

SECTION S
SANITARY SEWER CONSTRUCTION

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SECTION S - SANITARY SEWER CONSTRUCTION

S.1 SCOPE:

These specifications for construction of sanitary sewer mains are intended to provide a minimum quality workmanship acceptable to the Town of Prosper and lack of any specifications not listed in this document in no way relieve the Contractor of full responsibility for providing a complete project of quality, finish appearance and satisfactory for operation.

The Contractor shall furnish and install all materials, labor, and equipment for constructing the work included in these specifications and as detailed on the plans.

Construction of all sanitary sewer systems shall comply with Texas Commission on Environmental Quality (TCEQ) Chapter 317 (Design Criteria for Sewerage Systems), latest revision.

S.2 PROTECTION OF WORK:

The Contractor will be held responsible for the care of all work until final completion and acceptance, and he will be required to make good, at his own expense, any damage or injury it may sustain for any cause. He shall assume all risks from floods and casualties of every description and make no charge for damages from such cause.

S.3 MATERIALS:

The Contractor shall furnish and place materials meeting the requirements of these specifications, of the dimensions and types at the locations and elevations shown on the plans or established by the Engineer. All materials shall be approved by the Engineer before being installed and any of these materials placed before they are so approved shall be removed and replaced with approved materials. Materials received on the project shall be accompanied by an invoice completely identifying the quantity, quality, and source of the material. The manufacturer's certificate of compliance to the specifications shall be shown on the invoice or attached thereto.

S.3.1 Testing of Materials:

It shall be the sole responsibility of the Contractor to prove to the Engineer's satisfaction that materials furnished for the construction of sanitary sewer lines comply with these specifications.

Sewer pipe shall be tested at the factory to see that the pertinent specifications are satisfied. The manufacturer shall furnish a certificate and test reports for each carload, showing the conformity of his material with the specifications herein, and that each and every piece of pipe and fitting have been inspected for visible physical defects and defective pieces rejected.

S.3.2 Storage of Materials:

Materials delivered to the site of the work prior to their use shall be stored so as to cause the least inconvenience to the public, and in a manner satisfactory to the Engineer.

Materials that will deteriorate such as cement and mortar shall be stored in weather-tight buildings. Rubber gaskets shall be protected from direct sunlight, oils or contamination.

Sewer pipe shall be stored and/or stacked in such manner as to prevent breakage. Pipe with pre-molded plastic joints shall be so stacked that the jointing material will not come in contact with the ground or other foreign material.

PVC pipe shall be delivered to the job site from the factory and stored at the job site in palletized units or bundles to prevent unnecessary deflection prior to installation. Each palletized unit shall be sized to limit the stacking of pipe to not more than sixty inches (60") high. Care shall be taken during the transporting of the pipe to insure that the binding and tie down methods do not damage or deflect the pipe in any manner.

Pipe bent, deflected, discolored or otherwise damaged during shipping will be rejected. Pipe stored on the job site shall be covered with canvas or other opaque material to protect it from the sun's rays. Air circulation shall be provided under the covering. PVC pipe shall not be removed from the pallet and/or laid out along the ditch until the bedding material is in place and ready to receive the pipe.

S.4 TRENCHING AND BACKFILL:

This item consists of excavating all necessary trenches for the sanitary sewer system and backfilling after the pipe has been properly laid, inspected, and tested.

This work shall include the furnishing of all labor, materials, tools, equipment, and machinery necessary for clearing and removing from the site of the work, wherever located, all obstructions, trees, stumps, brush, vegetation, and debris, and all earth, rock, and other materials to be excavated; the removal of existing structures except where specifically paid for as separate contract pay items; the stripping or removal of top soil or sod to be piled separately from other excavated materials and later to be restored to its original place after backfilling is completed; the furnishing, placing, and maintaining of all sheeting, shoring, and bracing necessary to protect the work and adjacent properties, all pumping, bailing, and draining necessary to keep the excavation free from seepage water, water from sewers, drains, ditches, creeks, and other sources; provision for the uninterrupted flow of sewers and surface waters during progress of the construction; the removal, after completion of the work, of all sheeting, shoring, and bracing not necessary to support the sides of the excavation; the satisfactory disposal of excess and unsuitable materials not required or which cannot be used for backfilling, tamping, compacting and refilling after settlement of all excavated areas; the restoring of all streets, alleys, fences, right-of-way, and other lands or structures, private or public, damaged or occupied by the Contractor in the performance of the contract, to as good a condition as they were prior to the beginning of the work.

S.4.1 Classification:

Excavation in trenches for sewer line construction will be unclassified and will not be paid for separately, but shall be included in the price bid per linear foot for the various sizes of pipe unless specific provision for separate payment is called for in the Special Provisions and on the Proposal Form.

Where no separate classification is provided, the price bid shall be on the basis of unclassified trenching, and the Contractor shall satisfy himself as to the material and conditions to be encountered.

"Unclassified" excavation will include all materials and conditions other than the above encountered in the excavation.

S.4.2 Construction Methods:

Trenches shall be excavated by a trenching machine, backhoe or dragline, except in locations where hand trenching is required. The banks of trenches shall be vertical, to a point one foot (1') above the top of the pipe.

Trenches will be excavated to the lines and grades laid out by the Engineer or as shown on the plans. No change in locations of the lines is contemplated, but should any changes be made in the lines not materially altering the amount or character of the trenching to be done, the Contractor shall proceed with the changed alignment at the unit bid price. In case any change involves greater construction difficulties than the original alignment, the Owner and the Engineer will agree with the Contractor for extra compensation thereof, prior to the construction of the changed line or lines.

The width of the trench on each side of the pipe bell shall be eight inches (8"). Minimum width of the trench shall be twenty-four inches (24").

Trenches for sanitary sewer lines shall be of such depth so that the pipe may be laid at the invert elevation shown on the plans and/or established by the grade stakes set by the Engineer.

The excavation shall not advance more than three hundred feet (300') ahead of the completed backfilled pipeline. Pipe shall be laid in all trenches that have been opened at the end of each day's work, unless the Contractor secures written permission to do otherwise from the Engineer.

If the bottom of the trench becomes an unstable foundation for the pipe through the neglect of the Contractor to adequately shore or de-water the trench, the Contractor will be required to remove the unstable material and backfill the trench to the proper grade with approved compacted gravel, and no extra compensation will be granted for this material or work.

Also, if the trench is inadvertently excavated deeper than necessary, it shall be backfilled to the proper grade with approved compacted gravel at the Contractor's expense.

However, if the undisturbed material encountered at the grade depth constitutes in the opinion of the Engineer, an unstable foundation for the pipe, the Contractor will be required to remove such unstable material and backfill the trench to the proper grade with approved compacted material. Compensation will be made to the Contractor in accordance with a mutually agreed upon cost per cubic yard.

The Contractor shall remove any water which collects in the trenches while sewer pipes are being laid. In no case shall water be allowed to run over the invert or foundation or through the sewer without permission from the Engineer. Water encountered shall be disposed of by the Contractor in a manner satisfactory to the Engineer.

The bottoms of the trenches for all sewers shall be carefully and truly graded, formed, and lined according to the grades and dimensions furnished by the Engineer. They shall be approved by the Engineer before any sewer pipe is laid therein. Bell holes shall be excavated by hand.

The Contractor shall excavate all trenches, including work necessary in working around existing pipelines or other obstructions. The Contractor shall give notice to the Owners of any such lines or obstructions in order that they may have time to take the necessary precautions for protecting their property. The Contractor shall be responsible for protecting the Owner from any damage from his operations in such work.

In rock, excavation shall be carried six inches (6") below the bottom of the pipe and gravel, thoroughly tamped, shall be used for backfilling to the grade of the bottom of the pipe line as specified by the specific embedment required.

After inspection of pipelines has been finished on any completed portion of the work, the trench may be backfilled. Backfilling shall be accomplished in compliance with the applicable portions of these specifications.

S.4.3 Sheathing, Shoring and Bracing:

The sides of all excavations shall be sheeted, shored, and braced in accordance with OSHA Regulations and installed by the Contractor's "competent person" so as to try to prevent slides, cave-ins, settlement, or movement of the banks and to maintain the excavation clear of obstructions that will in any way hinder or delay the progress of the work. In wet, saturated, or flowing materials, when it is necessary to install tight sheeting or cofferdams, wood or steel sheet piling of a design and type approved by the Engineer, who designed the trench safety plan, shall be used.

All sheet piling, shoring, and bracing shall have sufficient strength and rigidity to withstand the pressure exerted and maintain the sides of the excavation properly in place and protect all persons or property from injury or damage. When excavations are made adjacent to existing building or other structures or in paved streets, particular care shall be taken to adequately sheet, shore, and brace the sides of the excavation to prevent undermining of, or settlement beneath, the structures or pavement. Underpinning of adjacent structures or pavement shall be done by the Contractor at his own cost and expense in a manner satisfactory to the Engineer and when required by the Engineer. The pavement shall be removed, the void satisfactorily refilled and compacted, and the pavement replaced by the Contractor; the entire expense of such removal and subsequent replacement thereof shall be borne by the Contractor.

Sheeting, shoring, and bracing shall not be left in place unless otherwise provided for in the contract or authorized by the Engineer. The removal of sheeting, shoring, and bracing shall be done in such manner as not to endanger or damage either new or existing structures, private or public properties, and so as to avoid cave-ins or sliding of the banks. All holes or voids left by the removal of the sheeting, shoring, or bracing shall be immediately and completely filled and compacted with suitable materials. Sheeting, shoring, and bracing ordered left in place by the Engineer will be paid for at the unit price bid for this item, when such pay item is provided. In the event no separate pay item is provided, then the cost of sheeting, shoring, and bracing is to be included in such items as are provided.

S.4.4 Pumping, Bailing and Draining:

The Contractor shall immediately remove all surface or seepage water from sewers, drains, ditches, and other sources which may accumulate during the excavation and construction work by providing the necessary under drains or otherwise and by doing the necessary pumping, bailing or draining. The Contractor shall have available at all times sufficient equipment in proper working order for doing the work herein required.

All water removed from excavations shall be disposed of in an approved manner so as to not create unsanitary conditions nor to interfere unduly with the use of streets, private driveways, or entrances. Pumping, bailing, draining, under drains, ditches, etc., shall be considered as incidental work and will not be paid for as separate items, but their cost shall be included in the contract prices bid in the Proposal for the various units of excavation measure.

S.4.5 Support of Existing Pipes Across Trench:

It shall be the responsibility of the Contractor to protect and support all water, gas, and other conduits crossed by the excavation or work to be performed by him or to arrange for their temporary removal and subsequent replacement. All expense incidental to this phase of the work shall be borne by the Contractor.

S.4.6 Disposal of Excavated Materials:

Excavated materials, so far as needed and of a suitable character, shall be piled adjacent to the work to be used for backfilling as required. Excavated materials unsuitable for the backfilling or in excess of that required for backfilling shall be disposed of in an approved manner at locations designated on the plans or approved by the Engineer. Desirable top soil, sod, etc., shall be carefully piled separately and replaced in its original position when required. Excavated materials shall be handled at all times in such a manner as to cause a minimum of inconvenience to public travel and to permit safe and convenient access to private and public property adjacent to or along the line of the work. In parkways and easements where it is necessary to deposit excavated materials on lawns during the work, burlap or canvas shall be placed on the lawn to prevent contact between excavated materials and the lawn.

S.4.7 Protection of Trees, Plants, Shrubbery, etc.:

Where trees, plants, shrubbery, etc., are adjacent to the line of the work and are not to be removed or are to be removed and replaced, the Contractor shall protect such trees, plants, shrubbery, etc., by substantial wooden boxes and guards and shall not permit machinery or employees to scrape, tear the limbs from or damage or attach guy cables to them, and if, in the opinion of the Engineer, such trees, plants, shrubbery, etc., would be damaged by machinery, etc., hand excavation may be required. The Contractor shall be responsible for all damages to adjacent trees, plants, shrubbery, etc.

S.4.8 Use of Explosives:

The plans and specifications do not require the use of explosives. After approval by the Engineer, should the Contractor elect to use explosives in the prosecution of the work, utmost care shall be exercised so as not to endanger life or property and the Contractor shall use only such methods as are currently utilized by persons, firms, or corporations engaged in a similar construction business. The Contractor shall be solely responsible for the determination as to whether explosives shall be used and for any result from the use of explosives and shall indemnify and hold the Owner whole and harmless against any claim or damage or injury to persons or property, real or personal, as the result of the use of explosives by the Contractor or any subcontractor. The Contractor shall furnish the Owner with evidence of insurance sufficient to cover any such possibility, in which insurance shall either include the Owner as an insured or be of such character as to protect the Owner.

All explosives shall be stored in a safe and secure manner, under the care of a competent watchman at all times, and all such storage places shall be marked clearly "DANGEROUS - EXPLOSIVES". The method of storing and handling explosives and highly inflammable materials shall conform with Federal and State laws, Town ordinances, and Fire Department regulations, and to the satisfaction of the Engineer.

The Contractor shall notify each utility company having structures in proximity to the site of the work of his intention to use explosives, and such notice shall be given sufficiently in advance to enable the companies to take such steps as they deem necessary to protect their property from injury. Such notice shall not relieve the Contractor of responsibility for any damage resulting from his blasting operations.

S.4.9 Jacking, Boring or Tunneling:

This specification shall govern for the provision of the required opening for the installation of conduits by the methods of jacking, boring, or tunneling as shown on the plans and in conformity with this specification.

S.4.9.1 Materials:

The encasement and carrier pipe shall be of the type and strength as indicated on the plans.

S.4.9.2 Construction Requirements:

Where encasement or carrier pipe is required to be installed under railroad embankments or under highways, streets, or other facilities by jacking, boring or tunneling methods, construction shall be made in a manner that will not interfere with the operation of the railroad, highway or other facility, and will not weaken or damage any embankment or structure. During construction operations, barricades and lights to safeguard traffic and pedestrians shall be furnished and maintained, as directed by the Engineer until such time as the backfill has been completed and then shall be removed from the site.

The drilling of pilot holes for the alignment of pipe prior to its installation by jacking, boring or tunneling will not be a requirement but may be necessary to maintain grade. The drilling of pilot holes will be considered as incidental work and the cost thereof shall be included in such contract pay items as are provided in the proposal and contract. The Contractor shall take the proper precautions to avoid excavating earth or rock or shattering rock beyond the limits of excavation needed to install the conduit. All damages by excavating and blasting, either to surface or subsurface structures, shall be repaired or replaced by the Contractor at his own cost and expense.

The removal of any obstruction that may be found to conflict with the placing of this pipe will not be measured for payment or paid for as a separate contract pay item. The removal of any such obstruction will be included in such contract pay items as are provided in the proposal and contract. The Contractor shall dispose of all surplus materials at his own cost and expense at sites approved by the Engineer.

S.4.9.3 Construction by Jacking:

If the grade of the pipe at the jacking end is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking operations and for placing end joints of the pipe. This excavation shall not be carried to a greater depth than is required for placing of the guide and jacking timbers and no nearer the roadbed than the minimum distance shown on the plans.

At the other end of the pipe, an approach trench shall be excavated accurately to grade. All open trenches and pits shall be braced and shored in such a manner as will adequately prevent caving or sliding of the walls into the open trench or pit.

Heavy-duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating jacks, even pressure shall be applied to all jacks used. A suitable jacking head not less than six inches (6") larger than the outside diameter of the pipe, usually of timber, and suitable bracing between jacks and jacking head shall be provided so that pressure will be applied to the pipe uniformly around the ring of the pipe. The jacking head shall be of such weight and dimensions that it will not bend or deflect when full pressure is applied at the jack. The jacking head shall be provided with an opening for the removal of excavated material as the jacking proceeds.

A suitable jacking frame or backstop shall be provided. The pipe to be jacked shall be set on guides which are straight and securely braced together in such manner to support the section of the pipe and to direct it in the proper line and grade. All timber and other materials used in the construction of the jacking assembly will be of such quality and dimensions that they will

withstand all stresses to which they are subjected in such a manner as to insure even pressures on the pipe during jacking operations. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe.

As the jacking proceeds, the embankment material shall be excavated slightly in advance of the pipe in such a manner to avoid making the excavation larger than the outside diameter of the pipe, with the excavated material being removed through the pipe. The excavation for the underside of the pipe, for at least one-third (1/3) of the circumference of the pipe, shall conform to the contour and grade of the pipe. The excavation for the top half (1/2) of the pipe shall conform closely to the outside diameter of the pipe and a clearance greater than two inches (2") will not be permitted. All voids between the pipe and the earth will be filled with grout 1:7 minimum proportioned mix grout with five percent (5%) to forty percent (40%) air entrainment. Grout holes may be provided in the pipe or grouting may be made through drill holes from the ground surface if practical. The grouting shall follow immediately upon completion of the jacking operation.

All carrier pipe installed by jacking shall be supported by quarter point cradle of 2000 psi concrete across the jacking pit and to the first joint in the ditch section on each end.

The distance that the excavation shall be extended beyond the end of the pipe depends on the character of the material, but it shall not exceed two feet (2') in any case. The pipe, preferably, shall be jacked from the low or downstream end. Lateral or vertical variation in the final position of the pipe from the line and grade established by the Engineer will be permitted only to the extent of one inch (1") per ten feet (10'), provided that such variation shall be regular and only in one direction and that the final grade of flow line shall be in the direction indicated on the plans.

When jacking of pipe is once begun, the operation shall be carried on without interruption, insofar as practicable to prevent the pipe from becoming firmly set in the embankment.

Any pipe damaged in jacking operations shall be repaired or removed and replaced by the Contractor at his entire expense. The pits or trenches excavated to facilitate jacking operation shall be filled immediately after the jacking of the pipe has been completed unless an encasement only has been installed; in which case, the trenches and pits shall be left open until the carrier pipe has been laid through and manholes have been built if required. The pits or trenches will then be backfilled in accordance with the location and conditions as are covered elsewhere in these specifications.

If a carrier pipe is laid through an encasement pipe the bedding of crushed rock, concrete, grout or granular material, if any, will be considered a part of the unit price of the jacking operation.

S.4.9.4 Construction by Boring:

The hole shall be bored mechanically with a suitable boring assembly designed to produce a smooth, straight shaft and so operated that the completed shaft will be at the established line and grade. The size of the bored hole shall be of such diameter to provide ample clearance for bells or other joints. All carrier pipe installed by boring shall be supported by quarter point cradle of 2000 psi concrete across the boring pit and to the first joint in the ditch section. All voids will be grouted with a 1:7 minimum proportioned mix with five percent (5%) to forty percent (40%) air entrainment, and will be considered a part of the unit price of the boring operation.

In addition to the requirements stated above, the applicable provisions of Section S.4.9.3, "Construction By Jacking", in regard to the construction of trench, tolerance in line and grade, method of operation, backfilling, etc., shall govern for construction by boring.

S.4.9.5 Construction by Tunneling:

The tunnel shall be excavated in such a manner and to such dimensions which will permit placing of the proper supports necessary to protect the excavation. The Contractor shall take the proper

precautions to avoid excavating earth or rock or shattering rock beyond the limits of excavation shown on the plans. All damages by excavating and blasting, either to surface or subsurface structures, shall be repaired or replaced by the Contractor at his own cost and expense.

Adequate provisions shall be made for safety and health of the workmen. All equipment operated in the tunnel shall be powered by either air or electricity. No equipment will be permitted in the tunnel that uses a petroleum product for fuel. Electric lights shall be used for illumination of the tunnel construction, for illumination of completed portions of the tunnel used for passage, and wherever lighting is needed for inspection of the work. Sufficient number of lamps shall be used to properly illuminate the work and all wiring for electric power and lights shall be installed and maintained in a safe and secure manner in accordance with the current applicable Electrical Code.

The Contractor shall maintain the tunnel air in a condition suitable for the health of the workmen and sufficiently clear for surveying operations. A sufficient supply of fresh air shall be provided and maintained at all times in all underground places and provisions shall be made for the quick and complete removal of gases and dust resulting from blasting or other tunnel operations. Except when unnecessary due to natural ventilation, artificial ventilation shall be maintained in the tunnel by ventilating plants of ample capacity operated when needed to meet the preceding requirements.

If required by the plans or as required for safety, suitable steel or timber sheeting, shoring and bracing shall be used to support the sides and roof of the excavation. Supports may be left in place provided that they clear the encasement or carrier pipe. No separate payment will be made for supports left in place.

Nothing contained herein shall prevent the Contractor from placing such temporary or permanent supports as he shall deem necessary, nor shall it be construed as relieving the Contractor from his full responsibility for the safety of the work, and for all damages to persons and property.

If the tunnel is to be lined with concrete as a monolithic structure, then the over-break, if any, or voids will be poured with concrete of the required strength as detailed on the plans. If the strength is not indicated, the twenty-eight (28) day strength will be a minimum of 3000 psi. The Contractor will not be compensated for over-breaks.

No pipe shall be placed until the foundation is in a condition satisfactory to the Engineer. Tunnel dimensions shown on the plans are minimum dimensions and any excess excavation and subsequent backfill, concrete or grout fill, shall be at the expense of the Contractor. The pipe shall be laid in the tunnel true to the line of grade. Tolerance in line and grade shall be as specified in Section S.4.9.3., "Construction by Jacking."

Unless otherwise indicated or specified, the entire void between the outside of the pipe and the tunnel walls or the inside face of the tunnel lining shall be backfilled with concrete having a minimum compressive strength of 2000 psi at twenty-eight (28) days or 1:7 minimum proportioned mix grout with five percent (5%) to forty percent (40%) air entrainment. No concrete or grout shall be placed around the pipe unless the permanent sheeting, bottom, sides and roof of the tunnel are in a condition satisfactory to the Engineer. The minimum thickness of concrete or grout backfill shall be maintained throughout. Concrete required for backfill in excess of the minimum dimensions shown on plan will be at the entire expense of the Contractor.

All pipe damage during construction operations shall be repaired or removed and replaced by the Contractor at his entire expense.

S.4.9.6 Joints:

When reinforced concrete pipe twenty-four inches (24") and larger in diameter with tongue and groove joints is used for the encasement pipe, the interior joints for the full circumference shall be sealed and packed with mortar and finished smooth and even with the adjacent section of pipe.

S.4.10 Protection of Buildings:

The Contractor shall, at his own expense, shore up and otherwise protect any building or other structure which may, in the opinion of the Engineer, be endangered during the work, and he shall restore all buildings, culverts, fences, walls, or other properties disturbed during his work to a condition similar or equal to that existing before his operations.

The Contractor shall be responsible for any injuries to persons and property, for all damages to any pipe, conduit, sewer, or other structures injuriously affected by the work. The Owner shall not be liable therefore.

S.4.11 Crossing to be Kept Open:

At such street, railroad, and all other crossings as may be designated by the Engineer, the trenches are to be filled in such a manner as to prevent any serious interruption of traffic upon the roadway or sidewalks. The cost thereof shall be borne by the Contractor.

S.4.12 Protection of Unfinished Work:

Before leaving work for the night, during a storm, or at other times, care must be taken to protect and securely close the unfinished end of the pipe. Any earth or other materials that may find entrance into the pipe through any such open or unplugged end of the pipe must be removed at the Contractor's expense.

S.4.13 Lights and Guards:

The Contractor must provide and maintain adequate detours around the work under construction. The Contractor shall provide lights, warning signs, and/or watchmen in accordance with the Texas Manual on Uniform Traffic Control Devices (TMUTCD), latest revision, to provide adequately for the safety of the public.

S.4.14 Backfill:

Excavation shall be backfilled only with approved materials. The placing of backfill material shall not begin until approval has been given by the Engineer and shall be done immediately when so ordered by the Engineer.

Backfilling shall be brought up to an elevation slightly above the original ground level to allow for subsequent settlement. The top surface or slopes of all backfill shall be neatly graded off in a workmanlike manner, and where select top soil, sod, or other material is removed and piled separately, such material shall be carefully replaced in a manner satisfactory to the Engineer.

S.4.14.1 Backfill Material:

Backfilling shall be done with good sound earth. Broken concrete, rock, bituminous pavement, or other lumpy material shall not be used in the backfill except as the lumps are small and their dispersal in the backfill is made in the upper section in a manner satisfactory to the Engineer.

Materials of a perishable, spongy, or otherwise improper nature shall not be used in backfilling. Where good sound earth is not available from the excavated material, gravel cushion and/or granular backfill material will be used for the initial backfill operation to a point twelve inches (12") above the top of the pipe. Gravel cushion and/or granular backfill material will not be required when concrete encasement is specified or used around the pipe. No backfill shall be made until it is authorized by the Engineer. All debris shall be removed. Sheeting, shoring and bracing shall be pulled and removed during the progress of the backfilling in a manner satisfactory to the Engineer.

S.4.14.2 Concrete Encasement (Class F4 Embedment):

The pipe shall be supported by concrete block.

Concrete encasement, when required, shall be composed of a free flowing material consisting of small stone, pea gravel, limestone chat, or pit run sand and gravel. The material shall be free from sticks, lumps, stones, and organic matter. Concrete encasement shall be poured either wet or dry as may be directed by the Engineer. Concrete encasement shall have an average compressive strength at twenty-eight (28) days equal to or greater than 3000 psi.

When concrete encasement backfill material is specified or ordered by the Engineer to be poured DRY, the Contractor shall place this material on each side of the pipe for the pipe for the full width of the trench using shovels to cut the material back under the pipe and shall be tamped to a height of six inches (6") above the pipe to receive final backfill.

Care must be exercised not to dislocate or disturb the grade or alignment of the pipe. If ordered by the Engineer to be poured WET, caution and care must be used not to float the pipe out of place. In the event pipes are floated out of proper position, they shall be removed and relayed at the expense of the Contractor.

S.4.14.3 Cement Stabilized Backfill:

Where backfill material shown or called for on the plans is cement stabilized the material shall extend from the top of the standard embedment to the natural ground elevation and include the entire width of trench. Cement stabilized backfill shall contain a minimum of two (2) sack mix (per yard of earth).

S.4.14.4 Embedment:

In the construction of sanitary sewer lines, the trench shall be excavated to a minimum depth of six inches (6") below the grade of the outside of the pipe.

On sewer line construction, when, in the opinion of the Engineer, the subgrade material encountered at grade is soft, spongy, and unsuitable, it shall be removed to such a depth that the replacement thereof with firmly tamped gravel or crushed stone will provide an unyielding, stable foundation.

Class F2 Embedment: the trench shall be filled with Standard Crushed Rock, Fine Crushed Rock or Natural Gravel up to 3/4 outside diameter of the pipe. (Standard PVC Pipe)

Class F3 Embedment: the trench shall be filled with Standard Crushed Rock, Fine Crushed Rock or Natural Gravel up to 1/6 outside diameter of pipe. (Ductile Iron Pipe)

Class F5 Embedment: the trench shall be filled with Standard Crushed Rock, Fine Crushed Rock or Natural Gravel up to six inches (6") above the pipe. (Deep SDR 35 PVC Pipe)

A. Rock

The stone used in cushion shall consist of durable particles of crushed rock and shall be free from lumps, stones over two inches (2") in diameter, free from frozen material or injurious amounts of salt, alkali, loam, vegetable or other organic matter. It shall have a wear of not more than forty percent (40%) when tested in accordance with Texas SDHPT Test Method TEX-410-A. Gradation is provided in table below:

B. Gravel

The gravel used in cushion shall consist of uncrushed stones meeting the requirements of wear as referenced in Section S.4.14.4(A) above. The material shall be washed and screened and not have by weight more than one percent (1%) organic matter, clays or loam and not more than five percent (5%) by weight of any one of or combination of slate, shale, schist or soft particles of sandstone. Gradation is provided in table below:

When tested by standard laboratory methods, gravel cushion embedment shall meet the following requirements for percentage by weight as stated in the Texas State Department of Highways and Public Transportation Standard Specifications for Construction of Highways, Streets and Bridges.

TABLE – GRAVEL CUSHION EMBEDMENT

STANDARD CRUSHED ROCK (Aggregate Grade 4 or Size No. 57 ASTM C 33)	
<u>Sieve Size</u>	<u>Percent</u>
Retained on 1-1/2 inch	0%
Retained on 1 inch	0% to 5%
Retained on 1/2 inch	40% to 75%
Retained on No. 4	90% to 100%
Retained on No. 8	95% to 100%
NATURAL GRAVEL	
<u>Sieve Size</u>	<u>Percent</u>
Passing 1-1/2 inch	100%
Retained on 3/4 inch	100%

Subgrades that have been allowed to become unstable by neglect of the Contractor, by improper drainage or lack of drainage, when in the opinion of the Engineer, the condition was caused by the neglect or fault of the Contractor, the Engineer shall order the Contractor to remove the unstable subgrade and replace the same with gravel at the expense of the Contractor, and no extra compensation will be allowed.

S.4.15 Initial Backfill:

After pipe has been laid and the joints have hardened to such an extent that they will not be damaged by backfilling operation, the pipe lines shall be backfilled in accordance with ASTM D-698 as follows:

Class F2 Embedment: Select or granular material compacted to ninety-five percent (95%) Standard Proctor Density a minimum of six inches (6") over the top of the pipe or as required by the Engineer.

Class F3 Embedment: Select or granular material compacted to ninety-five percent (95%) Standard Proctor Density a minimum of six inches (6") over the top of the pipe or as required by the Engineer.

Sand shall consist of clean, hard, durable, uncoated grains, free from lumps and organic material. All particles must pass a No. 8 sieve.

Any special backfill where shown on the plans shall replace the backfill procedure shown herein.

Detectable Metallic Tape ("Green-Caution Buried Sewer Below" or approved other) shall be installed after initial backfill on approximate centerline of pipe prior to final backfill.

S.4.16 Final Backfill:

The final backfilling operation shall be in accordance with ASTM D-698 and one of the following methods used for any of the initial backfill procedures. All final backfill material shall be less than six-inch (6") diameter.

- A. The remainder of the backfill shall be native material placed in uniformly compacted layers not exceeding six inches (6") in loose depth and hand or mechanically tamped in a manner approved by the Engineer to ninety-five percent (95%) Standard Proctor Density.
- B. With Town approval where an existing street or driveway surface has been cut (asphalt pavements shall be saw cut before excavation), the following procedure is to be used in backfilling and replacing the pavement (unless otherwise shown on the plans):
 1. The top twenty-four inches (24") of the trench shall be filled with crushed stone flex-base.
 2. In not more than seventy-two (72) hours after backfill of the pavement cut is completed, unless otherwise approved by the Engineer, the Contractor shall remove the gravel backfill to a point and pour a minimum six-inch (6") thick concrete slab extending twelve inches (12") beyond the trench width. The slab shall be covered with twelve inches (12") flexible base (95% Standard Proctor Density) and then place fine graded surface course hot mix asphaltic concrete, which, when compacted, will be not less than one and one-half inches (1-1/2") thick or equal to the adjacent asphalt.
- C. Where concrete pavement is cut, the Town of Prosper Representative and the Contractor shall meet to determine the amount of removal.

S.5 SEWER PIPE:

Sewer pipe shall be as specified on the plans, bid proposed or herein.

Sewer pipe shall conform to all the requirements for manufacture, resistance to action of acids, methods of tests, acceptance or rejection on results of test, permissible variations, workmanship, finish and marking of the current specifications.

S.5.1 Polyvinyl Chloride (PVC) Pipe for Gravity Mains:

The pipe and fittings shall be made of PVC having a cell classification of 12364 or 12454 as defined in ASTM Specification D-1784.

The pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density and other physical properties.

Joints for PVC pipe and fittings shall be compression rubber gasket joints conforming to the material and performance requirements of ASTM D-3212 and F477.

The bell shall consist of an integral wall section with compression rubber rings.

PVC sanitary sewers shall be in conformance with the current ASTM designation D-3034, SDR35 or SDR26 for four-inch (4") through fifteen-inch (15") diameter and ASTM designation F679 for greater than fifteen-inch (15") diameter.

S.5.2 Polyvinyl Chloride (PVC) Pipe for Force Mains:

Unplasticized polyvinyl chloride pipe shall be the integral wall bell and spigot joint type which meets or exceeds all of the requirements set forth in ASTM Standard Specification D-3139 and F-477 (latest revision).

Latitudes in workmanship and finish allowed by ASTM notwithstanding, all pipe shall have smooth exterior and interior surfaces, be first quality, be free from cracks, blisters and other imperfections, and be true to theoretical shapes and forms throughout each length.

PVC pipe shall be white in color. Twelve-inch (12") and smaller pipe shall be ASTM D-2241 SDR 21. Pipes larger than twelve-inch (12") shall be C905 DR25.

The pipe will be extruded from clean, virgin, approved class 12454 PVC resin compound conforming to ASTM Specification D-1784; of the sizes shown in the proposal and on the drawings.

Each pipe size to be furnished on this project shall be tested by the manufacturer, in accordance with the governing product standard, latest revision. Results of these tests shall be submitted to the Engineer with each truckload when delivered to the job site.

S.5.3 Profile Wall Pipe

If allowed by the Town Engineer, twenty-four inches (36") and larger profile wall pipe shall conform to ASTM 794. "Helically wound" or "pipe stiffness series 10" profile wall pipe will not be allowed.

S.5.4 Reinforced Concrete Sewer Pipe with Rubber Gasket Joints:

Reinforced concrete pipe shall conform to the current specifications for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe, ASTM Designation C76 Class III, or Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe, ASTM Designation C655. Reinforced Concrete Pipe is allowed only on lines larger than thirty inches (36") in diameter.

All rubber-type gaskets shall be of the round "O-ring" design, and shall be required to meet and be tested in accordance with specifications for Joints for Circular Concrete Sewer and Culvert Pipe, using Rubber Gaskets, ASTM Designation C443. The gaskets shall be the product of a manufacturer having a successful experience record of at least five (5) years in the manufacture of rubber gaskets for concrete pipe joints.

Liner shall be provided with material approved by the Town Engineer.

S.5.5 Ductile Iron Pipe :

Ductile Iron Pipe for all aerial crossings and for sewer line construction, both gravity and force mains where called out on the plans, shall be centrifugally cast in metal molds in accordance with the latest revision of the following specifications:

ANSI A21.51 (AWWA C151)

Federal Spec. WW-P-421 C

Joint details shall be rubber gasket in accordance with ANSI A21.11 (AWWA C111)

Ductile Iron Pipe of all sizes and uses shall be thickness Class 50 with embedments as detailed in the plans and these specifications. Ductile iron pipe shall be bell and spigot or mechanical joint pipe.

Ductile iron joint pipe shall be installed with a gasket as recommended by the pipe manufacturer. Just prior to assembly all surfaces with which it comes in contact shall be brushed thoroughly to remove all foreign material.

Liner shall be provided with material approved by the Town Engineer. Concrete will not be permitted.

S.6 PIPE LAYING:

This part shall include the furnishing of all labor and materials including pipe which shall meet the requirement of these specifications and shall be of dimensions and types at the locations and elevations shown on the plans or established by the Engineer.

The construction of all sewers shall begin at the outlet or lower end, unless otherwise directed by the Engineer.

Appurtenances shall be constructed as soon as the sewer of which they are a part is constructed to their locations. Upon request by the Contractor, the Engineer may permit postponement of

the construction of manholes on sewers, and the Contractor shall, without additional cost to the Owner, lay the pipe continuously through the manhole location.

The construction of appurtenances in advance of the construction of the sewer line will not be permitted. The appurtenances to sewers shall be constructed in accordance with the plans and these specifications. This work shall be done in such manner as not to damage any of the structure involved. No connecting sewer shall project beyond the inside surface of the sewers or appurtenances.

The grade line shown on the profile is the elevation of the invert or flow line of the sewer. The Contractor shall establish the grade line in the trench or excavation from the grade stakes established by the Engineer. Pipe shall be laid in a straight line in the trench with no kinks or curves between manholes. The bottom of the trench shall be fine graded and bell holes provided such that the pipe will be supported on the entire length of the barrel.

When construction is stopped temporarily and at the end of the day's work, tight fitting stoppers or bulkheads shall be securely placed in or across the ends of all pipes, such closures need not be watertight, but are to prevent trash and debris from entering the pipes.

For all other structures, the Contractor shall make adequate provisions to prevent the entrance of trash and debris into the sewer.

S.7 PIPE JOINTS:

Joints for sewer pipe shall be one of the following:

- A. Factory made compression type joint on sewer pipe shall conform to the current Specifications Designation A.S.T.M. for sewer Pipe. The pipes, bells and grooves shall be wiped clean before laying and then a lubricant furnished by the pipe manufacturer shall be applied to both bell and spigot of the pipes and the spigot inserted into the bell at approximately a thirty degree (30°) angle, push forward and lower firmly into place using either a metal bar or some other form of mechanical leverage. All superfluous joint material shall be completely removed from inside surface of all pipe.
- B. PVC pipe for gravity sewers shall be jointed with an integral bell, bell-and-spigot type rubber gasketed joint. Each integral bell joint and gasket shall meet the requirements of ASTM D-3212 and ASTM F-477 and shall consist of a formed bell complete with a single rubber gasket.
- C. PVC pipe force mains shall be jointed with an integral bell and gasket meeting the requirements of ASTM F-477 and ASTM D-3139. Every reasonable precaution shall be taken to insure the construction of an absolute watertight sewer line. In case of infiltration, repairs will be required of the Contractor to correct the defective joints.

S.8 MANHOLES:

Manholes for sanitary sewer shall be constructed of either Precast Reinforced Concrete Pipe Manhole Sections A.S.T.M. Designation C478, or Poured-in-Place type, and shall be constructed in accordance with the plans, appurtenance sheets, and these specifications. Either type may be brought to grade with grade rings to a maximum height adjustment of twenty-four inches (24").

All concrete shall be designed to meet service conditions due to local soil, water, etc., characteristics. The Town of Prosper has soils of the Eagle Ford Shale Formation which can cause sulfate attack/deterioration of concrete if proper precautions are not undertaken in the concrete

mix design. Methods on increasing the resistance of concrete to sulfate attack shall be based on American Concrete Institute (ACI) and Portland Cement Association (PCA) standards.

A. Precast Reinforced Concrete Manhole:

Precast Reinforced Concrete manholes used as a water containment structure, as required for sanitary sewers, shall be of the modified bell and spigot type, with an "O-ring" rubber gasket and the risers and cones shall be placed bell down. Prior to placing each section of manhole riser or cone, the bells and spigots to be joined shall be thoroughly cleaned, the "O-ring" gasket properly placed, lubricated and the joint pushed home. Lift holes shall be plugged with non-shrink grout. A poured in place 4000 psi concrete slab shall be placed on firm, well drained material or crushed rock foundation. The slab shall extend a minimum of twelve inches (12") below the pipe invert and a minimum of six inches (6") above the top of the pipe. The base riser with "butt end" shall be integrated into the concrete base.

B. Poured in Place:

Poured-in-Place manholes may be used in lieu of precast manholes. The base, wall and cone shall be poured and vibrated to assure a monolithic structure free from infiltration. All concrete shall have an average compressive strength at twenty-eight (28) days equal to or greater than 4000 psi.

Manholes, including all types, shall be constructed in accordance with the plans and these specifications for materials and construction.

All receiving manholes from force mains shall have a protective coating. Coating shall be approved by the Town Engineer.

Cast iron frames and covers shall be imbedded in a full bed of mortar and shall have a full bearing with top at the established grade. No steps shall be placed in any manhole.

Flow channel shall be built of concrete of one-half (1/2) section of pipe; the flow line shall be true and shall be trolled to a smooth, hard surface.

Stubs will be made as directed by the Engineer.

All pipe extending through the manhole walls shall be extended to property line or easement a minimum five feet (5') long with concrete cradle under entire length and tightly sealed in place using cement coupling with "O-ring" rubber gasket, Kor-n-seal, A-lok or approved other.

All manholes shall be marked on the curb or pavement with "MH".

S.9 MANHOLE DROPS:

This item shall include the wye, sewer pipe for stack, concrete and all necessary labor, accessories, and materials required to join and drop the entering sewer into the standard manhole as shown on the plans.

S.10 INSERT:

Manhole insert shall be manufactured from corrosion proof material suitable for atmospheres associates with wastewater collection systems. They shall be made from High Density

Polyethylene Copolymer material that meets ASTM Specification Designation D-1248 Class A, Category 5, Type III. The thickness shall be uniform one-eighth inch (1/8") or greater, and manufactured to the size to be inserted into the manhole frame.

The insert shall have a system of relieving pressure from the manhole or relieving a vacuum in the manhole. Insert shall include a lift strap and vent hole with vent disk as manufactured by Knutson Manhole Inserts or approved other. The venting system shall contain no moving parts which could be affected by grit accumulations nor have any parts subject to corrosion. The venting system shall not allow water to completely fill the insert, which during freezing weather could freeze and lift the manhole cover. Each insert should be installed in accordance with the manufacturers instruction.

S.11 CLEANOUTS:

Cleanouts shall consist of a cast iron clean out boot and cover as manufactured by the Bass & Hayes Foundry Company, Inc., Pattern No. 339, or approved other and installed as shown on the plans. After installation of the boot, a block of concrete thirty-six inches (36") square by six inches (6") thick shall be poured level with the top of the boot. When the cleanout is not located under paving a concrete pad twenty-four inch (24") square, 3000 psi, six-inch (6") thick with four (4) #3 bars shall be poured around cleanout. The price bid for a cleanout shall include the bend or wye in the main sewer line, all pipe up to the surface of the ground, the cast iron boot and the concrete pad or block around the boot.

All cleanouts shall be marked on the curb or pavement with "CO".

S.12 STOPPERS:

Stoppers shall be plugs of the proper size for the pipe or fitting in which they are installed. Stoppers will be furnished and installed by the Contractor where directed by the Engineer.

S.13 CONCRETE:

Concrete for the construction of sanitary sewer appurtenances shall be of the strength required by these specifications and/or the plans. Where no strength is specified a minimum of 3000 psi at twenty-eight (28) days shall be required.

S.14 CRUSHED STONE:

Crushed stone used in the construction of sanitary sewer lines shall be one-quarter inch (1/4") to one and one-half inches (1-1/2") in size.

S.15 SANITARY SEWER SERVICES:

Practically all sanitary sewer services when specified and installed will be four-inch (4") diameter sewer pipe in residential subdivisions, six-inch (6") diameter in commercial developments. The proposal carries one item for sewer service connections and another for furnishing and installing sewer pipe in place on a unit price basis. The unit price bid for sewer service connection shall include furnishing and installing the wye or tee in the main sewer line. In general, the residential sewer service line will extend from the main sewer to ten feet (10') inside property line at a maximum depth of five feet (5') then at a forty-five degree (45°) angle to four feet (4') above finished grade and capped.

The sewer service line at the property line shall be at such a depth that will provide for a service line of the proposed building site with a minimum grade of one percent (1%) and a maximum grade of two percent (2%) from the building site to the property line.

If there is a curb, the curb shall be sawcut with the "II" in good quality green paint at the point where the sewer service pipe passes under the curb. The subdivision plan shall be revised to indicate sewer service location as installed and shall indicate field measurement on ties to at least one (1) property corner.

Standard sewer service connection shall consist of the service wye or tee. No fittings are permitted between the wye and the property line.

Sanitary sewer services shall not be attached to sewer mains that are deeper than twelve feet (12').

S.16 SEPARATION OF WATER AND SEWER LINES:

Sanitary sewers, manholes, etc., shall be designed and constructed to comply with the Texas Commission on Environmental Quality (TCEQ) Chapter 317 (Design Criteria for Sewerage Systems). These rules and regulations are divided into several parts among which include the following requirements.

- A. Sanitary sewers shall be installed no closer to water lines than nine feet (9') in all directions. Sewers that parallel water lines must be installed in separate trenches. Where the nine-foot (9') separation distance cannot be achieved, the following guidelines will apply:

TABLE - SEPARATION OF WATER AND SEWER LINES

<u>Condition</u>	<u>Location</u>	<u>MATERIAL</u>		<u>MINIMUM SEPARATION</u>		<u>Comments</u>
		<u>Water</u>	<u>Sewer</u>	<u>Vertical</u>	<u>Horizontal</u>	
NEW WATER AND NEW SEWER SYSTEM						
Sewer force main and gravity sanitary sewer parallel to water main	Water above Sewer	Std	CI DI PVC 150 psi	2 feet	4 feet	Separate trenches
Gravity sanitary sewer crossing water main	Water above Sewer OR Sewer above Water	Std	CI DI PVC 150 psi	6 inches	N/A	Center one joint of sewer pipe on water main. Cement stabilize sand backfill 12 feet past joints.
Gravity sewer crossing water main	Water above Sewer	Std	ABS, Clay Concrete Composite	2 feet	N/A	Cement stabilize sand backfill initial backfill zone of sewer for 9 feet each side of crossing. Center one joint of sewer pipe on water main.
NEW WATER AND EXISTING SANITARY SEWER						
New water parallel existing sewer	Water above Sewer	Std	ABS, Clay, Concrete CI DI PVC	2 feet	4 feet	If sewer shows no sign of leakage, then leave sewer alone. If sewer shows signs of leakage, then repair or replace.
New water crossing existing sewer	Water above Sewer	Std	ABS, Clay, Concrete Composite	2 feet	N/A	If sewer shows no sign of leakage, then leave sewer alone. If sewer shows signs of leakage, then repair or replace.
New water crossing existing sewer	Water above Sewer	Std	ABS, Clay, Concrete Composite	2 feet	N/A	Replace existing sewer with one joint CI, DI, PVC 150 psi, centering over water line.

New water parallel to existing sewer	Water above Sewer	Std	ABS, Clay, Concrete Composite	2 feet	4 feet	Replace exist. sewer with CI, DI, PVC 150 psi, or cement stabilized sand backfill in initial backfill zone of sewer where parallel closer than 9 feet, or encase the water in 150 psi pipe two nominal sizes larger.
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TABLE - SEPARATION OF WATER AND SEWER LINES (continued)

<u>Condition</u>	<u>Location</u>	<u>MATERIAL</u>		<u>MINIMUM SEPARATION</u>		<u>Comments</u>
		<u>Water</u>	<u>Sewer</u>	<u>Vertical</u>	<u>Horizontal</u>	
EXISTING WATER AND NEW SANITARY SEWER						
New sewer parallel to existing water	Water above Sewer OR Sewer above Water	Std	CI DI PVC 150 psi	2 feet	4 feet	Separate trenches
New sewer crossing existing water	Water above Sewer OR Sewer above Water	Std	CI DI PVC 150 psi	6 inches	N/A	Center one joint of sewer pipe in water line.
New sewer crossing existing water	Water above Sewer	Std	ABS, Clay, Concrete Composite	2 feet	N/A	Cement stabilized sand backfill initial zone of sewer for 9 feet each side of crossing. Center one joint of sewer pipe on water main.

1. Where a sanitary sewer parallels a waterline, the sewer shall be constructed of cast iron, ductile iron or PVC pipe meeting ASTM specifications with a pressure rating of 150 psi for both the pipe and joints. The vertical separation shall be a minimum of two feet (2') between outside diameters and the horizontal separation shall be a minimum of four feet (4') between outside diameters. The sewer shall be located below the water line.
2. Where a sanitary sewer crosses a water line and the sewer is constructed of cast iron, ductile iron or PVC pipe with a minimum pressure rating of 150 psi, an absolute minimum distance of six inches (6") between outside diameters shall be maintained. In addition, the sewer shall be located below the water line where possible; and one length of the sewer pipe must be centered on the water line.
3. Where a sewer crosses under a water line and the sewer is constructed of ABS truss pipe, similar semi-rigid plastic composite pipe, clay pipe or concrete pipe with gasketed joints, a minimum two foot (2') separation distance shall be maintained. The initial backfill shall be cement stabilized sand (two or more bags of cement per cubic yard of sand) for all sections of sewer within nine feet (9') of the water line. This initial backfill shall be from one-quarter (1/4) diameter below the centerline of the pipe to one (1) pipe diameter, but not less than twelve inches (12") above the top of the pipe.
4. Where a sewer crosses over a water line, all portions of the sewer within nine feet (9') of the water line shall be constructed of cast iron, ductile iron, or PVC pipe with a pressure rating of at least 150 psi using appropriate adapters. In lieu of this procedure the new conveyance may be encased in a joint of 150 psi pressure class pipe at least eighteen feet (18') long and two (2) nominal sizes larger than the new conveyance. The space around the carrier pipe shall be supported at five feet (5') intervals with spacers or be filled to the springline with washed sand. The

encasement pipe should be centered on the crossing and both ends sealed with cement grout or manufactured seal.

- B. Unless sanitary sewer manholes and the connecting sewer can be made watertight and tested for no leakage, they must be installed so as to provide a minimum of nine feet (9') of horizontal clearance from an existing or proposed water line. Where the nine-foot (9') separation distance cannot be achieved, a carrier pipe (as described in subsection 4 above), may be used where appropriate.

S.17 CONNECTIONS AND OPERATION OF ANY SEWER OR DRAIN:

The Owner shall have the right to make connections with and operate any and all parts of the sewer or drain when, in the opinion of the Engineer, such connection does not in any way interfere with the progress of the work. It is understood that by making such use of connections, the Owner does not accept the sewer or waive its right to object to any defects found therein until the same has been finally inspected by the Engineer and found to be in accordance with the contract and the specifications.

S.18 CLEANUP:

During construction the Contractor shall maintain the premises in an orderly, neat, and presentable manner. Scraps and debris shall not be left scattered but shall be assembled together and such as are unusable shall be moved from the premises or disposed of to the satisfaction of the Engineer.

The Contractor shall make a final cleanup of all parts of the work before final acceptance by the Owner. This cleanup shall include among other things, left over construction materials, equipment, scraps, removal of all objectionable rocks, pieces of concrete, and other debris. Earthwork shall be smoothed and graded to the lines shown on the plans. Backfill over all trenches shall be left in a uniform and neat condition.

Disposal is not to be made on adjacent private or public property without written permission filed with the Engineer. If permission is granted by the property owners, the material so disposed of is to be leveled and left in a condition satisfactory to the Engineer.

S.19 MAINTENANCE:

All sewers and sewer structures shall be thoroughly cleaned and maintained in a workable condition until final acceptance.

S.20 INSPECTION AND TESTS:

Tests and inspection will be made on the entire project by sections designed by the Engineer to ascertain that the main is in an acceptable condition to perform the function for which it was designed and constructed.

The Town will furnish the Inspector to observe the construction of the project on a routine basis. No final acceptance will be given until the entire project has been completed; including all tests conducted and passed as may be required.

S.20.1 Inspection – General:

During the process of unloading, all pipe and accessories shall be inspected by the Contractor for loss or damage in transit. No shipment shall be accepted by the Contractor until notation of any lost or damaged material shall have been placed on the bill of lading by the agent of the carrier.

All material found during the progress of the work to have cracks, flaws, or other defects will be rejected by the Engineer, and the Contractor shall promptly remove from the site of the work such defective material.

The Contractor shall be responsible for all material furnished to him or by him and shall replace at his own expense all such material that is found to be defective in manufacturing or that has become damaged in handling after delivery by the manufacturer. The Contractor shall be responsible for the safe storage of material furnished by or to him until it has been incorporated in the completed project.

Pipe fittings, manholes, and other accessories shall be unloaded at the point of delivery, hauled to, and distributed at the site of the project by the Contractor. They shall, at all times, be handled with care to avoid damage. In loading and unloading they shall be lifted by hoists, slid or rolled on skidways in such a manner as to avoid shock. Under no circumstances shall they be dropped. Pipe handled on skidways must not be skidded or rolled against pipe already on the ground.

In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Pipe shall be handled in such a manner that a minimum amount of damage to the coating will result. Damaged coating shall be replaced in a manner satisfactory to the Engineer.

Pipes shall be placed on the site of the work parallel with the trench alignment and with bell ends facing the direction on which the work will proceed unless otherwise directed.

S.20.2 Visual Inspection:

During the course of the construction, the Project Inspector will take continuous routine inspection to ascertain that the project is being constructed in accordance with the plans and specifications and that the materials are of the type and kinds specified.

Upon completion of the project, or part of the project, the Engineer or his authorized representative (the Project Inspector), in the company of a representative of the Contractor (usually the Job Foreman), will make a visual inspection of the entire project, or a part of the completed project, checking, but not limited to, the following items:

- A. Verify that all ditches are properly flushed or jetted, if this method of compaction is approved by the Engineer, to obtain maximum consolidation of backfill and to secure good bedding. Start at the low end of each line and observe each manhole as flushing or jetting proceeds up grade, to isolate any infiltration which may occur.
- B. Check all cleanouts for:
 1. Location and accessibility
 2. Correct size and type of casting
 3. Correct cover - verify that it will turn and lock
 4. Ease of rodding, and
 5. That the plug is in place and free to be lifted.

C. Check all manholes for:

1. Correct type and weight of casting and cover
 - a. "Sanitary Sewer" on lid
 - b. Two (2) lifting holes, large enough to admit sharp point of pick or of the type specified on the plans.
 - c. All trash, debris, and spilled mortar removed from bottom.
2. General appearance, including:
 - a. Vertical walls, of correct inside diameter and proper taper to chimney
 - b. No excess mortar on inside
 - c. All trash, debris, and spilled mortar removed from bottom.
3. Correct grading of ground to slope away from manhole top and to see if manhole markers are in place.
4. Sound inflow and outflow pipe.
5. Water-tight plugs installed in stub-out (if any)
6. Properly shaped inverts of correct height and width, with smooth-finished channel.

D. Where pipe is sufficient in size for personnel to enter, the Inspector should check for:

1. Cracked pipe and bells
2. Proper spacing of gaskets
3. Visual infiltration

E. Verify that all other special structures are in accordance with the plans.

F. After corrections have been made, if any, the final inspection may consist of a television inspection, and/or additional infiltration test.

S.20.3 Television Inspection Test:

Television inspection tests are required on all sewer mains and sewer services as identified on the construction plans. Any line or lines found to be defective will be corrected at the Contractor's expense.

S.20.4 Low Pressure Air Test:

This item covers the testing of completed sections of installed sewer pipe using low pressure air. The Contractor shall conduct low pressure air tests on all completed sections of sewer mains prior to paving and again at final inspection.

The air test results will be used to evaluate materials and construction methods on sections of the pipe lines, and successful air tests shall be mandatory to prove acceptability of the sewer lines.

Air testing shall be in accordance with the following specifications:

A. Equipment Required for Test

The equipment used for testing will not be installed as a part of the project but shall be furnished and will remain the property of the construction contractor.

1. Telethermometer

The telethermometer shall be as manufactured by Yellow Springs Instrument Company Model #43 TD or equal. The telethermometer probe shall be W.H. Curtain, Number 21607K6 or equal. The probe extension leads shall be long enough to reach a recording station in a safe position and shall be W.H. Curtain Company Catalog Number 2167R or equal.

2. Compressor Air Supply

Any source which will provide at least three hundred (300) cubic feet per minute at 100 psi. Plugs, Valves, Pressure Gages, Air Hose, Connections and other equipment necessary to conduct the air test shall be furnished by the Contractor. The test equipment for air testing will consist of valves, plugs, and pressure gages used to control the rate at which air flows to the test section and to monitor the air pressure inside the plugs.

B. Preparation for Test:

Flush and clean the sewer line prior to testing, thus serving to wet the pipe surface as well as clean out any debris. A wetted interior pipe surface will produce more consistent results.

Plug all pipe outlets to resist the test pressure. Give special attention to stoppers and laterals.

C. Procedure:

1. Insert the temperature probe inside the section to be tested and seal both ends.
2. Apply air pressure until the pressure inside the pipe reaches 4 pounds per square inch guage (PSIG).
3. Allow the temperature and pressure inside the pipe to stabilize at a minimum pressure of 2.5 PSIG for a period of twenty (20) minutes prior to the start of the testing operation; then either increase or decrease the pressure to 3.5 PSIG prior to the start of the testing.
4. At 3.5 PSIG the time, temperature, and pressure will be observed and recorded. A minimum of five (5) readings will be required for each test.
5. If the pipe to be tested is submerged in ground water, increase all gate pressures by adding 0.43 psi for each vertical foot of ground water over the top of the pipe.

6. This test procedure may be used as a presumptive test which enables the installer to determine the acceptability of the line prior to backfill and subsequent construction activities.

If the time in seconds, for the air pressure to decrease from 3.5 PSIG to 2.5 PSIG is equal to or greater than that shown in the following table, the pipe shall be presumed to be free from defect. When these rates are exceeded, pipe breakage, joint leakage or leaking plugs are indicated and an inspection must be made to determine the cause. After repairs have been made by the Contractor another test shall be required on the section that has failed to pass the air test.

TABLE – DURATION REQUIREMENTS FOR AIR TESTING

<u>Pipe Diameter D (Inches)</u>	<u>Minimum Time T (Seconds)</u>	<u>Length for Minimum Time, L (Feet)</u>	<u>Time for Longer Length (Seconds)</u>
6	340	398	0.855(L)
8	454	298	1.520(L)
10	567	239	2.374(L)
12	680	199	3.419(L)
15	850	159	5.342(L)
18	1020	133	7.693(L)
21	1190	114	10.471(L)
24	1360	100	13.676(L)
27	1530	88	17.309(L)
30	1700	80	21.369(L)
33	1870	72	25.856(L)

Specification time required for loss of pressure from 3.5 PSIG to 2.5 PSIG for size and length of pipe indicated computed from the following equation:

$$T = (0.085 \cdot D \cdot K) / Q$$

Where:

- T = Time for pressure to drop 1.0 pounds per square inch gauge (PSIG), in seconds.
- D = Average inside pipe diameter, in inches.
- K = $0.000419 \cdot D \cdot L$, but not less than 1.0.
- L = Length of line of same pipe size being tested, in feet.
- Q = Rate of loss, 0.0015 cubic feet per minute per square foot internal surface shall be used.

The Contractor shall furnish and witness the testing of the low pressure air test. The test report shall be prepared on a form acceptable to the Engineer. Complete test records shall be furnished for all line construction on this project.

S.20.5 Vacuum Testing of Manholes:

Each manhole shall be tested immediately after completion and prior to any backfilling. Lift holes shall be plugged with non-shrink grout. No grout is allowed in horizontal joints prior to testing. All lines shall be securely plugged.

A vacuum of ten inches (10") of mercury shall be drawn. The time required for the vacuum to drop to nine inches (9") will be measured. The manhole passes if the following times are met:

- 4' diameter M.H. > 60 seconds
- 5' diameter M.H. > 75 seconds
- 6' diameter M.H. > 90 seconds

Failed manholes shall be repaired and retested until they pass.

The Contractor shall furnish and witness the testing of the low pressure air test. The test report shall be prepared on a form acceptable to the Engineer. Complete test records shall be furnished for all line construction on this project.

S.20.6 Deflection Test:

Upon completion of PVC sanitary sewer pipe installation, the Contractor shall pull a mandrel through the pipe to test for a maximum five percent (5%) deflection. The mandrel shall be sized at ninety-five percent (95%) at the base inside pipe diameter.

S.20.7 Compaction Test:

Frequency of tests shall not be less than one (1) for any pipe section and every three hundred linear feet (300') of main pipe per two feet (2') of lift until final grade, starting at two feet (2') above top of pipe. Sewer services are to be tested at a rate of one (1) for every six (6) services staggered or every three hundred linear feet (300') of sewer service installed. Each sewer manhole will receive a density test every two feet (2') of lift until final grade, alternating around all quadrants. Every other main and stubout that crosses the existing or proposed street, alley, or firelane subgrade shall also receive at least one set of density tests. All ditches shall be mechanically tamped and compacted to ninety-five percent (95%) Standard Proctor Density at zero percent (0%) to four percent (4%) above optimum moisture. Water jetting is not permitted.

If there is any doubt in the opinion of the Engineer that the compaction requirements as stipulated have not been met, then the Engineer may order such Density Test made by a soils engineering firm at the expense of the Owner. If these tests prove that the backfill is not of sufficient compaction, then the Contractor will be required to remove the backfill and replace the backfill properly compacted to obtain the value required or re-compact to secure the compaction required. If a retest indicates that compaction is not satisfactory, the retest will be at the Contractor's expense.

S.21 MEASUREMENT AND PAYMENT

The bid items include the work of every nature required for the completion of the job in every respect except as may be otherwise provided for in these specifications. The Contractor shall include the furnishing of all materials and labor, including any incidental labor, in his bid prices.

Trenching and Backfill:

- A. Trench excavation for sewers for unclassified excavation will not be measured directly, but will be included in the price bid per foot for the various sizes of sewer lines and mains as bid in the proposal.
- B. Unclassified excavation is not a pay item and will not be paid for directly but shall be included in such other items as are provided.
- C. Payment for all special excavation, if applicable, will be in addition to the price bid for pipe line in normal excavation and will be per linear foot of trench or special excavation.
- D. Sheathing left in place will be paid for by the cubic yard in place, per M.C.B.M.

- E. Backfilling will not be paid for directly but will be included in the unit price bid per linear foot for the various sizes of pipe. Fifteen percent (15%) of the price bid for sanitary sewer mains complete in place may be withheld for incomplete or unacceptable backfill.

- F. Gravel cushion, gravel embedment and granular backfill will not be measured directly, but will be included in the price bid per foot for the various sizes of sewer lines and mains as bid in the proposal.
- G. Tunneling, boring, and/or jacking shall be paid for at the unit bid price per linear foot. Where casing is required to be placed by tunneling, boring or jacking, the casing and furnishing the casing complete in place and will be paid for at the unit bid price per linear foot.
- H. Casing of sewer pipe shall be paid for at the unit bid price per linear foot in place when placed in open cut.
- I. Concrete encasement measurement and payment will be made by the cubic yard in place.
- J. The minimum width of asphalt pavement replacement will be as follows for the size pipe shown as installed. All pavement replacement outside these limits will be at the Contractor's expense.

MINIMUM WIDTH FOR ASPHALT

<u>Pipe Diameter D (Inches)</u>	<u>Pavement Replacement (Inches)</u>
2	30
4	36
6	36
8	42
10	44
12	46
16 and above	Pipe O.D. + 30

Pipe: Sewer pipe of the class stated in the proposal or on the plans or in the Special Provisions of all sizes will be measured by the linear foot, complete in place including trenching, embedment and backfilling.

Manholes:

- A. Standard or minimum depth manholes, up to ten feet (10') deep, unless specified otherwise in the proposal, will be measured and payment made by the unit of one (1) complete in place including all necessary materials, labor, equipment, and incidentals necessary to construct the manholes, including excavation, backfill, and concrete foundations.
- B. Drop manholes will be measured by the unit of one, up to ten feet (1'-10') deep, unless specified otherwise in the proposal. Measurement and payment will include the standard manhole and drop connection, complete in place, including full compensation for furnishing all materials, labor, equipment, and incidentals necessary to construct the manholes, including excavation, backfill, and concrete foundations.
- C. Additional depth for standard and drop manholes deeper than ten feet (10'), unless specified otherwise in the proposal, will be measured by the vertical foot. The price bid per additional foot of depth for standard and drop manholes shall be full compensation for furnishing all materials, labor, equipment, and incidentals necessary to construct the additional depth of manhole and addition length drop connection.

- D. Stubs will not be measured for payment as separate contract items, their cost to be included in the price bid for manholes.

Cleanouts: Shall be measured by the unit of one (1) complete in place. The price bid for each clean-out shall be full compensation for all materials, equipment, labor, incidental work, including excavation and backfill, necessary to complete the work.

Stoppers: No separate payment will be made for stoppers. The cost of such work shall be included in the price bid for pipe in place.

Concrete: All concrete cradles, concrete encasement, or concrete used in the construction of piers or creek crossings will be measured by the cubic yard of the particular class of concrete complete in place. This item does not include concrete used in making extra depth sewer service connections.

Steel: Reinforcing steel as called for on the plans or ordered by the Engineer will not be measured separately but the cost of reinforcing steel is to be included in such other items as are provided in the Proposal.

Sanitary Sewer Service: Standard service connections will be measured by the unit of one (1) complete in place. Each standard sewer service connection shall include the service wye with necessary one-eighth (1/8) bends. Standard sewer service connections shall be paid for at the price bid for each complete in place.

Low Pressure Air Test and Vacuum Tests: No separate payment will be made for the tests. The cost of the tests shall be included in the bid price for pipe in place.