

**DIVISION 2 – SITE WORK****SECTION 02722 – SEWER SYSTEM - MINIMUM DESIGN STANDARDS****1. PLAN APPROVAL**

In addition to the requirements for plan approval in the General Requirements, the plans shall clearly show the lots and blocks to be served and the location of the sanitary sewer mains with reference to property lines. All service wyes shall be stationed for proper control and for future location. Profiles shall give dimensions, grade, rim elevations, and invert elevations into and out of the manholes of the sewer to be constructed. The plan view shall include topographic information with at least 2 foot contours for all lots in the service area.

**2. DESIGN FLOW**

**2.01.** The design shall include consideration for providing service to the entire area tributary to the outfall point. Estimates of residential sewage contribution shall be based on 100 gallons per capita per day with a peak hour factor of 3. Minimum residential population density shall be figured on a basis of 3.5 persons per house, structure density based on the zone, and 70 percent of total land area developed as residential unless otherwise zoned, subdivided, or restricted.

**2.02.** Institutional, commercial, and industrial sewage contribution estimates shall be based on the design criteria set by the Colorado Department of Public Health and Environment (CDPHE) with review by the Town. Allowance shall be made for infiltration flow of 50 gallons per day per inch diameter per mile of pipe. Design flow shall be the sum of the peak flow as computed above and the flow due to infiltration as determined above or by actual field experience if worse.

**2.03.** Sewers 15 inches in diameter and smaller shall carry the peak design flow at a maximum flow depth of half the pipe diameter. Sewers larger than 15” in diameter may be designed to flow up to three quarters full at peak design flow rate. The minimum velocity at the design flow rate shall be 2.0 feet per second (fps). Where actual flow will be much below normal for several years the minimum velocity shall be achieved by suitable grades at the partial design flow.

**3. PIPING DETAILS**

**3.01.** Materials: Piping materials shall meet the requirements specified in the Standard Specifications for Sewer Collection System Construction. In most cases pipe shall be SDR 35 PVC. Use of materials other than PVC pipe shall be permitted only with prior approval of the Town.

**3.02.** Size: Normally sanitary sewer mains shall be 8 inch diameter or larger to facilitate maintenance. Service connections shall be 4 inch diameter or larger. Six (6) inch sewer mains may be installed under special conditions where only 3 or fewer residential connections will be made to the line, and where approved by the Town. Smaller force mains may be used under certain conditions with approval of the Town.

**3.03.** Grades: The following minimum grades shall apply unless hydraulic (flow) requirements above supersede the grade criteria:

<u>Sewer Diameter</u>	<u>Minimum Grade (percent)</u>
4 inch	2.0 or 1/2 inch per foot
6 inch	1.00
8 inch and larger	0.50

**3.04. Minimum Velocity:** Pipes must be designed to flow at a minimum of 2 fps at design flows unless the Town approves a deviation which will only be considered under extreme circumstances.

**3.05. Maximum Slope:** Sewer shall be designed with slopes of less than 10%. If the ground profile is steeper than that, control the slope of the sewer with the use of adequately spaced drop manholes. Where velocities greater than 5 feet per second are attained, special provisions shall be made to keep the liquids from separating from the solids and to protect against displacement by erosion and shock.

**3.06. Manhole Spacing and Design:** Manholes shall be provided at every change in direction or grade, or connection with other sewer main; maximum spacing shall be 400 feet for lines 15 inches or smaller, and 450 feet for lines larger than 15 inches. A minimum of 0.10' foot drop shall be provided in manholes with a maximum change in direction of 45 degrees and 0.20 feet for changes in direction greater than 45 degrees. Sewer lines shall be straight and not curved between manholes in both line and grade. Manholes shall be stubbed out with suitable size pipe wherever future extension of the sewer is anticipated. Where pipes of different size come into or exit a manhole, the tops of the pipes shall be at the same elevation so that the smaller pipe is not subject to submergence from the larger pipe.

**3.07. Flexible Joints near Manhole:** Provide a flexible joint in the pipe 12 to 18 inches from all manhole walls and other solid structures.

**3.08. Terminal Manhole:** There shall be a terminal manhole at the end of all sewer lines, past the last sewer service.

**3.09. Underdrains:** Where underdrains are to be constructed with the sewer mains (or other locations), cleanouts or manholes shall be provided for the underdrain at each manhole or at 400 foot maximum intervals for the underdrain. Typically underdrains installed with sewer mains shall be placed to the side and below the sewer main

**3.10. Drop Manhole:** Drop manholes should be provided when the change in elevation through the manhole is in excess of 24 inches. Designs that require drop manholes, require Town authorization.

**3.11. Depth of Bury:** Minimum cover on sewer mains shall normally be seven feet to ground surface. Bury of 7 to 9 feet is considered normal. Depths outside this range will require specific approval of the Town.

**4. LIFT STATIONS**

The need for pumping facilities and the design of these facilities shall be discussed with the Town prior to beginning design. The use of lift stations is discouraged unless truly necessary. The Town reserves the right to dictate the location and type of pumping facilities to be constructed and to require extra maintenance services from the developer and/or to impose additional charges to the users.

**5. INVERTED SIPHONS**

The use of inverted siphons is discouraged especially in low flow and intermittent flow situations. If the Town does approve the use of a siphon system, the system shall have not less than 2 barrels, with a

minimum pipe size of 6 inches and shall be provided with necessary appurtenances for convenient flushing and maintenance. The manholes shall have adequate clearances for jetting. In general, sufficient head shall be provided with pipe sizes selected to secure velocities of at least 3.0 feet per second for average flows. The inlet and outlet details shall be arranged so that the normal flow is diverted to one barrel and so that either barrel may be out of service for cleaning.

## **6. SERVICE CONNECTIONS**

**6.01.** Typically, the service line should not be any closer than five feet to the side property line, and no service line may be constructed through or in front of any adjoining property. Whenever possible, service lines shall be installed perpendicular to the main and shall be located 10 feet inside the downhill property line. Minimum fall on 6 inch sewer service lines shall be 1/8 inch (1%) per foot (2% preferred) and for 4 inch pipe 1/4 inch per foot (2%). Minimum cover of the sewer service shall be three (3) feet at the property line where there will be no basements.

**6.02.** Full body wyes shall be provided in the sewer main for service connections at each building site. Service lines shall be shown on the drawings in plan and profile. Tapping saddles will only be allowed with approval of the Town for circumstances which necessitate their use and not allowed for new construction. Fittings shall be angled upwards so that the upper invert of one-eighth bend connected to the fitting will have an elevation equal to or higher than the inside top of the sewer main. Service lines installed during main line construction shall extend through the front utility easement, have a cleanout out at the termination and be plugged with a water and air tight seal and marked with a 2 x 4 brought to grade and backed by a steel T post marked with the depth of the line. Riser connections shall be installed where the elevation of the top of the fitting is more than 12 feet below finished ground surface. See Standard Specifications and typical drawing for more detail on service stub-ins and connections.

**6.03.** Before a Contractor or property owner begins building a basement or any habitable structure below ground, the Owner or Contractor shall ensure that the level of the most adjacent sewer is 6 inches in elevation lower than the flood level of the lowest fixture or drain in said basement. This requirement will be waived if the Contractor or Owner installs a sewer lift station or an approved backflow prevention device.

**6.04.** Sewer mains shall be extended to a point at least 20 feet up from the lowest lot corner adjacent to the sewer main of the uppermost lot to be served and terminate in a manhole. Service connections will not be allowed to enter directly into a manholes except when the diameter of the service line is 50% or more of the main in which case a special manhole shall be added for that purpose. Only with the approval of the Town may service connections be allowed immediately above or below a manhole.

## **7. CONSTRUCTION**

**7.01.** In general construction shall conform with the Standard Specifications for Sewer System Construction as well as with the Excavation, Backfill, and Compaction, Specifications (Section 02200). Select bedding shall extend from 6 inches below the pipe barrel to springline (half way up the pipe). Compaction in this region is critical to support the pipe and must be 95% Standard Proctor. The first one foot of backfill over the pipe shall be hand placed, hand compacted, select material as defined in the Excavation and Backfill Specifications. For gravity sewer line construction, a single size screen rock between ¾" and 1-1/2" shall be used as select bedding. Place a non-woven geotextile on top of the screened rock or wrap the entire pipe zone in a geotextile wrap.

**7.02.** In places where the sewer has less than four feet of cover, provisions shall be made to protect pipe from impact loading. If very shallow insulation may be required.

**7.03.** An approved cut-off wall shall be constructed on the lower side of crossings such as under open ditches, canals, or creeks, to prevent water from following the sewer trench.

**7.04.** Underdrains, where required, shall be formed by creating a non-woven geotextile wrap around screened bedding around the sewer pipe and underdrain. See Sewer / Seep trench typical drawing.

## **8. PROTECTION OF WATER SUPPLIES**

**8.01.** There shall be no physical connection between a public or private potable water supply system and a sewer, or appurtenance thereto which would permit the passage of any sewage, non-potable, or polluted water into the potable supply directly or through contamination of the surrounding soils.

**8.02.** Whenever possible, sewer mains and service lines should be laid at least 10 feet, horizontally, from any existing or proposed water main. Should local conditions prevent a horizontal separation of 10 feet, a sewer may be laid closer than 10 feet to a water main if it is laid in a separate trench, or it is laid in the same trench with the water mains located at one side on a bench of undisturbed earth with at least five feet of horizontal separation.

**8.03.** Unless there is at least 10 feet horizontal separation, the elevation of the crown of the sewer must be at least 18 inches below the invert of the water main or the sewer line encased.

**8.04.** Whenever sewer must cross under water mains, the sewer shall be laid at such an elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of a sewer cannot be buried to meet the above requirement, the water main may be relocated to provide this separation or the sewer pipe shall be encased by either a single joint of PVC or HDPE pipe for a distance of 10 feet on each side of the water. When possible, one full length of water main shall be centered over the sewer so that both joints will be as far from the sewer as possible. When it is impractical to encase the sewer, the water line shall be encased with the same criteria above.

**8.05.** When sewer lines or services cross above water mains or services, the water mains must be protected at a minimum by the criteria above. In such cases, there shall be no joints within ten feet on each side of the water line. In all cases where the sewer line is above the water, a casing shall be required and the ends of the casing shall be sealed in a watertight manner with a reducing no-hub gasket or other approved method. Both lines should be pressure tested to assure water tightness.

**8.06.** There shall be a minimum clear distance vertically of 8" between the uppermost part of the lower utility and the lowermost part of the upper utility including casings to allow for proper bedding. In all cases, suitable backfill or other structural protection shall be provided to preclude settling and/or failure of any of the pipes.

**8.07.** The Town shall have final review authority of all proposed designs which do not provide adequate separation. These requirements for protection of the water system against contamination from non-potable water conveyances shall apply equally to water mains and service connections.

**9. MISCELLANEOUS REQUIREMENTS**

**9.01.** Rain water leaders, roof drains, surface drains, or ground water drains shall not be connected to the sanitary sewer. Each sanitary sewer service system shall be separate from the drainage system.

**9.02.** Grease and sand traps shall be installed where required by the provisions of the Ridgway Municipal Code and/or the International Plumbing Code.

**10. TESTING**

Testing of sewer lines and services, manholes and appurtenances shall conform with the requirements of the applicable portions of the Sewer System Construction (Section 02723) regarding lapping, vacuum, in- & exfiltration, and pressure testing.

**DIVISION 2 – SITE WORK****SECTION 02723 - SEWER SYSTEM CONSTRUCTION****1. GENERAL****1.01. Related Work Specified Elsewhere**

Section 02220 - Excavation, Backfill and Compaction

Section 02713 – Water System Construction

Section 02722- Minimum Design Standards – Sewer Collection System

**1.02. Description**

Work specified in this Section includes furnishing, installing, and testing of sewer mains, service lines, temporary services, drain and seep lines, manholes, valves, fittings, cleanouts, appurtenances, and manholes, and testing requirements for sewage and seep piping systems.

Sewers shall be constructed of such size and laid to such grades as approved by the Town. The Town must be notified in accordance with the General Requirements of when pipe will be laid. No pipe shall be laid or covered until it has been inspected by the Town.

Pressure sewer lines shall conform with applicable sections of these specifications and with the sections of Water Line Standard Specifications as they apply to installation and testing of piping lines under pressure.

**1.03. Certificates of Compliance**

Certificate of Compliance shall be submitted to the Town stating all pipe and materials furnished under these specifications do in fact comply with all referenced specifications.

**1.04. Referenced Standards**

- A. Uni-Bell PVC Pipe Association - Recommended Practice for the Installation of Polyvinyl Chloride Sewer Pipe (UNI-B-5) latest revision
- B. Uni-Bell PVC Pipe Association - Recommended Practice for Low Pressure Air Testing of Installed Sewer Pipe (UNI-B-6) latest revision
- C. C478 Standard Specifications for Precast Reinforced Concrete Manhole Sections

**2. PRODUCTS****2.01. Pipe Materials**

All materials shall be new, and of the best standard quality available for the purpose intended. Where materials are specified by brand names, materials of equal quality may be substituted if the Contractor submits adequate technical and descriptive data and secures the approval of the Town. The Town or its designated representative shall be the sole judge of the suitability and acceptance of materials. The Town in some instances may insist on a particular brand or model (to match materials in use) to minimize the parts inventory and/or O and M requirements.

A. Polyvinyl Chloride (PVC) Pipe

Conformance SDR 35, 3034 PVC sewer or heavier walled  
 Pressure Rating Gravity, open channel flow  
 Joints \*\* Unibell bell and spigot, elastomeric gasket  
 Service Gravity sewer lines, sewer service lines  
 Maximum Warp 1/32 inches per foot  
 Fittings Schedule 40 or Schedule 80 PVC

Conformance ASTM 1785 or AWWA C900  
 Pressure Rating 150 psi working pressure  
 Joints \*\* Unibell bell and spigot, elastomeric gasket  
 Fittings AWWA C151/A21.51  
 Service Pressure sewer lines

Conformance Schedule 40 PVC  
 Pressure Rating 150 psi working pressure  
 Joints \*\* Solvent weld conforming to ASTM D-2564 & D-2855 (Specifications and Recommended practices for Solvent-Cemented Joints with PVC pipe)  
 Fittings Schedule 40 - solvent cemented per ASTM D-2564  
 Service Force mains less than 3" in diameter only

B. Ductile Iron Pipe and Fittings

Conformance AWWA C151/A21.51  
 Class Class 50  
 Lining Cement Mortar, or epoxy  
 Coating Polyethylene wrap tubes, tape seal ends  
 Pressure Rating 100 psi working pressure  
 Joints \*\* Push on, Super Bell-tite

\*\* Joints shall be approved by the Town prior to purchasing the pipe and fittings.

C. High Density Polyethylene (HDPE) Pipe Perforated

Conformance 4-10" AASHTO M252, ASTM F2648;  
 12" - 60" AASHTO M294, ASTM F2648 and F2306  
 Perforated  
 Joints Bell and Spigot  
 Service Seep line

D. High Density Polyethylene (HDPE) Pipe

Conformance AWWA C906, DI or IPS  
 Thickness DR 11  
 Pressure Rating 200 PSI operating pressure  
 Joints Butt fusion, Heat welded  
 Fittings 200 psi, HDPE butt fused, heat welded when available or Ductile Iron AWWA C153 or C110, 250 psi,  
 Restraints Concrete & Megalug 2000 series or equal for DI MJ fittings  
 Service Only where shown on the plans or specifically approved by the Town. If allowed, HDPE will need to meet same ID as the specified pipe

- Service Connections      Electofusion tapping saddle or tee
- E. Steel Casing Pipe
  - Service                      Buried Pipe Encasement
  - Conformance              AWWA C200
  - Min. Yield Strength      35,000 psi
  - Pipe Wall                    Smooth inside, min wall thickness 3/8"
  - Exterior Coatings        Cold tar epoxy coating (16 mil minimum) exterior,
  - Interior Coating          Bituminous asphalt meeting ANSI-A21.4 or epoxy coating
  - Joints                        Welded, smooth interior
  - Carrier Pipe Support      Redwood slats per typical drawing or ENGR approved casing spacers using twice the manufacturer recommended number of spacers
- F. Cleanout: Materials for cleanouts shall conform to requirements listed on the typical drawing for gravity and pressure cleanouts
- G. Sewer Service Saddles: On new lines and in most cases on existing lines, full bodied PVC SDR 3034 wyes are required. Under unusual circumstances, where approved by the Town for use due to special conditions on existing lines such as having too much flow to be cut for installation of the full bodied wye, an elastomeric wye shaped saddle strapped to the main with an adjustable screw tightened stainless steel hose clamp that provides a water tight seal against the main may be authorized. Use of a saddle will be evaluated on a case by case basis by the Town.

**2.02. Manhole Materials**

- A. Bases, Inverts, and Cones
  - Material                    Precast Concrete
  - Conformance              ASTM C-478, 5" minimum wall thickness in State Highway Right of Way conform with State Specs
  - Cement                    Type I/II sulfate resistant
  - Concrete                  4000 psi w/reinforcement per ASTM C-478
  - Joints                        Watertight flexible gasket

Manholes shall have integral base and barrel section with pipe openings equipped with boots installed into the manhole during fabrication. Unless otherwise specifically approved, precast bases will be required even on existing lines and even if that requires pumping around an existing section of main during construction. Manholes shall have precast invert and the opening shall flared at springline and that at the top of the pipe shall be at least 50% wider than the largest pipe diameter in the manhole. The bench outside the invert shall slope upward from the springline of the pipe to the wall of the manhole at not less than 1" per foot and no more than 2" per foot. All inverts must have a smooth invert, sufficiently smooth to not tear a thin latex glove run across the surface, or snag solids, and without any lip between the pipes and the concrete. Use of water as a finishing aid is prohibited. Changes in direction of flow through the manhole shall be made with a smooth curved channel having as large a radius as possible. The change in size of channels shall be made gradually and evenly and shall be formed directly in the concrete. Imperfections in the precast concrete manhole base or sections shall be reviewed by Town prior to repair. If the damage looks sufficient to compromise the structural integrity or other key performance criteria, the precast concrete may be rejected by the Town.

- B. Markings: Manholes shall be clearly marked with the information specified for product marking in ASTM C478

C. Frame and Covers

Where approved by the Town, in non-traffic areas, the manhole frame and cover may be cast from an alloy of aluminum with physical properties exhibiting strength comparable to cast iron. The cover shall weigh about 60 pounds and the total assembly about 150 pounds. In traffic areas, except where noted on the plans, cast iron covers will be required. The assembly shall have a clear opening of 24 inches. For applications with pipes under pressure and where specified or shown on plans, frost free lids shall be furnished.

A good fit is required between the frame and cover to prevent rattling in traffic and leakage of dirt and water. To ensure good fit, the seat in the frame on which the cover rests and the matching face of the cover shall be machined. Provisions for opening the manhole shall consist of a pickhole or notch along the edge of the cover. Aluminum lids shall have a locking nut to secure them in place. Other means of opening the manhole shall be approved by the Town before the material is purchased.

D. Manhole Steps: Epoxy coated cast iron, plastic or other approved corrosion resistant steps shall be built into each manhole. The steps shall be at least 9 inches wide and shall protrude approximately 5 inches from the wall of the manhole, and shall be held in the wall by at least 4 inches of bar on each side. The steps shall be designed to provide an edge that will prevent the foot from slipping off the side of the step. Standard manufactured manhole steps shall be used. Reinforcing steel or other steel bars and material bent to form a step will not be permitted. Steps shall be spaced evenly at 12 inch intervals with each step being directly below the next. Spacing from the rim to the first step shall be as shown on the manhole typical drawing.

E. Non-Shrink Grout: Commercial factory-mixed product made especially for intended use, including for a highly corrosive environment and providing a long-term watertight seal. Material shall be submitted for review and approval by the Town.

F. Butyl Rubber Flexible Gasket Material

Type	Preformed flexible rubber gasket
Conformance	Fed. Spec. SS-S210-A, Ram-Nek or approved equal.

G. Pipe Connections: Flexible pipe to manhole connectors complying with ASTM C923 shall be provided for all pipes that enter or exit the manhole to insure a water tight seal. Boot shall consist of EPDM and elastomers design to be resistant to ozone, weather elements, chemicals including acids, alkalis, and all fats. Hose clamps to fasten the boot must be at least 304 stainless steel.

H. Geotextile: Geotextile used for separation between graded rock and other backfill materials with any fines shall be a needle punched, non-woven 12 oz minimum such as Mirafi 1120 or approved equal.

**2.03. Tracer Wire and Marking Tape**

Tracer wire shall be insulated 10 gauge with green insulation for sewer lines. Tracer wire shall be fastened to all buried non-metallic pipes including service lines and shall be fastened to and looped to the surface on the outside of each manhole and cleanout, and cross through the grout of the frame and cover. Service line wire and any breaks in wire shall be connected by watertight connections.

Marking (warning) tape at least 6" wide labeled "sewer" shall be placed 12" above pipes of all materials.

### **3. EXECUTION**

#### **3.01. Handling and Storage**

Exercise proper precautions in unloading, handling, stockpiling, and installation in order to prevent damage to materials and to insure delivery and installation in a sound and acceptable condition. Special care shall be taken to protect the plastic on the spigot ends from any contact with the earth.

Remove any broken or damaged materials from the construction site and do not use in any portion of the construction. Any damaged, broken, or otherwise defective materials which are included in the construction shall be removed and replaced by the Contractor at his expense. Handle pipe using wide slings; the use of hooks or other equipment which could damage pipe will not be permitted. During pipe handling, protect against impact shocks and fall.

#### **3.02. Underground Obstructions**

The Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures, both known and unknown, may be determined. Hand excavation shall be used where necessary. If required, the Contractor will excavate and locate existing utilities ahead of trench excavation in order that necessary grade changes or utility adjustments may be known ahead of time. The Contractor will be responsible for notifying all appropriate utilities such as gas, electric, telephone, cable, etc. when working in areas where there may be such utilities.

The Contractor shall preserve intact any underground utilities encountered during construction unless they interfere with new pipe lines or structures being installed. When underground utilities will interfere with proposed construction, notify the utility and the Town. Contractor shall make suitable arrangements to adjust the proposed construction. In case any such utilities or other structures are accidentally broken, they shall be immediately replaced in a condition at least equal to that in which they were found, at the Contractor's expense.

#### **3.03. Excavation**

Excavation and preparation of the trench bottom shall be in accordance with Excavation, Backfill, and Compaction Standard Specifications (Section 02200) as should all backfill and compaction.

Excavation for pipe shall generally be by open trenches unless otherwise specified, required on the plans, or approved by the Town. The trench shall be excavated using conventional methods. Methods other than standard cut and cover must receive prior approval of the Town. The banks of the trench shall be kept as nearly vertical as soil conditions will permit, but shall not exceed the angle of repose of the soil. The Responsible Party shall assume shoring will be needed. Boring and pipe bursting methods where specified or authorized must be approved in advance by the Town.

Excavation for manholes and other accessories to have 16 inch minimum clearance on all sides.

Excavation shall not be carried below the required level. Excess excavation below required level shall be backfilled with structural gravels, or concrete, as appropriate for proper backfill and use, and shall be thoroughly tamped to achieve the density required in the pipe zone or manhole foundation as appropriate.

**3.04. Alignment and Grade**

Basic surveying and control and stationing will be provided by land surveyors retained by the Developer. Basic control shall be set with stakes, spikes, shiners, or crosses set at the surface and on an offset from the sewer line. Benchmarks shall be provided within 50 feet of each manhole and for grade and offset stakes on the ground at 50 ft intervals which the Contractor shall use to confirm his elevation while installing the pipe. The Contractor shall transfer line and grade from these control points to the construction work in a manner approved by the Town, with spot checks by the Town's representative. The preservation of stakes and other line and grade references is the responsibility of the Contractor.

Sewer lines and manholes shall be laid to within 0.1 feet horizontal and 0.02 feet vertical of design alignment and grade. Where design sewer grades are greater than 1.0% vertical tolerance can be increased to 0.03 feet.

Alignment of trenches shall be carefully controlled so that the pipe will be laid with adequate space for compaction of backfill between the pipe and trench walls. All excavation shall be of sufficient width to provide ample room for proper joining and compaction of pipe and fittings, typically 16" plus pipe OD. Minimum trench width shall be twelve (12) inches plus pipe OD assuming proper compaction can be provided. Maximum trench width will be restricted to pipe diameter plus two feet unless otherwise approved by the Town. If the maximum trench width is exceeded, provide special bedding, encasement, or higher strength pipe as approved by the Town.

Contractor shall furnish and utilize an in-pipe laser to assist in controlling the grade. Calibration of the laser shall be checked at least weekly by checking it over a 500 ft range on the ground. Note that the accuracy of the pipe laser can be adversely impacted by a number of factors including heat, strobe lights, and water in the pipe.

The laser shall be located in the trench bottom, manhole invert, or in the pipe unless otherwise approved by the Town. When the laser equipment is placed in the trench, it shall be positioned in such a manner that the laser will describe the center of the conduit. As each pipe section is installed, a special target or template shall be placed in the pipe's end and the vertical and horizontal alignment checked. The beam projected through the previously placed conduit sections shall also be used to provide line and grade for trench excavation and placement of bedding materials. The light beam shall be periodically checked against surface control points to insure its correct vertical and horizontal alignment. Reasonable care must be taken to ensure that the conduit line is properly ventilated.

**3.05. Laying Sewer Pipe**

A. Inspection: The pipe and accessories shall be carefully and thoroughly inspected for cracks and other damage before installation in the final position. Defective or unsound material, pipes with bells that are not full and continuous, pipe that does not meet the deflection tolerances for gravity pipe, shall be rejected. Rejected materials shall be promptly marked and removed from the job by the Contractor.

**B. Installation Instructions**

All installation work shall conform with applicable portions pipe manufacturer's installation instructions and recommendations, and with these specifications and referenced sections of the Standards. If there are conflicts, the more stringent specification shall apply unless otherwise directed by the Town.

Pipe shall be laid and maintained to the required line and/or grade shown on the plans at the required locations with spigots centered in the bells. When new pipe is to be connected to an existing pipe or when crossing an existing pipe line, the Contractor shall excavate the existing lines well in advance of the laying of the new line to enable the Contractor and OR (Owner's representative) to verify the elevation and placement and allow for adjustments in grade and/or alignment of the new pipe line that may be required.

- C. Potential Conflicts: The Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground infrastructure, both known and unknown, may be determined, and he/she shall be held responsible for the repair or replacement of such improvements when broken or otherwise damaged. Temporary support, adequate protection, and maintenance of all underground and surface utility structures, drains, sewers, and other structures encountered in the progress of the Work shall be furnished by the Contractor at his expense.
- D. Lowering Pipe into Trench: Proper implements, tools and facilities shall be provided and used by the Contractor for the safe and convenient performance of the Work. All pipe, fittings, manholes and appurtenances shall be carefully lowered into the trench piece by piece by means of straps, or other suitable tools or equipment, in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall the pipe or accessories be dropped or dumped into the trench. Dropped or dumped pipe will be rejected. All water must be kept out of the pipe and bell hole until the joint is completed and no water shall be allowed to rise in or about the pipe until the trench has been filled at least one foot above the pipe. No length of pipe shall be laid until the previous length has had sufficient backfilling placed around it to hold it securely in place and prevent floating.
- E. Keeping Pipe Clean: Every effort shall be made to keep the interior of pipe and fittings clean during all phases of construction. Every precaution shall be taken to prevent foreign material and trench water from entering the pipe and fittings. During construction, the Contractor shall provide and maintain adequate equipment to properly remove and dispose of all water entering the trench and any other part of the work. Keep water level below the pipe. Trench water shall not be allowed to flow through the pipe. The interior of the pipe shall be thoroughly cleaned of foreign material before being lowered into the trench and shall be kept clean during operations by plugging or other approved means. End of the pipe shall be kept sealed with a tight-fitting plug until joining with the next joint of pipe when there is water in the trench. Fittings shall be thoroughly cleaned, with a wire brush, if necessary. If the pipe laying crew cannot keep pipe clean while placing the pipe in the trench, Town may require that the ends of the pipe be covered before placing it in the trench and that the covers only be removed as the joints are assembled. If the cleanliness of the line is still in question, Town may require the line be hydrojetted or swabbing and video inspected at contractor's expense to confirm that it is clean. Providing access to all sections which are required to be videoed, then cleaning and reassembling pipe, shall be the responsibility of the Contractor.
- F. Laying and Joining Pipe
- Begin pipe laying at the lowest point, unless otherwise directed by the Town, and install the pipe with the spigot ends pointing in the direction of flow. A firm bed must be prepared for each pipe to the required depth true to line and grade with uniform bearing for the pipe barrel and the material hollowed out underneath the bell so that the body of the pipe shall be supported for its entire length upon the bed so prepared. Adjustments to line and grade shall be made by scraping

away or adding properly compacted bedding materials under the pipe and not by using wedges and blocks or beating or jumping on the pipe.

Lay all sewer pipes straight between changes in alignment and at uniform grade between manholes, unless directed otherwise by the Town. All pipe shall be carefully centered and with a smooth invert at the joint. The joint shall be made in a workmanlike manner and shall be watertight. Immediately before joining two lengths of pipe, the inside of the bell and the outside of the spigot end and the gasket shall be thoroughly cleaned. Caution shall be exercised to ensure that the correct type of gasket is used. A thin film of gasket lubricant shall be applied to the inside face of the gasket and the spigot end of the pipe. The spigot end of the pipe shall be centered in the bell with care to prevent the joint from contacting the ground. The joint shall be completed by pushing the pipe home (to the depth mark) by hand with a slow steady pressure, without jerky or jolting movements. Pipe furnished without a depth mark shall be marked before assembly to ensure insertion to the full design depth of the joint. The pipe shall then be properly set and brought to correct line and grade. Care shall be taken to ensure that no damage is done to the pipe, collar, or bell when the pipe is being homed. Use of excessive force will not be permitted. Any pipe that has had the grade or joint disturbed during or after laying shall be taken out and re-laid.

Prior to making a solvent weld joint, all water shall be removed from the trench and the pipe shall be clean and dry. Trench and pipe shall remain dry until welded joint has had time to cure. The length of the cure time shall be as stated on the welding solvent container as corrected for the temperature. The minimum curing time shall be 2 hours for the rapid set solvent.

Pipe lines shall be checked by the Contractor to determine whether any displacement or other damage has occurred after the trench has been backfilled approximately two feet above the pipe. If this check shows that the pipeline to be out of alignment, broken, or otherwise damaged, the defects shall be corrected by the Contractor before proceeding with other pipe laying. The Town may require lamping or other testing at this stage of backfill or may decide to only test the completely backfilled lines. It shall be the responsibility of the Contractor to check his work as he/she proceeds.

The pipe shall then be secured in place by installation of bedding material and backfill, in accordance with the plans, Pipe Bedding section below, and Excavation Backfill and Compaction Specifications (Section 02200) using permeable materials for gravity sewer. Place and secure tracer wire on the pipe prior to bedding. Place warning tape at the top of the pipe zone (12" above the pipe).

Where HDPE pipe is approved for use, it shall be installed in strict accordance with manufacturer's recommendation. All workers welding HDPE pipe must be trained and approved by the manufacturer for welding pipe of the size and DR being used on this project. At the beginning of welding each day, each worker who will be welding pipe shall demonstrate his qualifications by successfully completing a bend back test prior to welding any pipe for use on the project. All welds shall be full depth and shall have a uniform bead around the joint with no bead on the inside of the pipe.

If, in making any joint, previous lengths of pipe are disturbed, such lengths must be uncovered and re-laid. Any section of pipe, fittings, valves, or appurtenances already laid and found to be defective shall be taken out and replaced without additional expense to the Owner.

**G. Crossing Existing Lines**

Expose existing line ahead of laying sewer pipe to allow adjustments in line and grade as needed anticipating that considerable adjustment may be needed. Where gradual grade adjust of existing line will allow for the crossing an existing pressure line, that is the preferred option. Where there is significant elevation adjustment, it will be accomplished with 22.5° fittings on the pressure line. Place insulation where cover on pressure line is less than specified cover depths. Coordinate timing of the cut of the existing line with pipeline Owner, and provide required notice to affected customers. In cutting the existing pipe, take great care to prevent contamination of existing line. Keep water level in the trench below the level of the pipes. Make connection using required fittings and restrain all joints. Disinfect the line as called for Water Line Construction Standards (Section 02713). Cut off and remove all abandoned sections.

Where water service lines need to be raised or lowered to allow sewer lines to remain on grade and there is not sufficient slack to allow for adjustment, expose at least 5' of the existing service, squarely cut the existing water service line and install new copper pipe to gradually adjust the grade of the water service line and reconnect both end of the existing water service with appropriate couplings for the existing material and the copper. If soil conditions are adverse the copper piping with Town approval the use of pure core HDPE of the same inside diameter as the existing service line may be used.

- H. Cutting of Pipe: The pipe shall be cut in a neat and workmanlike manner in accordance with manufacturer recommendations. No damage shall be done to the pipe or any lining or coating and the cut shall leave a smooth end at right angles to the axis of the pipe. Flame cutting of iron pipe by means of an oxyacetylene torch shall NOT be allowed.
- I. Sequencing: The Contractor shall excavate in advance of pipe laying only a sufficient length to assure steady progress in the installation of pipe. No more than 150' of trench shall be open at a time unless specifically authorized by the Town. The length of open trench shall be limited where necessary to accommodate traffic, public safety, minimize service disruptions or as required by the Town and/or other entities with authority, in vicinity of the work being performed. All open trenches shall be appropriately barricaded. No more than 20 feet of trench securely barricaded may be left open overnight. Where the work includes removing old pipe and replacing with new pipe in the same location, temporary connection between what has been replaced and the old must be made at the end of each day. In addition to requirements elsewhere related to disruption of service, all existing sewer services shall be functional at the end of construction each day.

**3.06. Pipe Bedding**

The bottom of the trenches shall be accurately graded to provide uniform bearing and support throughout the full pipe length without placing stress on the pipe or allowing voids under the pipe. Excess loading of the bell will not be permitted under any circumstances. Dig bell holes and depressions for joints after trench bottom has been graded. Bell holes and depressions shall be only of such length, depth, and width as required to properly make the particular type of joint. The use of earth mounds for bedding the pipe will not be permitted.

Where existing pipes are being removed and replaced with new, remove the old saturated materials and replace with new.

All sharp stones, trash, and other materials which may damage the pipe or interfere with the proper bedding of the pipe and the placement and compaction of the backfill shall be removed from the trench.

The soil in the bottom of the trench shall be slightly loose, and at optimum moisture, so that uniform bedding and compaction around the pipe is easily obtainable. Should any material be encountered which would prevent the obtaining of suitable bedding, e.g. rock, wet, unstable material, etc., the trench shall be over-excavated as shown on the typical drawing for pipe bedding. Backfill any over-excavation, required or inadvertent, with materials equivalent to, and compacted as specified for haunching materials according to these specifications. Bedding and materials in the pipe zone, shall conform with materials specified in Section 02200, Excavation Backfill and Compaction for Class D bedding for gravity pipe lines and Class C for pressure pipes. At the top of the pipe zone, install non-woven geotextile on top of the Class D fill materials and place the warning tape on top of geotextile.

**3.07. Backfill and Compaction:** Backfill and compaction shall be in accordance with the applicable sections of the Excavation, Backfill, and Compaction Standard Specifications.

**3.08. Manhole Construction and Installation**

Precast manhole bases with integral bottom barrels are required. The ground surface below the precast concrete base shall be excavated a minimum of six inches below the elevation of the bottom of the base and backfilled with Mirafi RS 380i OAE geotextile on the bottom then on compacted  $\frac{3}{4}$ " or 1-1/2" screened gravel. The gravel shall be carefully leveled and smoothed to give uniform support to the precast base over its entire area. The precast base shall be set at the proper location to center the manhole over the sewer main.

The base of the manhole shall have a minimum of five inches between the lowest invert of the manhole and the inside base to allow room for the construction of a channel or a precast channel may be utilized but must widen out at the midpoint (springline) on the pipe diameter.

Only when authorized by Town for a particular location and cause, may cast in place manhole base be constructed. When a cast in place base is authorized concrete mix shall be 6.5 sack, 0.4 water/cement ratio, 4500 psi concrete, placed on uniform compacted base and in conformance with the typical details on the plans. Bases shall extend at least eight (8) inches below the invert of the pipe and shall be benched starting at springline. Precast manhole barrel sections shall not be placed on the cast in place base until it has reached sufficient strength to provide support without damage. Cast in place bases will be held to the same leak and vacuum test requirements as precast manholes.

Set each manhole section in a band of 1" minimum thickness of RamNek OAE, to make a watertight joint. Set sections plumb and neatly point inside of joint with grout. Use sections of various heights to bring manhole ring and cover to specified elevation. Set frames and covers in a full bed of mortar or RamNek and accurately set to the grade indicated or as directed. Encase frames in cement mortar (not concrete) around entire perimeter, but not in excess of the perimeter. Install preformed flexible plastic gasket joints in accord with manufacturer's recommendations in a manner such that all surfaces are clean, dry, and warm.

All pipes shall be connected to precast manholes with a pipe boot. The opening in the manhole wall where a pipe enters or leaves shall be sealed and patched in a neat workmanlike manner, both inside and out with cement mortar. All lifting holes and other imperfections in the interior manhole wall shall be filled with cement mortar.

Provide a flexible joint in the pipe 12 to 24 inches outside from all manhole walls and other solid structures.

Precast concrete adjustment rings shall be installed on top of the cone to support and adjust the manhole frame to the required final grade. The maximum depth of the adjustment rings shall be eight inches, and the maximum depth from top of cone to final grade shall be as shown on the manhole typical drawing. Use Ramnek or equal between each ring and between top ring and frame to provide secure, watertight seal.

The top elevation of the manhole shall be adjusted to match final street grade with the top of the lid being 1/4-1/2" below the finished pavement and sloped to match the slope of the pavement. If manholes are located in open fields, they shall be left at least 12 inches above grade and a locking ring and cover shall be installed. Where the road surface is gravel, the manhole shall be set 4-6" below finished gravel surface, sloped to match the surface.

**3.09. Connections to Existing Manholes:** Sewer pipe connections to existing manholes where there is no existing pipe stubbed out shall be made in such a manner that the finished work will conform as nearly as practicable to the requirements specified for new manhole construction. The Contractor shall carefully cut out as small an opening in the existing manhole as necessary to insert the new sewer pipe in a pipe boot using a saw which will cut a clean circular opening. The existing concrete foundation bench shall be cut with a hole saw similar to what is used to cut the manhole to the cross-section of the new pipe in order to form a smooth continuous invert similar to what would be formed in a new concrete base. Where practical, the upstream and downstream invert shall be plugged during construction to prevent flow and construction debris from entering the system. The Contractor shall pump out and clean the manhole before removing the plugs. A mortar that will securely bond to existing concrete shall be used to smoothly finish the new invert and to seal the new line, both inside and outside, so the junction is watertight and smooth.

**3.10. Connecting Existing Pipes to New Manholes:** Where an existing manhole is to be replaced, Contractor shall excavate and remove and dispose of the existing manhole and replace the manhole with a precast base with pipe boots to accommodate each of the sewer lines which needs to be connected to the new manhole. No more than two couplings per manhole shall be used to reconnect all the pipes. Manhole base shall be bedded in flowable fill from the manhole to three feet past the coupling for the depth of the pipe zone.

**3.11. Wyes and Risers:** The Contractor shall place wyes, stubs, and risers where required by the approved construction plans. Wyes shall be angled upwards so that the upper invert of a one-eighth band connected to the fitting will have an elevation equal to or higher than the inside crown of the sewer main. Riser connections shall be installed where the elevation of the top of the branch is more than 12 feet below finished ground. Riser connections shall ordinarily reach to a grade of 8 feet below finished ground surface. Temporary termini shall have water tight plugs in each branch pipe or stub. Wye and riser locations shall be marked with a fence post, tracer wire and be labeled with the depth. Details for service line connections and pipe laying are covered below and construction details are shown on typical drawings. As Built measurements shall be made by the Contractor to reference the wye or riser connection to the nearest manhole before backfilling.

**3.12. Service Installations**

Materials for service lines must meet the above specifications for each type of material. All installation work shall conform to applicable portions of the pipe manufacturer's installation instructions in addition to the requirements on the Town Typical Drawing for sewer service sewer installation requirements herein, and where applicable the International Plumbing Code.

Unless otherwise approved by the Town based on native soils types, all service pipe shall be bedded on 6 inches of well graded screened rock or pea gravel conforming to select bedding material in the standard specifications for Excavation and Backfill.

Sanitary sewer service lines shall be installed perpendicular to the main on the shortest and straightest route possible. There shall be a cleanout placed at property line and at any changes in grade and/or direction.

When installing a new sewer main, service wyes shall be installed as pipe laying progresses. Where a connection is being installed in an existing main and full bodied service wyes have not been previously installed in the main sewer, the main shall be cut and a section of pipe installed with a full bodied wye and coupling or if allowed by the Town the service may be tapped by cutting a hole in it sized to fit the saddle for the service line such that the tap is smooth and watertight. The cutting method shall be approved by the Town.

The Town's representative shall inspect the main and connection at every tap prior to backfilling. In the event the tap is covered before it is inspected, it shall be dug out by the Contractor, to allow visual inspection of the tap and the main by the Town. If the main sewer line is cracked or broken during the process of locating and/or tapping, it shall be repaired immediately, by replacing the broken section for at least 12" on each side of the damage. If the pipe needs to be cut, the tap shall be made with a full bodied wye.

A manhole shall be installed instead of a service wye when the size of the service line is more than 50% of the size of the main. Service taps to existing manholes shall be done in accordance with the Manhole section of these specifications and shall only be allowed when there are less than 3 inlet pipes and the service pipe will be at least 60 degrees in each direction from another inlet pipe.

Where a sewer service line will cross over a water main or service, a sealed end encasement shall be furnished around the sewer service at least 10' measured horizontally in each direction from the crossing. If the sewer service crosses under a water main or service with less than 18" of separation between the top of the sewer service and the bottom of the water, the sewer service shall be encased for at least 10' horizontal in each direction of the crossing.

In no instance shall a trench extend beneath an existing sidewalk or curb unless excavation conforms with the Town standards for concrete removal. The pipe shall typically be bored, jacked, or tunneled through the earth under the curb or sidewalk. If tunneled, backfill with flowable fill. Alternately, Contractor may remove the existing sidewalk back to joints on either side of the trench, backfill in accordance with the Standard Specifications for backfill and then replace the sidewalk.

Measurements shall be taken of the distances of the service wye from a manhole to the main, and the depth from back of the sidewalk or property line to invert at the main and at end of the service stub. In addition when a curb is present, the location shall be marked on the curb by a "SS" symbol. In all cases, the end of the service stub shall be marked with green painted 2 x 4 which marked at 1' increments starting at the top of the pipe brought to the surface and backed by a steel "T" fence post. Tracer wire shall be brought to grade and wrapped around the post. Where the sewer service is terminated on the lot side, install a glued-on cap.

**3.13.** Underdrains: Where excessive groundwater is encountered, and in other areas where it is deemed advantageous or necessary, gravel or piped underdrains shall be installed. Underdrains shall daylight to the nearest suitable point as approved by the Town. The trench shall be excavated to the required depth

and width, non-woven geotextile placed, the trench backfilled and compacted with screened bedding material and the geotextile wrapped over the top of the screened rock once the sewer and drain lines are installed. Where underdrain pipe is required, it shall be installed to a true line and grade and held in place with compacted single size screened bedding material. Additional underdrain bedding material shall then be placed to a level of at least 12" inches over the top of the underdrain pipe and the sewer pipe installed. The sewer shall be installed to one side of the underdrain and be offset at least one pipe diameter measured horizontally. The sewer pipe shall be bedded to springline and compacted and then covered with additional screened rock and compacted in lifts to 12" over the sewer pipe. Underdrain pipes shall be provided with cleanouts outside each sanitary manhole. Underdrain pipe shall be continued beside manholes by use of suitable bend and other fittings.

**3.14.** Lift Stations and Force Mains: Where necessary and with approval of the Town, lift stations and force mains shall be constructed in accordance with Town approved plans. Force mains shall be installed from pumping facilities to tie into the gravity collection system. At design average flow, a cleansing velocity of at least two feet per second shall be maintained. When possible, force mains shall have a high point a short distance from the manhole and flow open channel into the next manhole. Where the force main enters the manhole above the invert, a fitting shall be installed to direct the flow from the entry point in the manhole to the flow channel. Automatic air relief valves shall be placed at high points in the force main to prevent air locking. Such valves shall be designed to handle sewage and be equipped with fittings to allow cleaning.

**3.15.** Field Quality Control (Testing)

Compaction Testing shall be consistent with the requirements in the Excavation, Backfill, and Compaction Standard Specifications (Section 02000).

- A. Infiltration Test: Any observed infiltration shall be corrected.
- B. Tests for Displacement of Sewers: Check sewer mains to determine whether any displacement of the pipe has occurred after the trench has been backfilled to two feet above the pipe and tamped as specified. Test as follows: Shine a light between manholes, boxes, and/or bends (if authorized by Town) by means of a flashlight or by reflecting sunlight with a mirror. If illuminated interior of pipeline shows poor alignment, displaced pipe, or any other defects, remedy defects until acceptable to the Town. Misalignment shall be less than 3% of pipe diameter.
- C. Ovalation of Flexible Conduits: All gravity lines constructed of flexible conduit shall be tested for ovalation. Such testing shall be performed by the Contractor using a mandrel, "Go - No Go" gauge, or by other instruments which will measure and record actual pipe deflection. Deflection shall not be measured less than 30 days after backfill is completed and shall not exceed 5% of the pipe diameter. Sections of pipe not meeting this specification shall be excavated, pipe bedding replaced, and trench again backfilled, compacted, and retested for all the tests of this sub-section. Should it still fail to meet these ovalation requirements or other required tests, the section of line shall be replaced. The Town may elect to perform this test again at any time during the one-year warranty. The Town will notify the Responsible Party in writing if problems are detected. The Responsible Party shall promptly make arrangements to correct the problem in accordance with the warranty provisions of this contract.
- D. Video Inspection of Line Interior: At the completion of segments of sewer (and storm) lines, the lines shall be jetted with water. After water ceases to flow, Contractor shall video each segment to demonstrate cleanliness, proper jointing, conformance to alignment and grade, and proper roundness. Video work shall be done in coordination with ovalation testing so the video records

the testing results of the "Go-No Go" gauge. No line shall be put into service prior to the Town accepting the results of the video and leakage tests. Where there are active services connected during the line installation, video testing will be used to determine leakage as well. On new lines and lines with no active services shall be capped and the service lines tested with the mains.

E. Tests for Pressure Lines: Test sewer lines which will be subject to positive pressures in accordance with the testing the Town Standards for water line testing.

F. Air Test - Gravity Flow Lines

Conduct an air test on all gravity lines including service lines in conformance with UniBell publication B-6-90 and ASTM F1417. Special attention shall be paid the safety admonishments provided in that publication.

Preparation for tests: Flush and clean the line prior to testing in order to wet the pipe surfaces and produce more consistent results. Plug and brace all openings in the line and the upper end of any connections. Check all pipe plugs with a soap solution to detect any air leakage. If leaks are found, release the air pressure, eliminate the leaks and start the test procedure over again.

Procedure of Test: Low pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0 psig greater than the average backpressure of any groundwater above the pipe, but not greater than 8.0 psig. Allow sufficient time for the air temperature to come to equilibrium with the temperature of the pipe and the pressure to stabilize. Refer to the UniBell publication for adjustments of required pressures due to groundwater.

After the temperature has stabilized, and the pressure is stabilized at 4.0 psig greater than the average groundwater back pressure, the air hose from the control panel to the air supply shall be shut off or disconnected. Continuously monitor the pressure gauge. Once the reading has stabilized, begin the test. The pressure reading shall be observed and the timing shall commence with a stop watch or other timing device that is at least 99.8% accurate.

If the time lapse (in seconds) for the allowable pressure drop exceeds that shown in at the end of this section, the pipe shall be presumed to be within the acceptable limits for leakage.

If the time lapse is less than that shown in the table, the Contractor shall make the necessary corrections to reduce the leakage to acceptable limits. All visible or audible leaks shall be fixed even if leakage is within acceptable limits.

Safety: The air test may be dangerous if proper precautions are not taken. All plugs must be sufficiently braced to prevent blowouts and the pipeline must be completely vented before attempting to remove the plugs.

As a safety precaution, pressurizing equipment shall be provided with a regulator set at 8 psi to avoid over-pressurizing and damaging an otherwise acceptable line.

G. Manhole Tests

Vacuum Tests shall be performed in accordance with test methods in ASTM C 1244 following good safety practices. Do not pressurize manhole nor exceed the manufacturer's vacuum rating on vacuum disc or flat plate. Follow the manufacturer's instructions for the safe use of test plugs. Minimum test times shall conform Table 1 in ASTM C1244 which is partially quoted below:

<u>Depth</u>	<u>4' Dia</u>	<u>5' Dia</u>	<u>6' Dia</u>
8'	20 sec	26 sec	33 sec
10'	25	33	41
12'	30	39	49
14'	35	48	57
16'	40	52	67

Test vacuum shall start at 10 in Hg and not drop to less than 9 in. Hg during the test period.

Smoothness of inverts shall be checked for roughness by rubbing a hand in a latex glove over the full surface of the invert. If the glove is torn or snags, the surface will need to be smoothed. In addition, if Owner's representative has concerns about solids in sewage becoming snagged on roughness in the flow line, suitable materials shall be mixed with water and observed flowing through the manhole. Manholes with rough inverts or inverts which do not encourage smooth flow through the manhole will not be accepted by the Town.

**3.16. Inspection Cleaning and Lamping**

Final acceptance of the sewer line shall be based on an inspection for compliance with all items in these specifications. No pipe spalls, rocks, dirt, joint compounds, cement mortar, and other trash and obstructions shall be left in a sewer pipeline of any size or type. If this debris is removed by flushing, the manhole outlet shall be bagged or plugged before construction so that this debris will not be carried into or contaminate the existing lines.

Flow of any kind into the existing sewer system shall not be allowed until the sewer has been satisfactorily completed and such a connection is approved by the Town.

**3.17. Restoration and Cleanup**

The Contractor shall restore or replace all removed or damaged roadbase, paving, curbing, walks, sod, shrubbery, fences, irrigation ditches, or other structures or surfaces to a condition at least equal to that before the work began and to the satisfaction of the Town. The construction site shall be left neat and orderly.

Surplus materials, tools, and temporary structures shall be removed by the Contractor. All dirt, rubbish, and excess earth from excavations shall be disposed of by the Contractor and the construction site shall be left clean and orderly.

The Contractor shall maintain the surface over the trenches in approved condition against any settlement or deterioration throughout the warranty period.

**3.18. Abandonment**

Sewer lines, services and/or manholes that are to be taken out of service will be completely removed and shall become the property of the Contractor. Abandonment in place will not be allowed. The location shall be backfilled in 8" lifts and compacted per Town Specifications.

MINIMUM SPECIFIED TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015

TABLE I

1 Pipe Diameter (in.)	2 Minimum Time (min: sec)	3 Length for Minimum Time (ft)	4 Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)										
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft			
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	8:52	10:08	10:08	11:24	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	13:51	15:49	15:49	17:48	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	19:56	22:47	22:47	25:38	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	31:09	35:36	35:36	40:04	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	44:52	51:16	51:16	57:41	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	61:00	69:48	69:48	78:31	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	79:46	91:10	91:10	102:33	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	100:57	115:22	115:22	129:48	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	124:38	142:26	142:26	160:15	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	150:43	172:21	172:21	193:53	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	179:29	205:07	205:07	230:46	230:46

UNI-B-6-90