6.01 SCOPE

The work covered by this section of the specifications consists of the furnishing of all plant, labor, materials, equipment and supervision and performing all operations involved in the construction of sanitary sewer mains in accordance with the provisions of the Plans and Specifications and subject to the terms and conditions of the Contract Documents.

Sanitary sewer leads and sewer appurtenances are covered under Section 7 of these specifications.

6.02 MATERIALS

A. Sewer Pipe

1. General

a. Sewer pipe, unless otherwise indicated on the plans or authorized in writing by the Township, shall be new, unused material of the size and type shown on the plans and shall conform to the requirements of these specifications.

b. Pipe, materials and accessories offered by the Contractor shall be the standard products of reputable manufacturers normally engaged in the manufacturing of the particular item in question. The Township Engineer shall have the final approval of a pipe manufacturer.

2. Sewer Pipe Selection

The sanitary sewer pipe used at a particular location shall be based on depth of bury as shown in Table 6-1.

If the depth of cover over the sewer changes during construction or is different than the depths shown on the approved project plans, it shall be the responsibility of the Design Engineer to ensure that the correct material is utilized.

TABLE 6-1 Determination of Sanitary Sewer Pipe Material

Depth of Bury	Sanitary Sewer Pipe Allowed
0’ to 16.00’	PVC SDR 35, Truss Pipe, Ductile Iron
16.01’ & over	Truss Pipe, Ductile Iron

An entire sewer segment must be constructed of the same pipe material. If greater than 50% of the sewer pipe in a given segment has a depth of bury of 16.01' or greater, then the heavier pipe material shall be used.

3. PVC Sewer Pipe

PVC sanitary sewer pipe 15 inches in diameter and smaller shall meet the requirements of ASTM Designation D-3034 (latest edition), "Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings". The minimum wall thickness shall conform to SDR-35. Sewer lead pipe shall be Schedule 40 PVC.

PVC sanitary sewer pipe 18 inches to 27 inches in diameter shall meet the requirements of ASTM Designation F-679 (latest edition), "Standard Specification for Polyvinyl Chloride (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings". The minimum wall thickness shall conform to ASTM Designation T-1.

The use of PVC sewer pipe requires special attention to proper subgrade and backfilling procedures. Failure of the Contractor to provide proper construction will result in probable excessive deflection of the PVC pipe and require replacement by the Contractor at no additional cost to the Owner.

4. Ductile Iron Pipe

Ductile iron pipe shall meet the requirements of ANSI A21-50 A21-51, and AWWA C151, and shall be of the design thickness classification as indicated on the plans.

5. Composite Sewer Pipe (Truss Pipe)

Composite sanitary sewer pipe shall meet the requirements of ASTM Designation D 2680 (latest edition). The thermoplastic linings may be ABS or PVC.

B. Pipe Joints

1. For PVC Sewer Pipe: PVC sewer pipe joints may be either solvent cement or elastomeric gasket type, in accordance with ASTM D3212 (elastomeric gasket type) and/or in accordance with ASTM D2855 (for PVC pipe solvent cemented joints). Only chemical solvents approved by the pipe manufacturer shall be used.

2. For Ductile Iron Pipe: Ductile iron pipe joints shall conform to the following:

   a. Flange joints shall meet ANSI B 16.1, Class 125.

   b. Mechanical joints shall meet ANSI A21.11, and AWWA C111, or Federal Specification WW-P-421.

   c. Rubber gasket joints shall be of a bell and spigot type "TYTON", "SUPER BELL-TITE" or equal.

3. For Composite Sewer Pipe (Truss Pipe): Composite Sewer Pipe (Truss Pipe) joints shall be bell and spigot type gasketed joints meeting ASTM D3212.

C. Pipe Fittings

Pipe fittings in sewer lines shall correspond in type, size, class, joints and all other respects with the type of pipe used as specified above including the applicable ASTM requirements. Where linings and coatings are specified for pipe, the fittings to be used in conjunction therewith shall have the same lining and coating.

Fittings shall be used in ductile iron pipe lines as required, whether specifically called for or not, according to the best practice in installation of these lines. A manhole water stop shall be provided at each manhole connection as shown in the standard details.

As approved by the Township Engineer, specifically designed adapters shall be used to connect pipes of different diameter or materials of construction. The adapters shall be constructed of flexible materials and clamped onto the pipe with stainless steel bands. Use mastic, solvent weld or rubber gasket seals and encase in concrete to prevent displacement.

6.03 EXECUTION

A. Excavation

As specified in "Excavation, Trenching and Backfilling".

B. Laying Sewer Main

Thermoplastic sewer pipe shall be installed per ASTM designation D 2321 (latest edition) unless otherwise indicated in these specifications. Rigid pipe types (DIP) shall conform to ASTM C12. Embedment material shall conform to ASTM D2321 standards unless otherwise indicated herein, or in the standard details.

Pipes located inside structures or above ground shall be rigidly supported as shown on the plans or as specified herein. The full length of each section of underground pipe shall rest solidly upon the prepared bed of undisturbed earth or compacted backfill with recesses only to accommodate pipe bells and joints. Any pipe which has its grade, alignment or joints disturbed after laying shall be taken up and re-laid.

The interior of all pipe shall be thoroughly cleaned of all foreign matter before being lowered into the trench and shall be kept clean during laying operations.

The pipe shall not be laid in water or when trench or weather conditions are unsuitable for work. Water shall be kept out of the trench until the joints and backfilling are completed. When the work is not in progress, open ends of pipe and fittings shall be securely closed so that no water, earth or other foreign substances can enter the line.

All sanitary sewer main shall be laid using a pipe laser for alignment and grade. The Contractor shall be responsible for checking their work using the hubs, stakes, and/or benchmarks provided by the Owner and/or Design Engineer. Any sewer found to have a grade or alignment that varies by more than 10% from the plan grade or elevation will be considered deficient. Variations up to 10% will not be accepted if this variation results in a pipe that is below the minimum slope as defined for that pipe diameter in the latest version of Recommended Standards for Wastewater Facilities (Ten State Standards). The Design Engineer and

Township Engineer will determine if the deficiency is serious enough to affect the objective of the project. The Contractor shall remove and re-lay

any deficient sewer, if directed by the Design Engineer or Township Engineer, at no additional cost to the Owner or Township.

Any section of pipe found to be defective, either before or after laying, shall be replaced with new pipe at the Contractor's expense. If repairs are necessary, Fernco adaptors will not be allowed for main line pipe. Similar material shall be utilized.

The Township Engineer shall be notified at least 48 hours prior to the start of laying sewer main.

C. Placement within Easements

Where sewer lines are shown crossing private property, the alignment of the sewers shall be as shown on the plans and as directed by the Engineer and extra care must be taken to ensure that the work is done within the construction easements.

D. Handling

The sewer pipe shall be handled at all times in such a manner as to ensure delivery to the site and installation in a sound, undamaged condition. Any damaged or defective pipe or other materials will not be accepted. PVC pipe shall not be stored or handled in a manner which will permit exposure to sunlight for extended periods of time.

E. Horizontal and Vertical Separation

Sewers shall be laid at least 10 feet horizontally from any existing or proposed watermains. This distance shall be measured edge to edge. Should local conditions exist which do not allow for this separation, the crown of the sewer pipe shall be laid at least 18 inches below the invert of the watermain - with the approval of the Township Engineer and the Michigan Department of Environmental Quality, Drinking Water division.

Sewers crossing watermains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the pipes. This shall be the case where the watermain is either above or below the sewer. The crossing shall be arranged so that one full length of sewer pipe shall be centered with respect to the water pipe. Where a watermain crosses a sewer, adequate structural support shall be provided to prevent damage. If the 18-inch isolation distance cannot be maintained due to site constraints, then approval from the MDEQ Water Division will be required for the special construction method proposed (casing, sleeving, etc.)

When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the sewer shall be designed and constructed equal to water pipe and shall be pressure tested to assure watertightness prior to backfilling.

In all cases, state and local permit requirements shall be adhered to.

F. Placement of Sewer Pipe

The pipe shall be placed as soon as possible after the trench excavation has been made. The pipe shall be carefully laid to the required grade in a prepared trench, up-grade from structure to structure, with the bell or groove end of the pipe upgrade. Each section shall have a firm bearing throughout its length with recesses only to accommodate pipe bells and joints. Any pipe which has its alignment, grade or joints disturbed after laying shall be removed and re-laid. The joints and interior of all pipe shall be thoroughly cleaned of all foreign matter before being lowered into the trench and shall be kept clean during the laying operations. Starting sewer construction in the middle of a project must be approved in writing by the Township Engineer.

Water shall be kept out of the trench until the material of the joints has hardened and the trench partially backfilled to prevent floating of the pipe. When work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth or other foreign substance can enter the line.

G. Joints

Joints shall be of the material specified and shall be placed in accordance with the manufacturer's specifications.

H. Backfilling

As specified in "Excavation, Trenching and Backfilling".

I. Cleaning Sewers

The sanitary sewer main must be clean at the time of acceptance. If, at any time, there is an accumulation of earth or silt in the pipe, the Contractor shall clean out and remove such deposits at their own expense.

J. Acceptance Tests

1. Air Testing

All new sewers shall be subjected to air, infiltration or exfiltration tests or a combination of same prior to acceptance by the Owner. All tests for acceptance of the sewer line shall be witnessed by the Township Engineer. All sewers where the groundwater level above the crown of the sewer at the upstream manhole is over seven (7) feet shall be subjected to air tests or infiltration tests. If an exfiltration test is performed, the maximum exfiltration rate shall be the same as that permitted from infiltration. For the purposes of exfiltration testing, the internal water level shall be equal to the external water level plus seven (7) feet as measured from the crown of the pipe at the upstream manhole.

No sewer lines will be accepted until testing has been satisfactorily completed and approved. Testing shall be completed within 30 days of laying operations.

Where groundwater conditions require dewatering operations in order to construct sewers, the Contractor may, at his option, perform preliminary air tests after backfilling and while the dewatering equipment is still operating. After dewatering operations have ceased and the groundwater has stabilized at its normal level seven (7) feet or less above the sewer and if the preliminary air test was satisfactory, the preliminary air test may be accepted as final.

Maximum allowable infiltration shall not exceed 100 gallons per inch of diameter per mile of pipe per 24 hours for any individual run between manholes.
The procedure for air testing of rigid pipes such as DIP must conform to ASTM C828 (VCP) or ASTM C924 (concrete) as determined and approved by the engineer or as otherwise recommended by the pipe manufacturer.

The procedure for air testing of PVC (flexible/plastic pipe) sewers shall conform to ASTM F1417 and be as follows:

The sewer line shall be tested in increments between manholes. All leads and wyes shown on the plans must be in place prior to testing. The lines shall be cleaned and plugged at each manhole. Such plugs shall be designed to hold against the test pressure, be braced in place, and shall provide an air tight seal. There shall be

no standing water in the pipe during testing operations. One of the plugs shall have an orifice through which air can be introduced into the sewer. An air supply line shall be connected to the orifice. The air supply line shall be fitted with suitable control valves and a pressure gauge for continually measuring the air pressure in the sewer. The pressure gauge shall have a minimum diameter of 3-1/2 inches and a range of 0-10 PSIG. The gauge shall have minimum divisions of 0.10 PSIG and an accuracy of ±0.04 PSIG.

The sewer shall be pressurized to 4 PSIG greater than the greatest back pressure caused by groundwater over the top of the sewer pipe. Greatest back pressure is determined by averaging groundwater depth over the top of the pipe averaged at each manhole and multiplying by 0.433 to obtain psi. At least two (2) minutes shall be allowed for the air pressure to stabilize between 3.5 and 4 PSIG. If necessary, air shall be added to the sewer to maintain a minimum pressure of 3.5 PSIG during the stabilization period.

After the stabilization period, the air supply control valve shall be closed so that no more air will enter the sewer. The sewer air pressure shall be noted and timing for the test begun. The test shall not begin if the air pressure is less than 3.5 PSIG or such other pressure as is necessary to compensate for groundwater level.

The air test shall be performed for the duration shown in Table 6-2. The air pressure shall not drop over 1.0 psi during this test period.

TABLE 6-2 Required Test Time for Air Pressure Testing

Pipe Diameter In Inches	Duration of Air Test in Minutes per 100 ft. of Sewer Pipe Length
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5
21	10.5
24	11.5

If a sewer segment fails to pass the air pressure test, the

Contractor shall determine the location of the deficiency, repair them and retest the sewer. The sewer will not be accepted until satisfactory results are obtained.

The actual groundwater level for sanitary sewers subject to air tests shall be determined by the Township Engineer or Resident Project Representative.

The air test pressure shall be adjusted to compensate for the maximum probable groundwater level above the top of the sewer pipe that is being tested.

The method of testing and measurement shall be approved by the Township Engineer. The Contractor shall provide the necessary equipment and labor for making tests and the cost of same shall be included in the unit price bid for completed sewer.

Chemical grouting will be considered an acceptable method of repairing leaking pipe joints. Before this type of repair is undertaken, the Contractor shall obtain approval of the Township Engineer to hire a pipe grouting firm for making such repairs. Additionally, if chemical grouting of pipe joints is necessary, this operation must be performed under the observation of the Township Engineer and a complete report of all grouting operations shall be furnished to the Township Engineer upon completion.

2. Deflection Testing of Thermoplastic Sewer Pipe

Thermoplastic sewer pipe shall be tested for vertical deflection. **Deflection tests shall be performed on 100 percent of the total footage of PVC sewer.**

Truss sewer pipe will also require testing for deflection.

This testing shall be carried out under the observation of the Township Engineer using a Go-No-Go device approved by the Township Engineer and furnished by the Contractor. The deflection testing shall be performed at least thirty (30) days after final backfill of the trench. The maximum allowable vertical deflection of the cross section of the pipe will be five percent (5%) of the actual internal pipe diameter. If the results show the deflection of any sewer to be in excess of allowable, then the Contractor shall make repairs by re-excavation and compaction or replacement prior to acceptance.

The deflection testing must be satisfactorily completed prior to final acceptance of the sewer. There will be no additional payment for deflection testing performed while the sanitary sewer is in service if the Township executes their right to utilize the sewer upon Substantial Completion. The Township Engineer shall be notified at least 24 hours prior to air testing of the sewer.

3. Television Inspection

All new sewers shall be inspected after installation by means of closed circuit television. Video taping equipment shall have a running footage indication for aiding in locating all wyes, defects, etc. which is displayed and permanently recorded on the video tape of the section being filmed. The complete system shall be permanently recorded using video tape along with handwritten documentation indicating all information such as wye location, defects, infiltration and cleanliness. Immediately upon completion of the filming, the finished video tapes shall be turned over to the Township Engineer in cassette style (VHS Format). Wyes and laterals shall be in place prior to the television inspection. This television inspection work will be done under the direction and observation of the Township Engineer. The Contractor shall notify the Township Engineer at least 24 hours prior to the television inspection.

The television inspection shall be completed prior to the final acceptance of the sewer section. The Township may exercise their option to use the sewer upon substantial completion. No additional payment will be made for televising the sewer under live conditions.

Any defect in the sewer construction observed during the television inspection such as poor grade, cracked or leaking pipe sections or excessive amounts of debris shall be corrected by the Contractor immediately. Sections with defects will have to be retelevised after the repairs are made.

4. Visual Observation

Any observed defects in the sewer or groundwater flowing in the sewer shall be repaired by the Contractor prior to final acceptance.

K. Certification

The manufacturer of pipe and fittings shall furnish a certification statement that all pipe and fittings furnished to the project have been inspected and tested in accordance with the applicable specifications. Pipe will be subject to inspection and approval upon delivery and no cracked, broken, damaged or defective pipe or fitting shall be laid in the work. Any piece that is found to be defective after it has been laid shall be removed by the Contractor and replaced by a sound and perfect piece. Material certifications must be received prior to final acceptance and/or final payment for the work.