

SECTION 700 SANITARY SEWER FACILITIES

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SECTION 700

SANITARY SEWER FACILITIES

710.00 DESIGN CRITERIA

711.00 General

All extensions of and/or additions to the Town sewer systems will comply with the requirements of these STANDARDS AND SPECIFICATIONS for sewer main and service line construction.

712.00 Design Flow

The design will include consideration of providing service for the entire area tributary to the outfall point. The following wastewater flow rates, which include infiltration, shall be used:

User Type	Unit Wastewater Flow Rate
Residential	90 gallons/capita/day
Industrial	1,500 gallons/acre/day
Commercial	1,000 gallons/acre/day
Park/Recreation	50 gallons/acre/day
Elementary Schools	13 gallons/student/day
Jr. & Sr. High Schools	20 gallons/student/day

The Town’s minimum residential population density or household density is 2.89 people per dwelling unit. The land usage shall be as noted on an approved PUD and/or Plat.

Wastewater flow peaking factors shall be computed using the following equation:

$$PF = 2.6 * Q_{Max Day}^{-0.16}$$

Where $Q_{Max Day}$ = maximum daily flow in CFS

The peaking factor will not be less than 2.0 or greater than four (4.0).

713.00 Hydraulic Design

Sewers twelve (12) inches in diameter and smaller shall carry the peak design flow at a maximum flow depth of fifty percent (50%) of the pipe diameter (d/D). Sewer mains larger than twelve (12) inches in diameter may be designed to 0.70 d/D at the peak design flow rate.

The minimum velocity at the peak design flow rate shall be two (2) feet per second. Where actual flow will be considerably below the design flow for several years, the Town Engineer may require that the minimum velocity be attained by suitable grades at the partial peak design flow rate.

Maximum allowable velocity shall not exceed ten (10) feet per second at eighty percent (80%) flow depth in the pipe.

Care shall be taken to design invert elevations at manholes in such a manner that the energy gradient is consistently falling in the direction of flow. In addition, when the velocity of an upstream sewer entering a manhole at peak flow is above critical velocity, the hydraulic gradient shall be computed to insure that a surcharge will not occur at a service connection, and that the energy gradient will remain level across the manhole.

714.00 Design Details

714.01 Sewer Mains

Sanitary sewer mains must be eight (8) inch diameter or larger. Service connections will be four (4) inch diameter or larger. The following minimum grades will apply:

Sewer Diameter (Inch)	Minimum Grade (Percent)
4	2.0 or 1/4 inch/foot
6	1.0 or 1/8 inch/foot
8	0.40
10	0.28
12	0.22
15	0.15
18	0.12
21 or larger	As approved by the Town Engineer

Sewer mains shall ordinarily have a minimum of eight (8) feet of cover to finished ground surface or a depth as needed to provide for basement service. Sewers deeper than 15 feet are not recommended and will not be allowed unless approved in writing by the Town Engineer. For deep sewers, additional easement width may be required, as determined by the Town’s Engineer.

Where the sewer depth will not provide service to basements, it will be indicated on the plans that the lot is served by a "shallow sewer" and appropriate elevation information will be given. Where pipe has less than (4) feet of cover, provisions shall be made to protect the pipe from impact loading. Design sewer reaches to provide a consistent slope wherever feasible.

Sewer mains shall be extended at least ten (10) feet uphill from the lowest lot corner of the uppermost lot to be served adjacent to the sewer main. Sewer mains will terminate in a manhole. Service connections will not be made at manholes but will be provided above or below the manhole, as required, unless otherwise approved by the Town Engineer. Manholes will be stubbed out with suitable size pipe wherever future extension of the sewer is anticipated.

714.02 Manholes

Manholes shall be a minimum of forty-eight (48) inch diameter and will be provided at every change in direction grade, or at connection with another sewer main; maximum spacing will be four hundred (400) feet for lines fifteen (15) inches diameter or smaller or five hundred feet (500') for lines eighteen (18) inches diameter or larger. Sewer lines shall be straight and not curved between manholes, both in line and grade.

Manholes shall be forty-eight (48) inches diameter for lines eight (8) inches to eighteen (18) inches in diameter, sixty- (60) inches for lines twenty-one (21) inches to forty-eight (48) inches in diameter, and seventy-two (72) inches for lines fifty-four (54) inches in diameter. Special designed vaults are required for pipes sixty inches or greater (> 60") in diameter,

Manholes over 15 feet deep shall have a stainless-steel ladder with non-slip rungs, similar or equal to Halliday L1D.

Drop manholes shall be provided for a sewer entering a manhole at an elevation twenty-four (24) inches or more above the manhole invert. Both outside and inside drops are acceptable and shall conform to details shown on the Standard Drawings. For inside drops, the minimum manhole diameter shall be 5 feet. Where the difference in elevation is less than twenty-four (24) inches, the invert will be shaped to provide a uniform slope and prevent solids deposition.

714.03 Service Connections

Wyes or tees will be provided in the sewer main for service connections at each lot or building site as shown on the plans. Services shall not be permitted under driveway except by written permission of the Town Engineer. Fittings shall be angled upwards so that the upper invert of one-eighth (1/8) bend connected to the fitting will have an elevation equal to or higher than the inside crown of the sewer main. See Section 743.04, of these STANDARDS AND SPECIFICATIONS for details on service stub-ins and house service connections.

715.00 Location Details

Unless otherwise approved by the Town Engineer, sanitary sewer mains installed in local or collector streets shall be located ten (10) feet east or south of the centerline of these streets. Service connections will not be permitted to cross an arterial street.

Where mains are installed in easements, they will ordinarily be located in the center of the easement, provided that proper maintenance manholes can be located to provide reasonable access for maintenance crews.

716.00 Relation to Water Mains

Sewer lines will be located a minimum of ten (10) feet, horizontally, from existing or proposed water mains (centerline distance). Where sewer lines cross water mains, the sewer pipe will be a minimum of eighteen (18) inches, clear, below the water main. If this clear distance is not feasible, the crossing must be designed and constructed so as to protect the water main. The Town Engineer must approve the crossing design.

Minimum protection shall consist of the installation of an impervious and structural sewer. Sewer pipe will be encased in reinforced concrete. The encasement shall be at least six (6) inches thick around the entire pipe and will extend a distance of ten (10) feet on either side of the water main. In all cases, suitable backfill or other structural protection must be provided to preclude settling and/or failure of the higher pipe.

717.00 Underdrain and Drain Pipes - Private

Underdrain systems shall be private and will **NOT** be maintained by the Town of Erie.

Underdrain and drain pipe shall be installed at locations shown on the accepted plans. Underdrain pipe will be installed at those locations where excessive groundwater is encountered and the Soils Engineer recommends it. If an underdrain system is not installed but recommended by the Soils Engineer, then the developer shall be responsible for adequately conveying sump pump discharges to the drainage system that minimizes discharge flow over sidewalks. Under-drain installations will require the approval of the Town Engineer.

Should the Developer desire to install an underdrain system to specifically collect the discharge of peripheral drain systems from individual house foundations or from sump pumps installed as a part of a peripheral drain system for house foundations, such a system shall be constructed for the exclusive advantage of the Developer and will **NOT** be maintained by the Town of Erie. Any such system shall **NOT** be tied into the sanitary sewer collection system in any manner. Clean outs shall **NOT** be installed within a sanitary sewer manhole and will **NOT** be maintained by the Town of Erie. Any such system will require the approval of the Town Engineer and must meet all applicable portions of Sections 732.02 and 733.04 of these STANDARDS AND SPECIFICATIONS.

Underdrains (consisting of perforated pipe) shall only be allowed at the building perimeter. Non-perforated pipe is required past the perimeter drain.

Perforated drain pipe shall be installed in a separate trench, at least ten (10) feet horizontally from the sanitary sewer. Drain (consisting of solid, non-perforated pipe) pipes may be installed in the same trench as the sanitary sewer pipe.

Underdrain and drain pipes shall be white to distinguish from sanitary sewer pipes (green).

720.00 GENERAL PROVISIONS**721.00 General**

All sanitary sewer main construction within the Town system and all service line construction connecting to the Town's sewer mains must be completed in accordance with these STANDARDS AND SPECIFICATIONS and the accepted plans. These STANDARDS AND SPECIFICATIONS will cover new sanitary sewer service line construction and repairs to existing facilities within the Town.

722.00 Permits Required

A public improvements permit shall not be issued until the Town Engineer has accepted the sanitary sewer main plans.

723.00 Maintenance of Traffic

When street cuts are required for sanitary sewer facilities construction, the following conditions will be met so as to avoid interference with traffic:

- A. Street service cuts will be open only between 9:00 a.m. and 4:00 p.m.;
and
- B. Two-way traffic will be maintained at all times around the construction area. A Traffic Control Plan (TCP) must be prepared in accordance with Section 141.08, Traffic Control, Barricades and Warning Signs, of these STANDARDS AND SPECIFICATIONS and submitted to the Town for approval prior to the commencement of construction.

730.00 SANITARY SEWER MAIN CONSTRUCTION**731.00 Site Work and Earthwork**

731.01 General

Site work and earthwork shall be performed in accordance with Section 300.00, Site Work and Earthwork, of these STANDARDS AND SPECIFICATIONS.

731.02 Trenching, Backfilling and Compacting

Except where otherwise approved in writing by the Town Engineer, all major arterial or collector streets shall have pipe installed by jack and bore.

Trenching, backfilling and compacting shall be performed in accordance with Section 350.00, Trenching, Backfilling and Compacting, of these STANDARDS AND SPECIFICATIONS.

731.03 Preservation of Monuments

Refer to Section 141.00, Protection of Public and Utility Interests, of these STANDARDS AND SPECIFICATIONS.

732.00 Materials

732.01 Sewer Pipe

Unless otherwise approved by the Town Engineer, all sewer pipe and fittings shall be green, Polyvinyl Chloride (PVC) pipe and will conform to the requirements of ASTM D3034 or F379, SDR 35 minimum, or ASTM F794, F949. All PVC pipe and fittings will be subject to inspection by the Town in order to reject materials that fail to conform to the requirements of these STANDARDS AND SPECIFICATIONS. Defects must be marked so as not to disfigure the rejected pipe. Rejected pipe shall be removed from the job site within twenty-four (24) hours. All joints will be factory prepared compression type (Elastomeric Gasket Joint), providing a watertight seal. Solvent cement joints will not be used.

Carrier pipes to be installed in casing pipes by jack and bore methods shall be AWWA C900 with green color. The pipe shall have restrained joints to prevent over-belling and allow for future removal. Certa-Lok or other approved restrained joint pipe are acceptable alternatives.

732.01.01 Electronic Marker System

All sanitary sewer pipe shall be installed with electronic markers at a maximum spacing of one marker for every 50 lineal feet of pipe. These markers shall be green in color and as manufactured by 3M. Full range markers shall be used up to a maximum depth of 8 feet. If the sanitary pipe is to be installed at a depth greater than 8 feet, a marker shall be placed in the trench at a depth of 8 feet aligned with the pipe centerline.

732.02 Underdrain and Drain Pipe - Private

Underdrain and drain systems shall be private and will **NOT** be maintained by the Town of Erie.

If required as described in Section 717.00 of these STANDARDS AND SPECIFICATIONS, underdrain pipe shall be provided with joints which will prevent any shifting or misalignment of the line. Where drains are to be constructed offset from sewer mains in the same trench they shall be installed in accordance with the standard details. Clean-outs shall **NOT** be allowed in manholes. Suitable fittings shall be provided which will allow construction of clean-outs and bends outside of manholes.

The developer's engineer will determine all underdrain and drain pipe and fittings.

732.03 Plugs

A suitably restrained plug approved by the pipe manufacturer shall be provided to seal the end joint of wye connections and dead-end stubs. At dead-end stub ends, away from a manhole or where wyes are installed, their locations shall be marked with a piece of two (2) inch by four (4) inch lumber.

732.04 Manholes

Manholes may be constructed of cast-in-place concrete or precast concrete. Concrete precast reinforced risers and tops must conform to ASTM Designation C-478 except that wall thickness may be either wall "A" or wall "B" as described in ASTM Designation C-76. Manholes shall conform to details shown on the Standard Drawings unless otherwise approved by the Town Engineer. Cones shall be eccentric.

The top of the manhole vault shall be a maximum of twelve (12) inches below the finished street or ground surface elevation. Concrete extension risers or grade rings shall be used to bring the manhole ring and cover up to finished street or ground surface elevation. The first step shall be no greater than 18 inches from grade.

Steps shall have a minimum tensile strength of 38,000 psi, minimum yield strength of 35,000 psi, and have an elongation of not less than ten percent (10%) in two (2) inches without permanent

deformation, steps must carry a load of one thousand (1,000) pounds when projected six (6) inches from the wall and fifteen hundred (1,500) pounds when projected four (4) inches from the wall. Steps shall be one-half (1/2) inch diameter steel-reinforcing rods completely encapsulated in Copolymer Polypropylene as manufactured by M.A. Industries, Inc. or an approved equal. Steps shall be spaced as shown on the Standard Drawings. All manhole steps shall be cast into the manhole barrel when the manhole is poured. The maximum distance from the finished ground (street) surface to the first step shall be twenty-four (24) inches.

Mortar for manholes shall be mixed in the following proportions by volume: One (1) part Portland cement; one-half (1/2) part hydrated lime; and three (3) parts sand or masonry cement. The cement, lime, and sand will be thoroughly mixed dry and only enough water added to form a mortar of proper consistency. Mortar shall be used within one (1) hour after mixing with no retempering permitted. Mortar that has taken a partial set is prohibited from use.

732.05 Manhole Base Slabs

Manhole base slabs may be poured in place or precast. Where possible, inverts will be the PVC pipe with the top half cut out. The slab shall be designed to uniformly support the earth load and any other reasonable loads that may occur. The minimum slab thickness shall be six (6) inches. The minimum reinforcement will be #4 Rebar grid on one (1) foot centers.

732.06 Concrete

Concrete shall conform Section 400.00, Concrete Work, of these STANDARDS AND SPECIFICATIONS. Type II cement will be used. Concrete encasement of sewer pipe shall conform to the details outlined in Section 716.00 of these STANDARDS AND SPECIFICATIONS.

732.07 Cast Iron Castings

All cast iron manhole rings and covers, and other iron castings shall be made of gray pig iron conforming to ASTM Designation A-48 and shall be free from cracks, holes, swells, and cold shuts, and will have a smooth workman-like finish. Fittings shall be hot dipped in asphalt varnish in such a manner as to form a firm and tenacious coating. Fittings shall conform to details shown on the Standard Drawings unless otherwise approved by the Town Engineer. Cast iron manhole rings and covers shall have a combined weight of between three hundred (300) and four hundred (400) pounds. All metal bearing surfaces between the ring and cover will be machined or fabricated to insure good seating. Manhole lids shall be provided with non-slip pattern in surface that lies flush with the elevation of the ring. Lids shall be furnished with the word "SEWER" cast on top with a confined space warning in accordance with the Standard Drawings.

Manhole rings and covers (all traffic covers shall be designed for H-20 traffic loading):

- A. Twenty-four (24) inch manhole rings and covers; cover weight = approximately one hundred sixty-five (165) pounds, ring weight = approximately two hundred forty (240) pounds.
- B. Twenty-four (24) inch by thirty-six (36) inch double ring and cover (36" cover with auxiliary 24" opening and cover);
36" cover weight = approximately two hundred fifty (250) pounds.
24" cover weight = approximately one hundred sixty five (165) pounds.
36" ring weight = approximately two hundred eighty (280) pounds.
- C. Manholes located in drainage ways, floodplains, near roadway sump conditions, or as otherwise directed shall be fitted with water tight lids with hinges and locking devices. Bolted manhole lids are not acceptable. A submittal detailing the water tight lid to be used must be accepted by the Town.

732.08 Bedding Materials

Bedding materials shall be in conformance with Section 352.00, Bedding for Pipelines and Service Lines, of these STANDARDS AND SPECIFICATIONS.

The design engineer will determine the bedding materials needed for under drains, if required by the accepted plans.

732.09 Plastic Liner Pipe (Sliplining)

Sewer main sliplining shall be completed in accordance with the construction plans prepared under the supervision of a Registered Professional Engineer licensed in Colorado and accepted by the Town Engineer. Plans shall conform to all applicable sections of these STANDARDS AND SPECIFICATIONS.

A licensed and bonded Town of Erie General Utility Contractor shall do all sewer main sliplining construction. A permit must be obtained from the Town Engineer in accordance with Section 150.00, Permits and Inspections, of these STANDARDS AND SPECIFICATIONS.

732.10 Steel Casings and Spacers for Bores

Pipe casing shall be smooth wall welded steel cylinder fabricated in accordance with AWWA C200. It shall be round, straight, and free from defects or damage due to improper manufacturing or handling with a minimum yield strength of 35,000psi.

Pipe casing shall be designed by the pipe manufacturer with sufficient wall thickness to resist the loads applied. The inside diameter shall be at least four (4) inches greater than the outside diameter of the bell or joint of the carrier pipe to be installed therein. External loading shall be AASHTO H20 highway loading or E-80 railroad loading, plus jacking load.

The minimum wall thickness of the casing shall be:

CARRIER PIPE NOMINAL DIA	CASING MIN. WALL THICKNESS
4"	.25"
6"	.3125"
8"	.3125"
12"	.375"
14"	.375"
16" or 20"	.500"

Casing spacers shall be stainless steel, bolt on style type with a shell made of at least two (2) halves, as manufactured by Cascade Waterworks Manufacturing Company, CCS-JR and CCS-ER, or approved equal. The bands shall be fourteen (14) gauge at a minimum; the risers shall be ten (10) gauge at a minimum. If restrained joint pipe is not used, Joint Restraint Casing Spacers (carrier pipe skids) shall be installed at each pipe joint with the spigot side of the Restraint Joint Casing Spacer positioned at the "home line" and the bell side at the edge of the bell, per manufacturer's recommendations. The spacers shall provide sufficient restraint to prevent "over-belted" of the joint. The Contractor shall TV carrier pipe after installation to verify that the spigot has not been over inserted.

The four (4) runners shall be eleven (11) inches long as a minimum and manufactured of high abrasion resistant, low coefficient of friction, Ultra High Molecular Weight Polymer (UHMW) or Glass Filled Polymer. Runner heights shall be set to center the carrier pipe in the casing.

Casing end seals shall be performed designed to prevent entry of water or loss of material from casing. The end seals shall be 1/8-inch-thick sixty (60) durometer EDPM or neoprene rubber and shall be one piece pull on type. The seals shall overlap the casing by two (2) inches and shall be held on with AISI 304 I stainless steel worm gear clamps.

733.00 Installation

733.01 General

Installation of PVC sewer main will conform to ASTM Designation D-3034, "Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe". All work shall

conform to the accepted plans, specifications, special provisions and the above designation, except as modified herein.

733.02 Alignment and Grade

Sanitary sewers and structures appurtenances shall be constructed accurately to the line and grade as shown on the accepted plans. Construction stakes shall be placed by field parties under the direct supervision of a Registered Professional Land Surveyor licensed to practice in the State of Colorado.

The grade and alignment shall be determined by use of suitable surveying instruments (checking the invert of each piece of pipe) or laser equipment, operated continuously during the construction.

"As-built" drawings, as described in Section 161.00, Construction Plan Requirements, of these STANDARDS AND SPECIFICATIONS, shall be furnished to the Town Engineer.

733.03 Protection of Existing Underground Utilities

The Contractor will be held responsible for the protection of public improvements as stated in Section 141.00, Protection of Public and Utility Interests, of these STANDARDS AND SPECIFICATIONS. It will be the Contractor's responsibility to replace all public improvements so damaged at his own expense.

733.04 Underdrain and Drain Pipe - Private

Underdrain and drain systems shall be private and will **NOT** be maintained by the Town of Erie.

Under drains shall be installed where shown on the accepted plans as required by Section 717.00 of these STANDARDS AND SPECIFICATIONS. Under drains will be day-lighted to the nearest suitable point acceptable to the Town Engineer. The trench will be excavated to the required depth and width and backfilled with underdrain bedding material.

Underdrain and drain pipe sizes to be determined by the developer's engineer.

Where drain pipe shares a trench with the sanitary sewer main, the thickness of bedding shall be increased to provide six (6) inches of bedding material under the drain pipe and six (6) inches of bedding material between the drain pipe and the sewer pipe. Only solid (non-perforated) pipe shall be installed in a shared sanitary sewer trench. The drain pipe shall be installed to a true line and grade and held in place with drain bedding material as shown on the Standard Drawings. Drain pipe shall be continued around manholes by use of suitable bends and other fittings and have a cleanout installed outside the manhole. Drain pipes in separate trenches shall be a minimum of 10 feet from the sewer pipe and have undisturbed native material separating the trenches.

733.05 Handling Pipe and Fittings

All pipe, fittings, and specials will be unloaded, stockpiled, hauled, distributed, installed and otherwise handled in a manner that will prevent breakage or other damage thereto and which will insure delivery and installation in a sound and acceptable condition.

733.06 Sewer Pipe Installation

Sewer lines shall be constructed continuously upgrade from an existing sanitary sewer except when otherwise approved by the Town Engineer. Special care must be taken to lay sewer pipe to exact line and grade with spigot ends pointing in the direction of flow. A continuous trough will be pared or excavated in the bedding to receive the bottom quadrant of the pipe barrel. Bell holes shall be excavated so that after placement, only the barrel of the pipe receives pressure from the trench bottom. The bedding material shall be placed in the trench bottom, to a thickness of six (6) inches prepared as described above, to provide a uniform and continuous bearing support for the pipe at every point between bell holes. Preparatory to making pipe joints, all surfaces of the joint must be clean and dry. Lubricants will be used as recommended by the pipe manufacturer. The pipe shall be set in position and checked for line and grade using care to keep the joint absolutely free of dirt. When final grade is achieved, the joint shall be carefully pushed home using approved methods of leverage. In no case shall the pipe be inserted past the home line. Care must be taken so that the bell end of the pipe will not be deflected to the extent that the gasket is pinched or rolled. Adjustment to final line and grade will then be made. If O-ring gaskets are used, immediately after completing the joint, the seating of the gasket must be checked around the entire circumference of the pipe, by visual and finger inspection. PVC sewer pipe shall be secured in place by installation of bedding material tamped under and along it up to a level of twelve (12) inches over the top of the pipe. Bedding material will be compacted in accordance with Section 353.00, Backfill for Pipelines and Service Lines, of these STANDARDS AND SPECIFICATIONS.

All sewers shall be kept thoroughly clean and free of gravel, dirt and debris. Whenever work ceases for any reason, the unfinished end of the pipe will be securely closed with a temporary light-fitting plug.

The Town will be notified at least two (2) working days (forty-eight [48] hours) in advance of pipe being laid in any trench. No pipe will be covered until a representative of the Town Engineer has inspected it.

733.07 Connections to Existing Manholes

Sewer pipe connections to existing manholes, where there is no pipe stubbed out, shall be made in such a manner that the finished work will conform as nearly as practicable to the essential

requirements specified for new manholes. The Contractor shall core drill or saw cut as small an opening in the existing manhole as necessary to insert the new sewer pipe. The existing concrete foundation bench must be chipped to the cross-section of the new pipe in order to form a smooth continuous invert similar to what would be formed in a new concrete base. The surface of the PVC pipe shall be roughened and an approved gasket installed, so it is centered in the manhole wall. Gaskets for connecting PVC pipe to manhole sections shall be specifically manufactured for that purpose. The gasket shall be provided by the pipe manufacturer.

Cement grout shall be used as necessary to smoothly finish the new invert and to seal the new line so the junction is watertight. Grout shall be non-shrink type with aluminum filings; grout with iron filings are not acceptable.

733.08 Construction of Manholes

Manholes must be constructed in accordance with the Standard Drawings. Concrete foundations (bases) will extend at least six (6) inches below the bottom of the pipe and will be benched up to at least two (2) inches over the top of the pipe. The concrete manhole floor between the sewer pipe and the outer portions of the bench shall be flush with the top edges at the pipe spring line and will slope upward at least two (2) inches per foot. Wherever grade and alignment permit, the sewer shall be laid continuously through manhole locations and the manhole constructed later.

In such cases, the foundation shall be poured, as above, and the floor of the manhole sloped upward at least one (1) inch per foot out from the spring line of the pipe. When pouring the base, care must be taken to prevent flotation of the pipe. After the manhole is complete, the upper half of the pipe shall be neatly cut out and the rough edges smoothed with cement grout.

Where it is not practicable to lay the pipe continuously through manholes due to breaks in alignment, grade, or elevation of intersecting sewers, the sewer invert will be made of concrete deposited between forms. The shape of the invert shall conform exactly to the lower half of the pipe it connects. Side branches will be constructed with as large a radius of curvature as possible. Inverts will be plastered with cement mortar and left smooth and clean. Where called for on the plans, a pipe bell will be stubbed out and plugged.

Outside each manhole where the pipe enters/exits, within 12 inches of the manhole base, the Contractor shall install a bell section of pipe or a solid sleeve coupling as indicated on the Drawings.

Precast manhole sections will not be placed on the foundation until after it has reached sufficient strength to provide support without damage. The top of the bench shall be thoroughly cleaned and wetted with water. Ram-Neck sealant will be applied to the precast section bearing seat. The first precast section will be carefully lowered onto the bench. Each succeeding precast section will be jointed in a similar manner. All lifting holes and other imperfections in the interior manhole wall will be filled with cement mortar.

All joints between precast manhole sections, grade rings and cast ring shall be made watertight with Ram-Nek material or equal. Diameter of gasket shall be as recommended by the manufacturer.

733.09 Plastic Liner Pipe (Sliplining)

See Section 732.09 of these STANDARDS AND SPECIFICATIONS.

733.10 Steel Casing and Carrier Pipe Installation

Pits shall be excavated such that the timber blocking can be installed to give an unyielding backing for the hydraulic boring machine or jacks and to prevent sloughing of the header face. Subgrade on which rails or guides are to be set shall be stabilized with washed rock where soft or springy ground is encountered. Excavation and casing installation shall be performed simultaneously. At no time shall the advancing edge of the casing trail the excavation by more than twelve (12) inches.

Sections of the steel casing shall be trimmed, beveled and aligned in the pit so that when welded together the thrust of the boring machine will be uniformly transmitted through the casing in a horizontal plane. Welds shall be made to provide a solid firm watertight connection without the use of butt straps.

The casing pipe shall be installed by boring or jacking upgrade from the outlet end. When the carrier pipe to be installed is for gravity flow, the horizontal and vertical alignments of the casing pipe, when in place, shall not vary from those called for on the accepted plans by more than the following:

Alignment	Entrance	Midpoint	Outlet
Horizontal	+0.02'	+0.35'	+0.70'
Vertical	+0.02'	+0.10', -0.05	+0.20', -0.10

When excavation exceeds the advancing edge of the casing by more than twelve (12) inches or sloughing of the hanging wall occurs such that voids are created along or above the casing, external grouting of the casing will be required. Grouting shall be accomplished by pumping at between five (5) and ten (10) psi, equal parts of Portland Cement and mortar sand mixed with sufficient water to provide a slump of less than two (2) inches through grout holes in the casing until all voids are filled. Grout holes, one (1) inch to two (2) inches in diameter, shall be provided or drilled in the casing on four (4) foot centers along the pipe arch and at eight foot (8') centers along each spring line. As grouting advances each of the completed grout holes shall be plugged to a watertight condition.

Each section of carrier pipe shall have a minimum of three (3) casing spacers. The spacers shall be mounted twelve (12) inches from the joint on each end, and one (1) spacer mounted at the center point between the pipe joints prior to being set in the casing. Subsequent sections shall be properly

joined to each other as they are set and the assembled line gradually threaded through the casing by means of applying force at the exposed end of the carrier pipe. Care shall be exercised to provide watertight joints, to not over insert the pipe and to protect the ends of the pipe as they are pushed by uniformly transferring said force through the pipe in a horizontal plane. It may be necessary to vary the quadrant location and thickness to obtain a uniform grade through the carrier pipe. This is especially critical on gravity lines when the alignment and grade specified for the casing pipe approaches the maximum allowable limits specified above.

733.11 Wyes and Risers for Service Connections

The Contractor shall place wyes, stubs, and risers where required by the accepted plans. Wyes will be angled upwards so that the upper invert of a one-eighth (1/8) bend connected to the fitting will have an elevation equal to or higher than the inside crown of the sewer main. Riser connections will be installed where the elevation of the top of the branch is more than twelve (12) feet below finished ground. Riser connections will ordinarily reach to a grade ten (10) feet below finished ground surface. Watertight plugs will be installed in each branch pipe or stub. All applicable portions of Section 740.00 of these STANDARDS AND SPECIFICATIONS shall apply. As-built measurements will be made by the Contractor or his representative to reference the wye or riser connection to the nearest manhole before backfilling. Said measurements shall be carefully and accurately made and recorded and will be shown on the "as-built" plans as required by Section 161.00, Construction Plan Requirements, of these STANDARDS AND SPECIFICATIONS.

733.12 Testing and Inspection (Initial Acceptance)

Prior to Initial Acceptance the Contractor, at the Contractor's expense, will jet-vac the sewer and have the lines inspected with TV video equipment (a copy of the video tape and written report must be supplied to the Town). If, after visual inspection of the sewer system and video, the Town Engineer suspects that there is a problem, he may require that lamp, alignment, infiltration, exfiltration and deflection tests shall be completed by the Contractor at the Contractor's expense. The inspector shall visually check each manhole's interior for flaws, cracks, holes or other inadequacies that might affect the operation or watertight integrity of the manhole. Should any inadequacies be found, the Contractor shall make repairs deemed necessary by the Inspector to correct the problem.

Prior to Initial Acceptance, the Contractor, at his own expense, for all new sewer construction, will conduct tests for water tightness. Tests shall be completed under the direction of the Town Engineer. The Town Engineer may require that the first two (2) manholes, including the main between them, of all sewer projects be tested before further construction to permit initial observation of the quality of construction workmanship. The Town Engineer may require additional testing during the course of construction if infiltration appears to be excessive or the quality of workmanship is questionable.

Low pressure air testing of the sewer lines (including services) and vacuum testing of all manholes will be required by the Town Engineer. Air and vacuum testing shall be completed in accordance with ASTM C-828 and as described herein. The Contractor shall provide all equipment and personnel necessary to perform the required tests. The Town Engineer shall record times and pressure and vacuum readings during the test period. A test section shall not be any longer than the length of pipe between adjacent manholes.

The low-pressure air test for sewer lines and the vacuum test for manholes shall be done after completion of backfilling and compaction. If the Town Engineer determines that reliable and uniform results are produced by the Contractor's construction methods, the low-pressure air test may be done after initial backfill and compaction.

733.12.01 Air Testing Pipeline

The ends of the sewer pipe being tested shall be plugged and braced and the test section shall be pressurized to four (4) psi. The pressure pump shall be turned off and the air in the pipe allowed stabilizing for a minimum of two (2) minutes or until the pressure reaches three and one-half (3.5) psi. The time shall be monitored as the line either holds pressure or drops no more than one-half (.5) psi (if the ground water is higher than the top of the pipe, the test pressure will be increased to account for the high groundwater).

The portion of the line being tested shall be termed "acceptable" if the time required in minutes for the pressure to decrease from 3.5 to 3.0 psig (greater than the average back pressure of any ground water that may be over the pipe) shall not be less than the time shown for the given diameters in the following table:

TIME REQUIRED FOR A 0.5PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE

1 Pipe Diameter (in.)	2 Minimum Time (min: Sec)	3 Length for Minimum Time (ft)	4 Time for Longer Length (sec)	Specified Minimum for Length (L) Shown (min:sec)							
				100ft	150ft	200ft	250ft	300ft	350ft	400ft	450ft
4	1:53	597	.190L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	.427L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	.760L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6.837L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54
30	14:10	80	10.683L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12.926L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15.384L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23
42	19:74	57	20.942L	34:54	52:21	69:49	87:15	104:42	122:10	139:37	157:04
48	22:67	50	27.352L	45:35	68:23	91:11	113:58	136:46	159:33	182:21	205:09

If ground water is known to exist, the test pressure is to be increased. An air pressure adjustment shall be added to the normal test starting pressure when ground water is present. The height of ground water in feet shall be divided by all readings. (For example, if the height of water is eleven (11) and one half (1/2) feet, then the added pressure will be 5 psig. This increases the 3.5 psig to 8.5 psig, and the 2.5 psig to 7.5 psig. The allowable drop of one pound and the timing remain the same. ***In no case however, should the starting test pressure exceed 9.0 psig.***

Sections of pipe that fail the air test shall have the defects repaired and the test shall be repeated. Repair and repeat testing shall be continued until the testing requirements are met.

733.12.02 Vacuum Testing Manholes

Manholes shall be tested before the ring and cover and grade adjustment rings have been installed. All pipes entering the manhole shall be plugged and braced and a vacuum of ten (10) inches of mercury shall be drawn. The vacuum pump shall be turned off and the time monitored as the vacuum drops one (1) inch. The vacuum must not drop more than one (1) inch for the duration of the time indicated in the following table:

MINIMUM TEST TIMES FOR VARIOUS MANHOLE DIAMETERS									
Depth (ft)	Diameter (in.)								
	30	33	36	42	48	54	60	66	72
8	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	29	34	40	46	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	64	78	87	97
26	36	39	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	108	121

Manholes that fail the vacuum test shall have the defects located and repaired and the test shall be repeated. Repair and repeat testing shall be continued until the testing requirements are met.

733.12.03 Deflection Testing Piping

All PVC sewer pipelines shall be tested for deflection after placement and compaction of backfill. Method of testing shall be by deflectometer of the rigid GO/No-GO type device. An alternative method will be permitted only by written permission of the Inspector. Maximum allowable deflection shall be five (5) percent of the pipe diameter. Any and all pipe with vertical deflection greater than the allowable shall be excavated, removed from the pipeline, replaced, backfilled and compacted as specified and retested.

Initial Acceptance of the sewer line shall be based on an inspection covering all items in this specification. The inspection will be done in an appropriate manner by representatives of the Town Engineer and shall comply with the requirements of Section 154.00, Inspections, of these STANDARDS AND SPECIFICATIONS. The Contractor will remedy, at his own expense, any poor alignment or any other defects in workmanship or materials revealed by conditional inspection. Final acceptance will be based on re-inspection of the sewer after the appropriate repairs and corrections are completed.

733.13 Testing and Inspection (Final Acceptance)

Prior to final acceptance the Contractor, at the Contractor’ expense, will jet-rod the sewer and have the lines inspected with TV video equipment (a copy of the video tape and written report must be supplied to the Town). If, after visual inspection of the sewer main, the Town Engineer suspects

that there is a problem, he may require that alignment, infiltration, exfiltration and deflection tests be completed by the Contractor at the Contractor's expense.

When required, infiltration tests will be conducted by placing an approved, calibrated V-notch weir in the line just above the lower manhole and plugging the line just above the upper manhole. Up to an hour time lapse will be allowed for the level of water behind the weir to stabilize before it is read. Any foreign matter hanging to the weir will be dislodged before reading. Successive readings will be taken until consistent results are attained.

When required, exfiltration tests will be conducted by plugging the line just above both the upper and lower manholes and adding water to the sewer up to a level marked in the upper manhole to produce a four (4) foot on the invert of the line at the midpoint between manholes. The water will be allowed to stand for a minimum of four (4) hours (preferably overnight) to allow absorption to take place in the walls of the manhole and pipe. Water will then be added to bring the water surface back to the mark. After a carefully timed interval, varying from fifteen (15) minutes to sixty- (60) minutes, the drop in elevation of the water surface will be recorded and converted to an exfiltration rate, or a measured amount of water will be added to bring the water level back to the mark and this amount of water converted to an exfiltration rate.

The exfiltration rate of the upper manhole may be determined in the same manner by plugging the line in both sides of this manhole. This amount of exfiltration may be subtracted from the rate determined above for the first test required on the project in order to determine the actual exfiltration rate resulting from the pipe joint leakage. The practical upper limit of head applied to the lower part of the line being tested is twenty (20) feet. Whenever the line is so steep as to require more head than this, an exfiltration test will not be attempted. The basic exfiltration leakage allowance will be increased by ten percent (10%) for each two (2) feet that the average actual head exceeds the basic four (4) feet of head, up to a maximum of thirty percent (30%).

The Town will not accept any sanitary sewer line where infiltration or exfiltration tests show leakage in the sewer line and manholes exceeding one hundred (100) gallons per inch diameter per mile per day between adjacent manholes.

Final acceptance of the sewer line shall be based on an inspection covering all items in this specification. The inspection will be done in an appropriate manner by representatives of the Town Engineer and shall comply with the requirements of Section 154.00, Inspections, of these STANDARDS AND SPECIFICATIONS. The Contractor will remedy, at his own expense, any poor alignment or any other defects in workmanship or materials revealed by final inspection. Final acceptance will be based on reinspection of the sewer after the appropriate repairs and corrections are completed.

733.14 Connection to Town Sewer System

Flow of any kind into the existing sewer system will not be allowed until the sewer has been satisfactorily completed and accepted for use by the Town Engineer.

740.00 SANITARY SEWER SERVICE LINE CONSTRUCTION**741.00 Trenching, Backfilling and Compacting**

Trenching, backfilling and compacting shall be completed in accordance with Section 350.00, Trenching, Backfilling and Compacting, of these STANDARDS AND SPECIFICATIONS.

742.00 Materials

742.01 Polyvinyl Chloride (PVC)

Pipe and fittings shall conform to the requirements of ASTM D3034. All joints shall be factory prepared compression type (elastomeric gasket joint), providing a watertight seal. A compression stop, as recommended by the pipe joint manufacturer, will be provided to seal the end joint of dead-end stubs.

742.02 Inspection

All pipes shall be subject to inspection at the point of delivery in Erie. The purpose of this inspection is to reject pipe that fails to conform to the requirements of these STANDARDS AND SPECIFICATIONS. Plastic joint material damaged in any way shall be cause for rejection of that joint of pipe.

743.00 Installation

743.01 General

All installation work shall conform to applicable portions of ASTM C-12 and to the pipe manufacturer's installation instructions.

743.02 Location and Alignment of Service

Sanitary sewer service lines shall be constructed on the shortest and straightest route possible. The service may be constructed with one or more horizontal one-eighth (1/8) bends between the house plumbing and the sanitary sewer main with the written approval of the Town Engineer. Clean-outs

shall be installed in accordance with UBC, the UPC and as described herein. Unless specific approval is obtained in writing from the Town Engineer, all sanitary sewer service lines shall have a minimum depth of three (3) feet.

At no time shall the service line be closer than three (3) feet to a side property line, and no service line may be constructed through or in front of an adjoining property. Sewer service lines shall be typically located a minimum of ten (10) feet to the low side of the water service, generally five (5) feet from the centerline of the lot, or as shown on the accepted plans. Generally, services shall not be located under driveways.

743.03 Crossing Sidewalk or Curb (Existing or Proposed)

In no instance will a trench extend beneath an existing sidewalk or curb. The pipe must be bored, jacked or tunneled through the earth under the sidewalk or curb. If the service line is installed prior to the placement of the sidewalk or curb, the trench shall be backfilled in accordance with Section 353.00, Backfilling for Pipelines and Service Lines, of these STANDARDS AND SPECIFICATIONS.

743.04 Service Stub-ins to Property Line

All sewer service lines shall be marked on the curb with an "X" or "S" symbol where the service crosses under the curb. All service stub-ins shall be stubbed into the lots, ten (10) feet beyond the back of walk or five (5) feet past any utility easement which ever is greater. All service stub-ins shall be plugged with a compression stop. All service stub-ins shall be located with the end marked with a 2x4 painted green.

THE PROPERTY OWNER SHALL BE RESPONSIBLE FOR THE MAINTENANCE OF THE SEWER SERVICE LINE UP TO BUT NOT INCLUDING THE MAIN, AS SET FORTH IN THE ERIE MUNICIPAL CODE, *SECTION 8-2-7, SERVICE LINES AND CONNECTIONS*.

743.05 Tapping the Main

When tapping into an existing main, the main will be tapped by machine, drilling a hole sized to fit the saddle being used for the tap. The Town Engineer shall approve the drilling machine and method of drilling. A representative of the Town shall inspect the main and saddle at every tap prior to backfilling. In the event that a tap is covered before it is inspected, the Contractor, at his own expense, shall uncover the tap and remove any concrete or mortar from around the fitting to allow for a visual inspection of the tap and the main. If the sewer main is cracked or broken during the process of locating and tapping, the Contractor shall, at his expense, immediately repair the broken. Sewer tapping saddle shall be an epoxy and double strapped saddle.

Service taps directly into a manhole will not be allowed without the written approval of the Town Engineer. When approved, service taps into manholes will be completed in accordance with Section 730.00 of these STANDARDS AND SPECIFICATIONS.

743.06 Pipe Installation

Pipe shall be installed in accordance with the Standard Drawings. In those cases where the sewer service cannot be installed a minimum of ten (10) feet horizontally away from a water service, concrete encasement of the sewer line will be required. The pipe shall be installed in accordance with all applicable portions of Section 733.00 of these STANDARDS AND SPECIFICATIONS.

In those cases where the water and sewer service lines must cross one another, installation shall be completed in accordance with Section 716.00 of these STANDARDS AND SPECIFICATIONS.

Where sewer service lines are engineered and controlled in accordance with Section 733.02 of these STANDARDS AND SPECIFICATIONS, the minimum grades set forth in Section 714.00 of these STANDARDS AND SPECIFICATIONS shall apply.

743.07 Industrial

All buildings (warehouses, etc.) constructed as a shell, with the intention of only being used for subdivided suites for commercial purposes, shall be required to install service connections extending a minimum of six (6) feet outside of the building with a clean-out for each set of proposed bathroom or suite. All commercial and industrial facilities must have a clean out on the outside of the building, located a minimum of three (3) feet from the building, on the service connection.

743.08 Other Requirements

Rainwater leaders, roof drains, surface drains or ground water drains shall not be connected to the sanitary sewer system. Each sanitary sewer service system shall be separate from the drainage system. Grease and sand traps will be installed where required by the provisions of the ICC.