity sewer, forcemain and service pipe will be paid for at the contract price per linear foot (linear meter) complete in place as shown on the plans and specified herein, and shall include furnishing and installing pipe, excavation, bedding, blanket, backfill, couplings, bends, testing, furnishing and placing temporary pavement trench patch, sheeting, shoring, dewatering, maintaining sewage flow, restoration, connection to existing sewers, and all other work required for or incidental to the completion of this item except as noted below.

**5.1.1** Common structure excavation required for the removal of unsuitable material below the typical trench section will be paid for as provided under 206.

**5.1.2** Rock structure excavation and common structure excavation exploratory will be paid for as provided under 206.

**5.1.3** Granular Backfill (Sand) to replace material excavated under 5.1.1 will be paid for as provided under 209.

**5.2** The accepted quantity of sewer casing pipe, including carrier pipe, will be paid at the contract price per linear foot complete in place as shown on the plan and specified herein, and shall include furnishing and installing carrier pipe, assembly of carrier pipe, excavation, bedding, blanket, backfill, furnishing and installing carrier pipe, pipe spacers, bulkheads and appurtenances, furnishing and installing grout and all other work required for or incidental to the completion of this item, except as noted below.

**5.3** The accepted quantity of sewer service wyes will be paid at the contract unit price and shall include furnishing and installing the wyes and all other work required or incidental to the completion of this item.

**5.4** The accepted quantity of sewer manholes will be paid for in accordance with NHDOT Standard Specification 604.31.

**5.5** Any work not specifically having a pay item and necessary for a complete and operational sanitary sewer, as herein specified and called for on the plans, shall be considered incidental and subsidiary to the pay item work specified herein. The work considered as subsidiary and not separately paid for shall include but not be limited to the following:

**5.5.1** Pipe material handling and storage on site.

**5.5.2** Excavation, bedding, blanket and backfill.

**5.5.3** Sheeting, shoring, and dewatering of trenches (if applicable).

**5.5.4** Maintaining existing sewer service.

**5.5.5** Restoration of property, utilities, and water lines (if applicable).

**5.5.6** Pressure testing and lamping.

**5.5.7** Plugging abandoned sewers and removal and disposal of existing manholes.

**5.5.8** Bituminous pavement for the temporary trench patch, including wheel cutting of existing pavement.

**5.5.9** Record drawings.

**5.5.10** Connections to existing sewers and couplings.

**Pay Items and Units (ENGLISH):**

612.2212	12-inch R.C. SEWER PIPE, 2000D, WITH NEOPRENE GASKETS	LF
612.2215	15-inch R.C. SEWER PIPE, 2000D, WITH NEOPRENE GASKETS	LF
612.2324	24-inch R.C. SEWER PIPE, 3000D, (6000 PSI), W/ NEOPRENE GASKETS	LF
612.2330	30-inch R.C. SEWER PIPE, 3000D, (6000 PSI), W/ NEOPRENE GASKETS	LF
612.2415	15-inch R.C. SEWER PIPE, 3750D, (6000 PSI), W/ NEOPRENE GASKETS	LF
612.2418	18-inch R.C. SEWER PIPE, 3750D, (6000 PSI), W/ NEOPRENE GASKETS	LF
612.43018	18-inch DUCTILE IRON SEWER PIPE, CLASS 50	LF
612.43106	6-inch DUCTILE IRON SEWER PIPE, CLASS 51	LF
612.43312	12-inch DUCTILE IRON SEWER PIPE, CLASS 53	LF
612.43604	4-inch DUCTILE IRON SEWER PIPE, CLASS 56	LF
612.43606	6-inch DUCTILE IRON SEWER PIPE, CLASS 56	LF
612.61403	2-inch PVC SEWER, SDR 21	LF
612.61403	3-inch PVC SEWER, SDR 21	LF
612.61506	6-inch PVC SEWER, SDR 35	LF
612.61508	8-inch PVC SEWER, SDR 35	LF
612.61510	10-inch PVC SEWER, SDR 35	LF
612.912	REMOVING AND RELAYING 12-inch SEWER PIPE	LF
612.924	REMOVING AND RELAYING 24-inch SEWER PIPE	LF

**Pay Items and Units (METRIC):**

612.2230	300 MM R.C. SEWER PIPE, CLASS III, WITH NEOPRENE GASKETS	LM
612.2238	375 MM R.C. SEWER PIPE, CLASS III, WITH NEOPRENE GASKETS	LM
612.2360	600 MM R.C. SEWER PIPE, CLASS IV, (41.4 MPA) W/ NEOPRENE GASKETS	LM
612.2375	750 MM R.C. SEWER PIPE, CLASS IV, (41.4 MPA) W/ NEOPRENE GASKETS	LM
612.2438	375 MM R.C. SEWER PIPE, CLASS V, (41.4 MPA) W/ NEOPRENE GASKETS	LM
612.2445	450 MM R.C. SEWER PIPE, CLASS V, (41.4 MPA) W/ NEOPRENE GASKETS	LM
612.43045	450 MM DUCTILE IRON SEWER PIPE, CLASS 50	LM
612.43115	150 MM DUCTILE IRON SEWER PIPE, CLASS 51	LM
612.43330	300 MM DUCTILE IRON SEWER PIPE, CLASS 53	LM
612.43610	100 MM DUCTILE IRON SEWER PIPE, CLASS 56	LM
612.43615	150 MM DUCTILE IRON SEWER PIPE, CLASS 56	LM
612.61476	50 MM PVC SEWER, SDR 21	LM
612.61476	76 MM PVC SEWER, SDR 21	LM
612.61515	150 MM PVC SEWER, SDR 35	LM
612.61520	200 MM PVC SEWER, SDR 35	LM
612.61525	250 MM PVC SEWER. SDR 35	LM
612.930	REMOVING & RELAYING 300 MM SEWER PIPE	LM
612.960	REMOVING & RELAYING 600 MM SEWER PIPE	LM

END OF SECTION