APPENDIX X

Technical Specifications for Sanitary Sewer work

INSTALLATION OF PIPE, FITTINGS AND APPURTENANCES

1. Pipe, fittings, and appurtenances shall be installed per manufacturer's printed instructions. Care shall be taken to ensure that no joints are made with uneven or rough edges. Pipeline deflection must be kept within the manufacturer's recommended deflection tolerance. Pipe and fittings shall be carefully handled and lowered into the trench. Special care shall be taken to ensure that each length shall abut against the next in such a manner that there shall be no shoulder or unevenness of any kind along the inside of the pipe. Where the contractor proposes to deviate from the specified instructions, the proposed deviation shall be submitted for approval.

2. All pipes shall be bedded on a solid foundation prior to backfilling. Before pipe is placed, the bottom of the trench shall be carefully shaped to fit the lower part of the pipe exterior with reasonable closeness for width of at least 60% of the pipe width. Bell holes shall be dug sufficiently large to insure the making of proper joints and so that after placement, only the barrel of the pipe receives bearing pressure from the trench bottom. No pipe shall be brought into position until the preceding length has been thoroughly bedded and secured in place. Any defects due to settlement shall be made good by the Contractor.

3. Pipe and fittings shall be kept clean until final acceptance of the work. All open pipe ends shall be provided with plugs to keep dirt, water and other materials from entering. This plug shall be kept in place when actual pipe laying is not in progress.

4. Excavation and backfill for pipes and appurtenances shall be in accordance with the applicable DelDOT specifications.

5. The Contractor shall not install pipe on frozen or frost penetrated subgrade. When directed, the Contractor shall install pipe on artificial foundations. Such foundation may consist of gravel or concrete and shall be to the dimensions and in the manner directed by the Engineer. Refer to the applicable DelDOT specifications.

6. Whenever a pipe requires cutting to fit into the line or to bring it to the required location, the work shall be done in a satisfactory manner so as to leave a smooth end perpendicular to the axis of the pipe. Field cut PVC pipe shall have a beveled edge before making the pipe joint.

7. No welding or blocking will be permitted in laying any pipe unless by written order of the engineer.

8. Pipe laying shall not begin until all stakeout and cut sheets have been approved by the Engineer.

9. Pipe shall be checked to determine whether line displacement or other defects have occurred. Inspection shall take place when 2 feet of earth cover is in place and upon completion of project. A flashlight or mirror-reflected sunlight shall be flashed between ends of pipe or structures. If the illuminated interior indicates poor alignment, debris, displaced pipe infiltration, or other defects, the defects designated shall be remedied by the Contractor.

10. Forcemains shall be laid 10 feet horizontally from any existing or proposed water. The distance should be measured edge to edge. All water lines should be buried to a depth of at least 3 feet (36 inches). Forcemains crossing water lines shall be laid to provide a minimum vertical distance of eighteen (18) inches between the outside of the forcemain and the outside of the water line, and the water main shall be above the forcemain. At crossings, one full length of forcemain pipe should be placed so both joints will be as far from the water as possible. Special structural support for the forcemain and water main pipes may be required. If this minimum vertical separation cannot be provided, either the forcemain line or the water line shall be encased for a distance of ten (10) feet on either side of the crossing. Forcemains crossing storm drains may require special structural support for the pipes. If a minimum vertical separation of one foot cannot be provided, the lower line should be encased in concrete.

FORCEMAIN TESTING

Forcemains are to be tested in accordance with the following requirements:

1. The Contractor shall furnish all equipment, labor and materials, including water, pumps, compressors, stopwatch, gauges, and meters as approved by the Engineer for testing. The Engineer shall determine the amount of forcemain to be tested at any one time and reserves the right to separate the installation into several test sections. Water for testing shall be of potable quality.
2. The Engineer shall be notified a minimum of 48 hours in advance of all tests, and all tests shall be conducted in his presence and to his entire satisfaction.

3. Pressure Test: After the pipe has been laid, all newly laid pipe or any valved section thereof, shall be subjected to a hydrostatic pressure of 125 psi. Test Pressure shall:

    a. Be of at least two-hour duration.
    b. Not vary by more than five psi.

4. Pressurization: Each valved section of pipe shall be filled with water slowly and the specified test pressure, based on the elevation of the lowest point of the line or section under the test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer.

5. Air Removal: Before applying the specified test pressure, air shall be expelled completely from the pie, valves and hydrants. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points, so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed, and the test pressure applied. At the conclusion of the pressure test all corporation cocks shall be removed and plugged or left in place at the discretion of the Engineer.

6. Examination: All exposed pipe, fittings, valves, hydrants and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, or hydrants that are discovered following the pressure test shall be repaired or replaced with same material and the test shall be repeated until it is satisfactory to the Engineer.

7. Leakage Test: A leakage test shall be conducted concurrently with the pressure test.

8. Leakage Defined: Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or at any valved section thereof, to maintain pressure within five psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.

9. Allowable Leakage: No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

   L = (ND)(SQRT of P)/7400

   in which the allowable leakage, in gallons per hour; N is the number of joints in the length of pipeline tested; D is the nominal diameter of the pipe in inches; and P is the average test pressure during the leakage test in pounds per square inch gage. Allowable leakage at various pressure is shown in Table I below.

10. Should any of the tests show the forcemain to be defective, the Contractor shall remedy such defects and retest the forcemain as specified above. This procedure shall be repeated until the test requirements are met. Segments of main which do not meet minimum requirements will not be accepted.

TABLE I

Allowable Leakage per 1000 feet of Pipeline* - gph

Avg. Test Pressure psi	Nominal Pipe Diameter - (inches)												
	2	3	4	6	8	10	12	14	16	18	20	24	30
100	0.15	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.80	2.25
125	0.17	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68	2.01	2.52
150	0.19	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84	2.21	2.76

* For pipe with 18-ft nominal lengths. To obtain the recommended allowable leakage for pipe with 20-ft nominal lengths, multiply the leakage calculated from the table by 0.9. If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.