

CHAPTER 10

SANITARY SEWER

CHAPTER 10  
SANITARY SEWER

INDEX

<u>Section</u>	<u>Topic</u>	<u>Page</u>
10.0	Sanitary Sewer Collection System	10.1
10.1	General	10.1
10.2	Reference Design Documents	10.1
10.3	Unlawful Connections	10.1
10.4	Minimum Sanitary Sewer System Design Criteria	10.1
10.5	Minimum Size/Grades	10.4
10.6	System Layout	10.5
10.7	Sewer Main Depth	10.6
10.8	Easements	10.6
10.9	Pipe Deflection	10.7
10.10	Future Connections	10.7
10.11	Location and Alignment of Service Laterals Extension and Taps	10.7
10.12	Appurtenances	10.9
10.13	Underdrain System Design	10.11
10.14	Minimum Acceptable Materials	10.13
10.15	Sanitary Sewer Manholes	10.18
10.16	P.V.C.	10.25
10.17	Ductile Iron Pipe	10.30
10.18	Precast Concrete Pipe	10.35

CHAPTER 10  
SANITARY SEWER  
INDEX (CONT'D)

<u>Section</u>	<u>Topic</u>	<u>Page</u>
10.19	Vitrified Clay Pipe	10.41
10.20	Underdrain Pipe	10.45
10.21	Handling and Installation for Sanitary Sewer Pipes	10.47
10.22	Testing of Sanitary Sewer Construction	10.51
10.23	Sanitary Sewer Service Lines	10.60
10.24	Construction Site Restoration	10.67

GRAPHICS

<u>Drawing No.</u>	<u>Subject</u>
SS-1	Sewer Manhole
SS-2	Outside Drop Manhole
SS-3	Outside Drop Manhole for Pipe 15" And Smaller
SS-4	Drop Manhole Detail
SS-5	Manhole Base Detail
SS-6	Manhole Platform Detail
SS-7	Manhole Steps
SS-8	24" Manhole Ring & Cover
SS-9	30" Manhole Ring & Cover
SS-10	Sewer Lateral Connections
SS-11	Sewer Service Wye Detail

CHAPTER 10

SANITARY SEWER

INDEX (CONT'D)

<u>Drawing No.</u>	<u>Subject</u>
SS-12	Sanitary Sewer Service Detail
SS-13	Clear-Out Detail
SS-14	Sanitary Sewer Clean-Out
SS-15	Pipe Crossing-Concrete Blanket
SS-16	Typical Bare Construction
SS-17	Thermite Weld & Joint Bond Detail

## CHAPTER 10

### SANITARY SEWER COLLECTION SYSTEM

#### 10.0 SANITARY SEWER COLLECTION SYSTEM

- 10.1 GENERAL: It is the intent of this Design Criteria Chapter to provide sufficient detailed information to enable the Consultant Engineer to correctly and efficiently design the overall Sanitary Sewer System for the Project. If there is a question or concern regarding the design of any portion of the Sanitary Sewer System that is not adequately answered within this Chapter, the Developer shall contact the Engineering Division to resolve these issues prior to design. Any variation from these Regulations shall be requested as outlined in Chapter 1.

The Sanitary Sewer System shall be designed by a Professional Engineer registered in the State of Colorado utilizing the most current technical standards along with good, sound engineering judgment throughout the design process. The design process includes the submittal of construction drawings for review and approval by the Town in accordance with Chapter 2 and 3 of this Manual.

- 10.2 REFERENCE DESIGN DOCUMENTS: Primary Standards and Reference Publications used in this section are from:  
American Society for Testing and Materials (ASTM)  
American National Standards Institute (ANSI)  
State of Colorado Department of Health Design Criteria.

- 10.3 UNLAWFUL CONNECTIONS: It shall be unlawful to discharge roof drainage, foundation drainage, sump pumps, surface drainage or any other non-acceptable wastes to the sanitary sewer.

- 10.4 MINIMUM SANITARY SEWER SYSTEM DESIGN CRITERIA  
10.4.1 Design Flow: The flows used to design the Sanitary Sewer System for a particular development vary depending

on the type of development. There are three general categories of development for which flow rates are given: residential development, commercial development and industrial development. The design shall include consideration of providing service for the entire area tributary to the outfall point.

Estimates of residential sewage contribution shall be based on 100 gallons per day per person average flow. Minimum residential population density shall be figured on a basis of 3.2 persons per house, 3.0 houses per acre and 100 percent of the total land area developed as residential. For more detailed and final designs the following values shall be used:

Base Wastewater Flow Rates by Land Use		
Land Use	Typical Demand/Unit	Typical SFEs/Unit
Single Family Residential	200 gpd/dwelling unit	1.00/dwelling unit
Multi Family Residential	130 gpd/dwelling unit	0.65/dwelling unit
Commercial/Retail/Office	600 gpd/acre	3/acre
Industrial	600 gpd/acre	3/acre
Institutional	400 gpd/acre	2/acre
School (year round)	12(elem), 16(jr/sr)gpd/stdnt	0.06(elem) 0.08(jr/sr) Stdnt
Churches	300 gpd/church	1.5/church
Irrigated land	0 gpd/acre	0/acre

*Infiltration*

Developed Area: 50 gpd/SFE, represents seasonal high value  
Undeveloped Area: 25 gpd/SFE

*Inflow*

Developed Area: 170 gpd/SFE, based on a 10 year storm event  
Undeveloped Area: 85 gpd/SFE

Sanitary sewers shall be designed to convey the peak daily flow plus Infiltration and Inflow. If an industry uses more than the average allowance, then the sewer must be designed to handle that industry's peak daily flow.

Flow rates downstream of lift stations

shall take into account the flow generated at the maximum pumping rate plus Infiltration and Inflow.

10.4.2 Hydraulic Design: Sewers shall be designed to carry, when running full, not less than the following daily per capita contributions of sewage or other water flows from industrial plants:

- A. Laterals and sub-mains - 400 gallons
- B. Main, trunk, interceptor and outfall sewers - 250 gallons

Where actual flow will be much below normal for several years, the minimum velocity shall be achieved by suitable grades at the partial design flow rate. 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 the flow.

- A. Sewers shall have a uniform slope and straight alignment between manholes.
- B. At all junctions where a smaller diameter discharges into a larger one and at all locations where the sewer increases in size, the invert of the larger sewer shall be lowered so that the energy gradients of sewers at junction are at the same level. Generally, this condition will be met by placing the 0.8 depth of flow in each sewer at the same elevation.
- C. Sewers shall be designed to be free flowing with the hydraulic grade below the crown and with hydraulic slopes sufficient to provide an average velocity of not less than 2.25 feet per second when running full. Computations of velocity of flow shall be based on a coefficient of roughness "n" in the Manning

formula of 0.013 for concrete pipe and 0.011 for polyvinyl chloride. For sewage flow depth less than one-fourth full, allowance shall be made for increased value of "n" and in no case shall velocities of less than 1.3 feet per second be permitted. The improved velocities shall be accomplished by steeper grades.

- D. The maximum permissible velocity at average flow (before applying peak flow factor) shall not exceed 7.5 feet per second.
- E. Suitable drop manholes shall be provided to break steep slopes to limit the velocities in the connecting sewer pipes between manholes.
- F. Invert channels in terminal manholes shall be built at a slope of not less than one inch per one foot.
- G. In general, the pipe diameter of subtrunk sewers shall increase continually with increase in tributary flow. Where steep ground slopes make possible the use of a reduced pipe size and a substantial economy of construction cost can be derived, the pipe size may be reduced, but due hydraulic allowances shall be made for head loss of entry, increased velocity and the effect of velocity retardation at the lower end where the flow will be on a flatter slope. In no case shall pipe sizes be reduced below 6" in diameter.

10.5 MINIMUM SIZE/GRADES: Sanitary sewer mains shall be a minimum of a 6" diameter. Service connections shall be a minimum of a 4" diameter. The sanitary sewer shall be designed to carry the



discharge calculated in accordance with 16.3.2. and to transport suspended material such that deposits in the sewer are precluded. The following minimum grades shall apply, unless approved by the Engineer in writing prior to drawing submittal:

Sewer Diameter	Minimum Slope	Maximum Slope
4 inch - Lateral Only	2.0%	-
6 inch - Lateral Only	1.0%	-
8 inch	0.40%	7.5%
10 inch	0.25%	5.5%
12 inch	0.20%	4.5%
15 inch	0.15%	3.5%
18 inch	0.11%	2.5%
21 inch	0.09%	2.0%
24 inch	0.08%	1.8%
27 inch	0.07%	1.5%
30 inch	0.06%	1.3%

10.6

SYSTEM LAYOUT: All mains shall be installed in dedicated right-of-way or public easements. Under no circumstances should sanitary sewer mains be installed parallel to and directly below any concrete such as sidewalks, curbs or gutters. Line designed within the street right of way shall be located in accordance to the requirements of Chapter 1 of these Regulations, unless otherwise approved, in writing, by the Town. Where mains are installed in easements, they shall be located in the center of the easement.

Sewer mains will be extended at least 10' 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.

Unless approved otherwise by the Town Engineer, sanitary sewer mains, installed in local or collector streets, shall be located in the street center lines, a 10' clear distance from reuse or water lines. Where mains are installed in easements, they shall ordinarily, be located in the center of the easement. Where necessary to locate the sanitary sewer main along back lot lines, the maintenance manholes shall be located to provide reasonable access for maintenance crews.

Sanitary sewer mains shall be laid a minimum of 10' horizontally from any existing or proposed utility. Upon written approval by the Town, a sanitary sewer main may be laid closer than 10' to a parallel water main if it is laid in a separate trench and if the elevation of the invert of the water main is at least eighteen inches above the crown of the sewer main and, in addition, polyvinyl chloride pressure pipe is used for the sewer main.

When the sanitary sewer main passes under a highway, railroad or drainage or irrigation ditch, there shall be a minimum of 5' of cover and steel casing. The steel casing shall extend the entire width of the right-of-way or easement of the crossing structure or as directed by the Town.

- 10.7 SEWER MAIN DEPTH: Sewer mains shall ordinarily have a minimum of 8' of cover to finished ground surface and maximum depth of 20'.
- 10.8 EASEMENTS: The minimum easement shall be 20' in width for one utility, 30' in width for two utilities and 40' in width for three utilities. Site specific circumstances may dictate the need for wider easements. The main shall be located in the center of the easement. In any case, the main shall be located a minimum of 10' from the edge of the easement. All easements shall be for the exclusive use of the Town of Bennett. No landscaping, except sod or private irrigation systems, or permanent structures, such as

mailboxes, sheds, buildings, etc. shall be placed in the easement. All easements shall provide access to all lines in any location.

10.9 PIPE DEFLECTION: Pipe deflection (curved sewer) shall not be allowed.

10.10 FUTURE CONNECTIONS: Manholes shall have pipes stubbed out which are sized to accommodate flows from the upstream basin whenever a future extension of the sanitary sewer main is anticipated. The main line stubout shall be capped and sealed.

10.11 LOCATION AND ALIGNMENT OF SERVICE LATERALS EXTENSION AND TAPS

A) In new projects where the sanitary sewer mains are being installed by the Developer, the Developer shall also install a stubout/extension from the sanitary sewer main to a minimum of 1' beyond the property line for each lot where sidewalk is not to be constructed. Where sidewalks are proposed to be constructed, the stubout/extension shall be constructed to 5' beyond the back of the sidewalk. The extensions shall be plugged. This extension is to receive the building sewer for each lot.

1. Such extensions shall be shown on the sewer plans submitted to and approved by the Director of Public Works and the extension shall be installed in the exact location as shown on the plan.
2. These extensions shall be constructed as specified in the Construction Plans.
3. The extensions shall enter the sanitary sewer through a manufactured wye, tee placed in the sanitary sewer by the Developer at the exact location for proper alignment with the extension.
4. The extension shall be laid at grades provided in the Construction Plans.

5. No extension connections to manholes will be allowed.
  6. The extensions shall be inspected and tested by the Public Works Inspector prior to backfill along with and at the same time inspections are being made for the installation of the sanitary sewer main.
  7. The service line shall be constructed on the shortest and straightest route possible.
  8. The service line shall be a minimum of 5' from the downhill side property line and shall not be constructed through or in front of any adjoining property.
  9. Sewer extension shall be a minimum of 10' from any water service line.
  10. No trenching shall occur beneath the existing sidewalk or curb, the pipe shall be bored through the earth under the curb or sidewalk.
  11. The location of the service line shall be marked on the curb by an "S" symbol impression into the concrete, and the Contractor shall furnish and install two marker posts as per the requirements of paragraph 10.23.1-C.
- B) Plan sheet(s) for projects where sewer extensions are to be installed shall show the following information:
1. Station of branch, length and direction of extension, pipe size and percent of grade shall in shown on the plan view.
  2. Station of branch and invert elevation and finished ground elevations at end of extension shall be shown in the profile view.

- C) All taps for sanitary sewer service connections shall be made per Standard Drawing No.'s SS-10, 11 and 12 within the back of this Chapter and the pertaining paragraphs of this Chapter.

10.12

APPURTENANCES

10.12.1 Manhole Spacing/Design Details.

- A. Manholes shall be a minimum of 48" diameter and be provided at every change of direction, grade or connection with other sewer mains. Sewer manholes for sewers up to 21" in diameter shall not be less than four feet inside diameter. Manholes for sewers 24" and up to 36" shall have an inside diameter of not less than 5'. If the angle of deflection does not permit use of a 5' inside diameter manhole, then a special manhole detail must be shown.
- B. Maximum spacing shall be 400' for lines 15" or smaller, or 500' for lines from 18" to 30" and 600' for lines larger than 30".
- C. Sewer lines shall be straight and not curved between manholes, both in line and grade.
- D. Cleanouts will not be allowed as replacements for manholes.
- E. Drop manholes shall be provided for a sewer entering a manhole at an elevation 24" or more above the manhole invert. When it is necessary to drop the elevation of the sewer at a manhole, the drop should be made by means of an outside connection.

- F. Where the difference in elevation is less than 24", the invert shall be filleted to prevent solids deposition.
- G. Manholes shall not be located in areas that are subject to flooding from surface runoff. If the possibility of surface runoff cannot be avoided, an internal watertight insert shall be installed to prevent inflow.
- H. Manholes shall be located in areas that allow direct access by maintenance vehicles when it is not feasible to locate the manhole in the public street. All manholes located outside dedicated street right-of-way shall be designed and constructed with locking-type cover and the manhole ring shall be bolted to the manhole cone.

When it is necessary to drop the elevation of the sewer at a manhole, the drop should be made by means of an outside connection. The maximum difference in elevation permitted between the influent and effluent lines in a manhole will be six inches.

- 10.12.2 Line Connections To Manholes: When designing new sewers to tie into existing manholes, the bench elevation at the inside manhole wall shall be stated on plans, so that the invert of the new tie-in is not established lower than the existing bench. When the existing sewer line is larger than the new connection, the crown of the new pipe shall be no lower than the highest crown of the existing line within the manhole.

10.12.3 Infiltration: All sanitary sewer manholes or appurtenances subject to infiltration of surface water shall have installed a standard watertight manhole frame and cover, which shall be shown on the plans.

Ventilation of gravity sewers shall be provided where continuous watertight sections greater than 1,000' in length are incurred.

Provisions for flow measurement (flume installations) will be provided at major junctions in the collection system where designated by the Town Engineer.

#### 10.13 UNDERDRAIN SYSTEM DESIGN

Where soils report indicate excessive groundwater may be encountered, an underdrain system shall be designed along with the sewer system. All underdrains shall daylight to suitable point or discharge into a properly sized storm drain system.

##### 10.13.1 Construction Plans.

- A. All plan sets that provide for underdrain construction shall have the following disclaimer note placed on the cover sheet immediately adjacent to the Town approval block:  
"The Town of Bennett does not take any liability or maintenance responsibility for sewer subdrains."
- B. As a minimum, the main underdrain in the streets shall consist of a perforated pipe in washed, crushed gravel and be wrapped in a non-woven geotextile fabric.

10.13.2 Surface Conditions.

A. A Geotechnical Soils Report shall be submitted with any construction plans requiring subdrains. This report is to address the need and extent of subdrains for utility and roadway protection. The soil report shall consider the insitu soil types, soil gradations for both existing soils and import fill material, and groundwater levels in the project area. The effects of soil migration on subdrain performance must be addressed and recommended subdrain lateral construction details provided in the report. Estimates of ultimate flow rates in the drains shall be included.

1. A well-graded washed, crushed rock shall embed all subdrains for the full width of the subdrain trench having maximum gradation of 1" and a maximum of three percent (3%) passing the No. 200 sieve.
2. The entire gravel and subdrain pipe system shall be wrapped in an envelope of non-woven geotextile fabric to lap a minimum of 12". The geotextile fabric shall be installed for the full length of the subdrain.

B. All subdrains shall daylight into drainage ways or storm sewers at the earliest opportunity. The Director of Public Works or the Town Engineer may request that outfalling shall be granted by the Colorado Department of Health via a discharge permit. The sub-drain daylight shall be via a concrete headwall structure when



at a surface drainage way. Tie-in details to storm sewers shall be provided by the Consultant Engineer and be subject to approval by the Town Engineer or Director of Public Works. The subdrain pipe, immediately prior to the daylight, shall consist of solid wall PVC for as far as 100' from the point of daylight, depending upon embankment conditions at the point of daylight. The perforated pipe, gravel and geotextile fabric shall end at the beginning of the solid wall pipe and an impervious cut-off wall shall be constructed in the Subdrain and sewer trench at the same location. Details of the cut-off wall, gravel and geotextile fabric and solid wall pipe bedding (same as sewer) and headwall shall be shown on the plans. The limits of the perforated and solid wall PVC, location of cut-off wall and daylight shall also be shown and labeled on the sanitary sewer profile. The estimated ultimate peak flow rate at the discharge point shall be shown on the profile.

10.14 MINIMUM ACCEPTABLE MATERIALS

- 10.14.1 Sanitary Sewer Pipe: All sanitary sewer collection systems preferably shall be of the following types: PVC (SDR 35)/ASTM D 3034 ductile iron pipe, CL 250 epoxy lined per AWWA and ASTM. Precast concrete pipe as per ASTM C76 or C655 is also allowed. For 6" to 15"

diameter pipe, pipe shall be installed at 20' lengths and for 15" diameter pipe and above, pipe shall be installed at 13' lengths. On some applications, the Director of Public Works or Town Engineer may require or allow the use of Vitrified Clay Pipe.

10.14.1.1 PVC (SDR 35): Polyvinyl chloride (PVC) plastic pipe fittings, couplings and joints shall be in conformance with the requirements of ASTM D 1784 and D 3034. The SDR shall be a minimum of 35 and all pipe shall have gasketed joints. The use of solvent cement joints is prohibited.

10.14.1.2 Ductile Iron Pipe: Normally used only where structural or pressure sewers may be required. All pipe and fittings shall conform to ANSI A 21.51 AWWA specification C-151-76 as amended. Joints shall conform to AWWA C111 for mechanical and push-on, and to AWWA C110 for flanged joints. In areas where the lines are close to flat, the Town Engineer may require the DIP line to be vinyl-lined.

10.14.2 Under-drain: Where required by ground water and/or trench conditions, the following under-drain materials may be used:

1. Perforated PVC sewer drain pipe shall conform to ASTM D-2729
2. Corrugated ABS plastic pipe, conforming to ASTM D-2680 and D-2751.

### 10.14.3 Manhole Materials

10.14.3.1 Manholes: Manholes shall be constructed of pre-cast concrete where possible and be asphalt-coated on the inside, when determined necessary by the Director of Public Works or Town Engineer. Concrete pre-cast reinforced risers and tops shall conform to ASTM C-478. Manholes shall conform to details shown on Drawing Numbers SS-1 through within the back of this Chapter. Cones shall be of the eccentric type. Steps for manholes shall be made of aluminum alloy conforming to CDOT standards, having a minimum tensile strength of 35,000 psi and have an elongation of not less than ten percent in 2". Steps shall incorporate two non-skid grooves and must, without permanent deformation, carry a load of 1,000 pounds when projected 6" from the wall, and 1,500 pounds when projected 4" from the wall. Plastic inserts must be anchored with no movement. Manholes deeper than 12" shall have a "safety" horizontal platform, (for example, a flat grate with removable cover), installed at midpoint, to provide an area for refuge and rescue. 18" maximum riser rings are allowed. Openings must align vertically.

10.14.3.2 Concrete for Manholes: Concrete for manholes shall be mixed in the following proportions by volume: One part Portland cement, one-half part hydrated lime, and three parts sand. Masonry

cement, ASTM C-91, Type II, if approved by the Director of Public Works or Town Engineer, may be used in place of Portland cement and hydrated lime. The cement, lime and sand shall be thoroughly mixed dry, and only enough water added to form a mortar of proper consistency. Mortar shall be used within one hour after mixing, with no re-tempering permitted. Mortar that has taken a partial set shall not be used.

10.14.3.3 Manhole Gaskets: Where preformed flexible plastic gaskets are used to seal joints between pre-cast manhole sections, they shall conform to Federal Specifications SS-S-00210 (6SA-FSS), Type I, Rope Form, and shall have minimum diameter of 1½". An approved water stop gasket assembly shall be placed around all pipe that is incorporated within manhole bases, inlet boxes or other concrete structures. The water stop gasket shall be capable of withstanding an internal hydrostatic pressure of 13 psi for 10 minutes without leakage. The word "Sewer", shall be stamped on the cover.

10.14.3.4 Cast Iron Manhole Covers: All 24" diameter cast iron manhole rings and covers and other iron castings shall be 410 lb. Cast iron, 23-7/8", ASTM A-48, with a minimum tensile strength of 30,000 psi, (Class 30), (Neenah Type R-1706 ring and cover or equivalent, (see Drawing No.'s SS-8 and 9). Castings shall be

hot-dipped in asphalt varnish in such a manner as to form a firm and tenacious coating. All metal-bearing surfaces between the ring and cover shall be machined or fabricated to ensure good seating. Manhole lids shall be provided with a non-slip pattern on the surface which lies flush with the elevation of the ring. Manholes installed outside of the street right-of-way and/or easement shall have locking lid covers. The first two manholes at the exit of a force main shall have locking lid covers. 30" diameter manhole rings and covers shall be as per Paragraph 13.15.4-I

- 10.14.4 Pipe Casement: Concrete encasement will be required on sewer line when clear vertical distance from water line is less than 1'-6" or horizontal distance is less than 10' between parallel lines. Concrete encasement will be required in all cases where the sewer line is above the water line or is under a waterway crossing.
- 10.14.5 Service Lines Materials, Tap Connections: Unless otherwise specified by these Public Works Director or the Town Engineer, manufacturing, inspection, marking, and acceptance of sewer pipe and related products shall be in accordance with the standard Specifications listed in this section. Unless otherwise approved by the Director of Public Works or Town Engineer and listed as such on the approved plans, all sanitary sewer pipe for collection mains and lines shall be PVC SDR-35 (ASTM 3033 or ASTM

3034). PVC pipe, delivered to the job-site, may be rejected if it does not conform to the ASTM D-3033 or D-3034, or does not conform to ASTM D2321, "Recommended Practice for Underground Installation of Flexible Thermoplastic Pipe".

10.14.5.1 Materials: Service line material shall be PVC - SDR 35 and D.I.P. Cl-250 epoxy lined.

10.14.5.2 Taps: Normally, taps are required to be made on the main while the line is being laid. These taps are fittings (e.g., 45° degree wye fitting on main to a 45° degree bend on the service line). Refer to Drawing No's SS-10, 11 and 12 for details. If tapping saddles are used in new construction, they shall be of a type manufactured and furnished by the pipe supplier. All PVC tapping saddles shall be of the type which uses stainless steel bands to attach the pipe with a bell gasket on the service side.

## 10.15 SANITARY SEWER MANHOLES

10.15.1 General: Preferably, manholes shall be constructed of pre-cast concrete and meet the minimum acceptable materials requirements specified under paragraph 10.14.3 of this Chapter. All dead end manholes shall have line laid through the manhole one length of pipe and plugged with a watertight plug provided by the pipe manufacturer. Service lines shall not empty directly into a manhole unless the manhole has been specifically and exclusively

constructed for the serviceline.  
Cleanouts shall not, under any  
circumstance, be installed in lieu of a  
manhole

- 10.15.2 Manhole Spacing: The maximum distance  
between manholes shall be as follows:

<u>Pipe Size</u>	<u>Maximum Distance</u>
8 to 15"	400'
18 to 30"	500'
larger than 30"	600'

- 10.15.3 Barrel Size: The internal diameter of  
the manhole barrel shall not be less  
than 48 inches for sanitary sewers of  
sizes 12" or less; 60" for sizes 15-27"  
inclusive and 72" for sizes 30" and  
larger.

- 10.15.4 Materials: The materials to be used in  
the construction of manholes shall  
conform to Paragraph 10.14.3 and the  
following supplementary requirements.

- A. Cones. All cones shall be  
eccentric.
- B. Precast Manholes. Precast manhole  
risers and cones shall be  
manufactured in conformity with  
ASTM Designation C478.
- C. Cast-In-Place Manholes. Cast-in-  
place manholes shall not be  
allowed.
- D. Brick Manholes. Brick used in  
manholes shall conform to ASTM  
Designation C-32, Grade MA. They  
shall only be used when  
specifically allowed by the  
Director of Public Works.

- E. Cement. All cement used in concrete and mortar shall conform to ASTM Designation C-150 Type II, Type IIA or when deemed necessary Type V.
- F. Aggregate. Aggregate shall conform to Standard Specifications for Concrete Aggregates ASTM Designation C33.
- G. Concrete for Manholes. Concrete used in precast manhole sections and the manhole foundation shall have 28 day strength of 3500 psi and shall have a maximum water cement ratio of 0.45. Also see Paragraph 10.14.3.2
- H. Mortar. Mortar used in laying brick and in grouting manhole rings shall be composed of one part Portland cement and not more than three nor less than two parts of fine aggregate. Hydrated lime or masonry cement shall not be used. Portland cement shall meet the requirements of ASTM C-150, Type II. Fine aggregate shall consist of well-graded natural sand having clean, hard, durable, uncoated grains, free from organic matter, soft or flaky fragments or other deleterious substances. The fine aggregate shall be thoroughly washed and shall be uniformly graded from coarse to fine with a minimum of 95 percent passing a number 4 sieve and a maximum of 7 percent passing a number 100 sieve. The mortar shall have a maximum water cement ratio of 0.45.
- I. Manhole Steps. Manhole steps shall be aluminum and shall be cast into the manhole wall at the same time



the manhole section is cast. The steps shall be Alcoa No. 13653B, as manufactured by the Aluminum Company of America or approved equal. Manhole steps shall be no more than 24" nor less than 18" from the top of the manhole ring or from the bench of the manhole. Manhole steps shall be located directly over the exit pipe. Also see Paragraph 10.14.3.1.

- J. Ring and Cover. Manhole rings and covers shall be 24" diameter for 48" diameter manhole barrels and 30" diameter for 60" and 72" diameter manhole barrels. 24" diameter manhole rings and covers shall be cast iron as per the specifications, as referred in Paragraph 10.14.3.4. 30" diameter manhole rings and covers shall be cast iron, Comco Catalog #C1360, weight 630 pounds or approved equal. The covers shall have a five point lock down assembly.

The cover shall be machined to fit the ring to exclude surface water and be level with the top of the ring. Covers shall have one lifting notch only which shall not extend beyond the lip of the ring seat.

The ring shall be held in place by being set on mortar and by mortar being placed over the ring from the edge of the support structure to one inch from the top edge of the ring. Also see Drawing No.'s SS-8 and SS-9.

- K. Flexible Joint Sealing Compound. When preformed plastic gaskets, as per Paragraph 10.14.3.3, are not

being used flexible joint sealing compound, "Kent-Seal No. 2" as manufactured by Hamilton-Kent Company, or other approved plastic joint material shall be used in all concrete joints. Sealing compounds shall conform to Federal Specifications SS-S-00210 and shall remain quite pliable to -20 degrees Fahrenheit and shall not become excessively pliable at +120 degrees Fahrenheit.

- L. Epoxy Coating Where required or shown on the drawings, epoxy coating shall be similar or equal to "PREBOUND CONCRETE BONDING AGENT ET-150H".

10.15.5 Construction: Manholes shall be constructed at the locations and to the elevations indicated on the drawings. Manholes shall be so constructed so as to form a circle in a horizontal plane. The internal diameter of manhole barrels shall be maintained to a distance of not more than 5' below finished grade. From the point the manhole barrel shall be tapered to the 24" internal diameter for 4' diameter manholes and 30" internal diameter for 5' diameter manholes, and larger as shown on the standard manhole drawings. When the overall possible height above the base is less than 8'6", a flat top manhole shall be installed as shown in the details. The manhole barrels shall be watertight at all joints.

The cone or flat top section shall not extend closer than 18" to no more than 24" from the top of the manhole cover. Brick mortared in place, or precast concrete adjustment rings shall be used on top of the cone to support and

adjust the manhole frame to the required final grade. The outside of the brick shall be covered by mortar, 5/8" thick, troweled smooth.

Manholes of brick construction shall be not less than 8" thick. Brick shall be laid two stretcher courses wide with a header course provided every seventh course. Brick shall be clean and thoroughly wet before it is laid. The brick shall be laid in full bed of mortar and all head or vertical joints shall be completely filled. The outside of the brick manhole shall be plastered and troweled smooth with a coat of mortar, 5/8" thick. Specifically brick manholes will only be allowed when approved by the Director of Public Works.

All manholes under construction shall be sealed tightly to prevent storm or other non-sewage flows from entering the sanitary sewer system.

10.15.6 Horizontal Joints: Flexible plastic joint sealing compound in accordance with Paragraph 10.15.4-K of these Specifications shall be applied to all manhole joints. The application of the priming compound and the sealing compound shall be accomplished in strict conformance with the manufacturer's instructions. The joint materials shall conform to the approximate manufactured shape at the time of installation. Any materials not conforming shall be rejected and not used. The joint materials shall not be stretched or in any other way distorted.

10.15.7 Manhole Bases: Except as otherwise shown on the drawings, the manhole bases shall be constructed as shown on

the Standard Manhole Detail drawings. Straight channels shall be pre-formed or shall be of clay pipe with the top portion broken out. Short stubs with flexible joints shall be installed before the line enters the base, and after it leaves the base. Changes in direction of flow through the manhole shall be made with a smooth curved channel having as large a radius as possible. The change in size of channels shall be made gradually and evenly and shall be formed directly in the concrete. The floor of the manhole outside of the channel shall be finished to a smooth surface and shall slope to the channel. The thickness of the base shall not be less than eight (8) inches nor more than twelve (12) inches under the invert of the channel. The elevation of the sugrade for the manhole shall not vary more than 0.05 feet. In the event the subgrade has been overexcavated, granular bedding material shall be used to bring the subgrade to the specified elevation. The granular bedding shall be compacted in accordance with Chapter 6 of these Specifications. The diameter of manhole bases shall be 6' for 4' barrels, 7' for 5' barrels and 8' for 6' barrels.

- 10.15.8 Connections To Existing Manholes: Sewer pipe connections to existing manholes, where there is no existing pipe stubbed out, shall be made in such a manner that the finished work will conform as nearly as practicable to the essential requirements specified for new manholes. The Contractor shall drill and break out as small an opening in the existing manhole as necessary to insert the new sewer pipe. The existing concrete foundation bench

shall 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. A non-shrink, Non-metallic, grout shall be used to smoothly finish the new invert and to seal the new line so the junction is watertight.

- 10.15.9 Reference Markers: Whenever a manhole is located outside of a traveled street or walkway, a reference marker shall be installed. The reference marker shall be a 3" galvanized pipe filled with concrete. The pipe shall be 9' long, set in at least an 8" diameter hole a depth of 4' and filled with concrete. The pipe shall be painted with alternating stripes of yellow and silver being each 4" in width. The pipe shall have reflectors as required by the Director of Public Works. Reference information shall be painted on the reference marker.

10.16 P.V.C.

- 10.16.1 General: All material, manufacturing operations, testing inspection of PVC sewer pipe shall be in conformity with the requirements of ASTM Specification D3034 - SDR 35.
- 10.16.2 Diameter of Pipe: The diameter indicated on the approved construction drawings shall mean the nominal diameter of the pipe. The inside diameter shall not be less than that required for vitrified clay pipe.
- 10.16.3 Wall Thickness Design of Pipe: The standard dimension ration of the diameter to the wall thickness shall not be greater than SDR-35 for 6" through 12" PVC Pipe and SDR-33.5 for 4" PVC Pipe.

- 10.16.4 Fittings and Specials: All fittings and specials shall conform to the requirements set forth in ASTM D3034 - SDR35 shall have the same structural properties, and the same bell and/or spigot configurations as an adjoining pipe.
- 10.16.5 Joints: All PVC joints shall be of bell and spigot type. The bell shall consist of an integral wall section stiffened with two PVC retainer rings which securely lock the solid cross section rubber ring into position. The rubber ring shall be in accordance with ASTM D-1869. The joint shall meet the requirements of ASTM D-3212. Spigot ends shall be smooth and free of burrs prior to making the joint. An approved lubricant shall be applied to the sealing ring to prevent damage to the ring and aid in making a tight joint.
- 10.16.6 Pipe Lengths: Pipe sections shall be furnished in lengths no shorter than 12.5 feet except service tees and closing pieces. The maximum pipe length shall be 20 feet.
- 10.16.7 Markings on Pipe: PVC Sewer Pipe shall be any color other than blue to distinguish the sewer pipe from water conduits. Each pipe shall be marked by the manufacturers with the appropriate ASTM designations and shall bear the seal of Approval of The National Sanitation Foundation. Any pipe or fittings not properly marked shall be rejected and removed from the jobsite.
- 10.16.8 Material Testing: All PVC Gravity Sewer pipe shall be capable of passing all of the following tests at 73° F ( $\pm 3^{\circ}F$ ).
- A. Stiffness. The minimum "pipe

stiffness" (F/Δ Y) at 5% deflection shall be 46 psi. For all sizes, when tested in accordance with ASTM Method of Testing D2412, External Loading Properties of Plastic Pipe by Parallel-Plate Loading.

B. Flattening. There shall be no evidence of splitting, cracking, or breaking when a section of pipe six inches long is compressed between parallel plates until the distance between the plates is 40% of the outside diameter of the pipe. The loading shall be a uniform rate and shall be completed between 2 to 5 minutes.

C. Drop Impact Test. A 6" long section of pipe shall be subjected to a free falling tup in accordance with ASTM Method Testing D2444. No shattering or splitting shall be evident when the following energy is impacted:

Nominal Size (inches)	4	6	8	10	12
Ft. - lbs.	150	210	210	220	220

10.16.9 Material Storage: Care shall be taken to store all pipe and fittings to maintain the condition of the pipe as manufactured. Pipe shall be stored on a flat surface to prevent the pipe from deformation due to temperature fluctuations and stress fatigue. Pipe shall be stored to prevent dirt or mud from entering the pipe and necessitating extensive cleaning procedures. Pipe shall be protected from exposure to ultraviolet radiation. Any discoloration of the pipe material shall be evidence of ultraviolet damage and the pipe shall be rejected and removed from the project.

10.16.10 Installation: Pipe shall be installed in full compliance with the Recommended Practice for "Underground Installation of Flexible Thermoplastic Sewer Pipe", ASTM Standard D 2321.

Pipe shall be installed with Class "B" Bedding, Town of Bennett Specifications, with the granular material brought up to a minimum of 6" of depth over the top of the pipe. Bedding material shall be hand placed under haunches of pipe to insure uniform support.

Bottom of trench shall be firm and on grade to provide uniform support along the barrel of the pipe. Bell holes shall be made at each joint.

Pipe installation shall start and end at manholes. Connections to pipe of other than PVC material shall be accomplished by matching plain ends of each pipe and by use of an adapter or such method that will insure a smooth transition of the invert at the connections.

Backfilling of acceptable material shall not be placed in lifts to exceed five feet (5') and shall be compacted to Town of Bennett Specifications. Random tests for compaction may be made in all elevations of the trench sections to insure firm support around the pipe and the backfill above it.

Bell grooves and gasket shall be cleaned of dirt or foreign matter before the lubricant is applied to the joint. The spigot end of the pipe shall be thoroughly cleaned and lubricated before insertion in the bell end. Cut ends of pipe shall be filed to an approximate angle of 30 degrees before



being inserted into the bell end. All gaskets and fittings used in the sewer line installation shall have the same cleaning and care before insertion into the line.

Sufficient backfill shall be placed on the barrel of each pipe section to secure the pipe against flotation from water in the trench or subsurface water. Each joint shall be inspected to ascertain that the "home" mark is in the right position before backfilling is completed. Joints shall be left open if a Public Works Inspector is not present during the pipe installation for any period of time until such time as each joint is inspected.

Care shall be taken to insure a clean line. Pipe plugs shall be used in each end of the sections of pipe as installed, whenever pipe laying is not in progress. A wooden bulkhead shall be installed at the upper end of the project in addition to the pipe plug.

10.16.11 Testing after Construction

- A. General. PVC gravity sewer pipe shall be tested in accordance with this section as well as in accordance with other sections of these Specifications.
- B. Maximum Deflection Test. PVC gravity sewer pipe shall not deflect more than 5% of the diameter of the pipe prior to initial acceptance. The deflection shall be tested in every section by the Contractor with a Pin-Type Go/No-Go Gauge. When the test fails, the line shall be repaired prior to initial acceptance. A Public Works

Representative shall be present during the test and shall verify the accuracy of the equipment.

- 10.16.12 Acceptance of Pipe After Construction:  
Initial acceptance of the project will be issued after the project has passed all testing required within this Chapter of the Manual. The Town, may at its option, reinspect the project and use closed circuit television and a Pin-Type Go/No-Go Gauge to verify that the line is free of defects prior to the warranty expiration. The Contractor shall be responsible for replacing all defective sections of pipe for a period of Two Years at no expense to the Town. A defective section shall be any section with excessive infiltration or exfiltration, any section with deflection in excess of 5% of the diameter, any section with structural failure, any section with a defect that prevents the designed discharge from flowing through the pipe or any section that would cause an abnormal amount of maintenance due to construction. A Public Works Inspector shall witness each repair or replacement so he can make it part of the permanent record that the defect has been corrected. Final acceptance will be issued at the end of the second year after the initial acceptance and if the line is not defective.

**10.17 DUCTILE IRON PIPE FOR SANITARY SEWER LINES**

- 10.17.1 General: All material, manufacturing operations, testing, inspection and marking of ductile iron pipe shall be in conformity with the requirements of ANSI A21.5. Ductile iron pipe shall be installed where required on the plans

and as required by the Director of Public Works.

- 10.17.2 Diameter of Pipe: The diameter indicated on the drawings shall mean the nominal diameter of the pipe. The inside diameter of the pipe after lining shall not be less than that required for vitrified clay pipe.
- 10.17.3 Wall Thickness Design of Pipe: The minimum wall thickness for each section of the pipe line shall conform to ANSI Standard A21.50 for the specified class of pipe.
- 10.17.4 Grade of Iron: The grade of iron shall be 60-42-10 having a minimum tensile strength of 60,000 psi, a minimum yield strength of 42,000 psi, and a minimum percent of elongation of 10 percent.
- 10.17.5 Pipe Lengths: Pipe sections shall be furnished in not less than 18' nominal lengths, except bends, closure pieces and approved specials which may be of shorter lengths.
- 10.17.6 Fittings and Specials: Fittings shall conform to ASA Standard A21.10 (AWWA C110) and shall be cast iron or ductile iron. The designer shall furnish for approval by the Town Engineer or Director of Public Works, details of all specials, and other fittings which are not covered by ASA A21.10.
- 10.17.7 Field Joints: Field joints shall be push-on joints conforming to ASA Standard A21.11 (AWWA C111).
- 10.17.8 Protective Coatings: The surface finish of all ductile iron pipe shall conform to the following:

A. Exterior - The exterior coating shall be the standard outside bituminous coating as specified in ASA Standard A21.51. (AWWA C151).

B. Interior - The interior coating for all ductile iron pipe shall be "Polybond Lining" as manufactured by American Cast Iron Pipe Company, "U.S. Polylined" as manufactured by United States Pipe and Foundry Company or equivalent. Any variance from this requirement shall require written approval by the Town Engineer or Director of Public Works.

10.17.9 Corrosion Protection: Cast and ductile iron pipe and all fittings shall be wrapped in polyethylene tubing to prevent corrosion. Polyethylene tubing and tape shall meet the following specifications:

Thickness            8 mils

Pigmentation        (1) Natural where exposure to ultra-violet light (sunlight for example) will be of short duration (less than 48 hours).

(2) Black - 2.0 to 2.5% well dispersed carbon black with stabilizers - where exposure to ultraviolet light (sunlight) may be prolonged (2-10 days).

(3) The polyethylene material shall be of virgin polyethylene produced from Du Pont

Alathon resin or U.S.I.  
Petrothene Resin or equal.

Tape (4) 2" Polyken #900,  
Scotchrap #50 or approved  
equal.

- A. Installation. Prior to installing polyethylene tubes, clumps of mud or other contaminants shall be brushed off the pipe surface. Polyethylene tubes shall be installed in accordance with ANSI A21.5 Method A. Method A requires the tubes to be overlapped 1' and secured with tape, and the slack width to be taken up on top of the pipe and taped at the quarter points. All rips, punctures or other damage to the polyethylene shall be repaired with tape or with a short piece of tubing cut open, wrapped around the pipe and secured in place.

10.17.10 Installation: Pipe shall be installed in accordance with AWWA Standard C600 and in accordance with the requirements of this Manual.

- A. Trench Width. The maximum trench width shall be the outside diameter of the pipe plus 3'. Whenever the allowable trench width is exceeded, the Town Engineer or Director of Public Works shall be notified. Any improved bedding required by the Town Engineer or Director will be at the expense of the Contractor. There shall be a minimum clearance between the pipe and the trench wall of 8".

B. Bedding. Pipe shall be bedded in accordance with the bedding class noted on the plans. In no case shall the bedding class be less than Laying Condition Type 3 as specified in ANSI Standard A21.50. Compaction shall be in accordance with Chapter 6 of these Specifications.

10.17.11 Jointing to Other Materials: When it is necessary to join or connect D.I.P. to V.C.P. or other materials, the joint shall be made by use of a "CanTex" adapter or approved equal. The joint shall be encased in concrete in accordance with the Pertaining details of these Specifications.

10.17.12 Acceptance of the Pipe After Construction: Initial acceptance of the project will be issued after the project has passed all testing required within this Chapter of the Manual. The Town may, at its option, reinspect the project and use closed circuit television to verify that the line is free of defects prior to the warranty expiration. The Contractor shall be responsible for replacing all defective sections of pipe for a period of two years at no expense to the Town. A defective section shall be any section with excessive infiltration or exfiltration, any section with structural failure, any section with a defect that prevents the designed discharge from flowing through the pipe or any section that would cause an abnormal amount of maintenance due to construction. A Public Works Inspector shall witness each repair or replacement so he can make it part of the permanent record that the defect has been corrected. Final acceptance

will be issued at the end of the second year after the initial acceptance and if the line is not defective.

**10.18     PRECAST CONCRETE PIPE FOR SANITARY SEWER LINES**

- 10.18.1    General: All concrete pipe shall meet the requirements of ASTM C76 or C655.
- 10.18.2    Cement: Unless otherwise required by the Town Engineer or Director of Public Works, Type II Portland Cement complying with the requirements of ASTM Designation C-150 will be acceptable in the manufacture of concrete pipe.
- 10.18.3    Diameter of Pipe: The diameter indicated on the drawings shall mean the inside diameter of the pipe. The minimum allowable pipe diameter for concrete sanitary sewer pipe shall be 18".
- 10.18.4    Fittings and Specials: Details of all fittings and specials shall be submitted to the Town Engineer or Director of Public Works for approval. Fittings and specials shall be made up of pipe segments having the same structural qualities as the adjoining pipe and shall have the interior treated the same as the pipe.
- 10.18.5    Lifting Holes: Lifting holes shall not be allowed in Sanitary Sewer Pipe.
- 10.18.6    Visual Defects: In addition to deficiencies covered by the applicable ASTM Specifications, concrete pipe which has any of the following visual defects will not be accepted.
  - A.    Porous areas on either the inside or the outside surface of a pipe having an area of more than five

square inches and a depth of more than one half inch.

- B. Pipe which has been patched or repaired without approval of the Town Engineer or Director of Public Works.
- C. Improperly formed joints.
- D. Exposed reinforcement.
- E. Pipe which is fractured, cracked, chipped or damaged in any manner.
- F. Pipe with excessive interior surface roughness.
- G. Pipe that has been damaged during shipment or handling even if previously approved before shipment.

Acceptance of the pipe shall not relieve the Contractor of full responsibility for any defects in material or workmanship of the completed pipeline.

10.18.7 Marking: The following shall be clearly marked on the exterior surface of all pipe:

ASTM Specification

Class and size

Date of manufacture

Name of Trademark of manufacturer

10.18.8 Joints: Concrete sewer pipe joints shall conform with the pertaining Paragraphs of this Manual. The joint assemblies shall be accurately formed so that when each section of the pipes are forced together in the trench the



assembled pipe shall form a continuous water tight conduit with a smooth and uniform interior surface, and shall provide for slight movement of any piece in the pipeline due to expansion, contraction, settlement, or lateral displacement. The ends of the pipe shall be in planes at right angles, to the longitudinal center line of the pipe, except where bevel-end pipe is required for the drawings. The ends shall be finished to regular smooth surfaces.

10.18.9 Pipe Lengths: Pipe sections shall be furnished in not less than 3' nominal lengths, except closure pieces and approved specials which may be of shorter lengths.

10.18.10 Concrete Pipe Protection

A. General. All concrete pipe for sanitary sewers shall be protected from chemical attack by the use of protective coatings, linings or other approved means. Coal tar epoxy linings shall be Mainstay or approved equal. Epoxy linings shall have a minimum thickness of 45 mils. Sand filled coal tar epoxy shall have a minimum thickness of 90 mils.

B. Chemical Resistance. Coal tar epoxy linings shall not be affected by the following chemicals:

10% Hydrochloric Acid	1% Commercial Detergent
10% Acetic Acid	5% Sodium Chloride
10% Sulfuric Acid	5% Alum
10% Ammonium Hydroxide	3% Sodium Chloride
10% Sodium Hydroxide	100% Comm. Cooking Oil

5% Commercial Bleach      100% of Mineral Spirits

- C. Adhesive Strength. Coal tar epoxy shall have a minimum of 50 psi adhesive force between the compound and the concrete.
- D. Water Absorption. Coal tar epoxy shall be impervious to water.
- E. External Hydrostatic Resistance. Coal tar epoxy linings shall be able to withstand an external pressure of 25 psi.
- F. Three-Edge Bearing Test. When concrete is tested per ASTM C-76 coal tar epoxy, linings shall be able to span the initial hairline cracks without failure.
- G. Plant Inspection. The pipe lining shall be inspected at the plant with a modified holiday detector Model EP as manufactured by Tinker and Razor or an approved equal. After patching the lining the pipe lining shall be reinspected to insure that the holidays have been patched. After inspection the pipe lining shall be certified free of holidays by the manufacturer.
- H. Field Inspection. A minimum of 5% of the pipe shall be field inspected prior to installation. In the event that an excessive amount of holidays are discovered, all pipe shall be holiday tested prior to installation.

10.18.11 Bedding Requirements: The minimum class of bedding shall be in accordance with the following table. Where minimum cover is less than the values specified in the table, a structural concrete cap

shall be placed over the top of the pipe. The Town Engineer or Director of Public Works shall approve all structural concrete caps prior to construction.

\*The top of the pipe shall be a minimum of 6" below the bottom structural element of the roadway. The minimum wall thickness shall be Class III under all roadways.

18" RCP

Class	ALLOWABLE DEPTHS OF COVER FOR BEDDING CLASS*	
	C Min. - Max.	B Min. - Max.
II	6'	8'
III	2' - 9'	2' - 11'
IV	13'	16'
V	19'	24'

21" RCP

Class	ALLOWABLE DEPTH FOR COVER FOR BEDDING CLASS*	
	C Min. - Max.	B Min. - Max.
II	7'	8'
III	2' - 9'	2' - 11'
IV	13'	16'
V	19'	24'

24" RCP

Class	ALLOWABLE DEPTHS OF COVER FOR BEDDING CLASS*	
	C	B
	Min. - Max	Min. - Max.
II	7'	8'
III	2' - 9'	11'
IV	13'	16'
V	19'	24'

27" RCP

Class	ALLOWABLE DEPTHS OF COVER FOR BEDDING CLASS*	
	C	B
	Min. - Max.	Min. - Max.
II	7'	9'
III	9'	11'
IV	13'	17'
V	19'	24'

10.18.12 Acceptance of the Pipe After Construction: Initial acceptance of the project will be issued after the project has passed all testing required within this Chapter of the Manual. The Town may, at its option, reinspect the project and use closed circuit television to verify that the line is free of defects prior to the warranty expiration. The Contractor shall be responsible for replacing all defective sections of pipe for a period of two years at no expense to the Town. A defective section shall be any section

with excessive infiltration or exfiltration, any section with structural failure, any section with a defect that prevents the designed discharge from flowing through the pipe or any section that would cause an abnormal amount of maintenance due to construction. A Public Works Inspector shall witness each repair or replacement so he can make it part of the permanent record that the defect has been corrected. Final acceptance will be issued at the end of the second year after the initial acceptance and if the line is not defective.

10.19 VITRIFIED CLAY PIPE

10.19.1 General: All pipe materials to be incorporated in the construction of sanitary sewers shall conform to the requirements specified herein or as modified elsewhere in these Specifications.

All material, manufacturing operations, testing, inspection and marking of vitrified clay pipe shall conform to the requirements of ASTM Designation C700 extra strength.

10.19.2 Diameter: The diameter indicated on the drawings shall mean the inside diameter of the pipe.

10.19.3 Wall Thickness and Class of Pipe: All vitrified clay pipe shall be "Extra Strength Clay Pipe" and the minimum allowable wall thickness for the given diameter shall not be less than that set forth in ASTM Designation C700.

10.19.4 Fittings and Specials: Fittings and specials shall conform to the requirements set forth in ASTM Designation C700 extra strength and

shall have the same structural qualities as an adjoining pipe.

10.19.5 Joints: All pipeline joints shall meet or exceed the requirements of ASTM C425 and Section 12.07 of these Specifications. The following joints have been approved for use in the Town of Bennett:

1. PVC Collar Joint. All PVC Collar Joints shall be factory applied and made of PVC resin conforming to ASTM D1784, Class 12454-B.
2. Perma-Joint.<sup>1</sup>
3. Dickey-Joint.<sup>2</sup>

10.19.6 Pipe Lengths: Pipe sections shall be furnished in not less than 3' nominal lengths except service tees, closure pieces and approved specials which may be of shorter lengths.

10.19.7 Marking: The following shall be clearly marked by indentations on the exterior of the pipe near the bell:

- A. "Extra-Strength" or "ES"
- B. Name of Trademark of manufacturer.
- C. ASTM Specification.

10.19.8 Acceptance of Materials: In addition to any deficiencies covered by ASTM Designation C700, clay pipe which has any of the following visual defects will not be accepted:

- A. Improperly formed pipe such that pipe intended to be straight has an

---

1 A product of Denver Brick and Pipe Company

2 A Brand Name

ordinate, measured from the concave side of the pipe exceeding 1/16 inch per foot of length.

- B. Pipe which is out-of-round to prohibit proper jointing.
- C. Improperly formed bell and spigot ends.
- D. Pipe which is fractured, cracked, chipped or damaged in any manner.
- E. Pipe that has been damaged during shipment or handling even if previously approved before shipment.

Acceptance of the pipe at point of delivery will not relieve the Contractor of full responsibility for any defects in material or workmanship of the complete pipeline.

10.19.9 Bedding and Backfill Compaction:  
Bedding and backfill compaction shall meet the requirements of Chapter 6 and the requirements of this Paragraph.

Pipe depths less than 5' and greater than the maximum allowable depth for "B" bedding require special approval of the Town Engineer or Director of Public Works.

Extra Strength

V.C.P.

Pipe Size      Maximum Depth for Bedding Class

	C	B
8"	20'	25'
10"	17'	22'
12"	16'	20'

15"	14'	18'
18"	14'	18'
21"	14'	18'
24"	14'	18'
27"	14'	17'
30"	13'	17'

10.19.10 Acceptance of the Pipe After

Construction: Initial acceptance of the project will be issued after the project has passed all testing required within this Chapter of the Manual. The Town may, at its option, reinspect the project and use closed circuit television to verify that the line is free of defects prior to the warranty expiration. The Contractor shall be responsible for replacing all defective sections of pipe for a period of two years at no expense to the Town. A defective section shall be any section with excessive infiltration or exfiltration, any section with structural failure, any section with a defect that prevents the designed discharge from flowing through the pipe or any section that would cause an abnormal amount of maintenance due to construction. A Public Works Inspector shall witness each repair or replacement so he can make it part of the permanent record that the defect has been corrected. Final acceptance will be issued at the record that the defect has been corrected. Final acceptance will be issued at the end of the second year after the initial acceptance and if the line is not defective.



10.20

UNDERDRAIN PIPE

- 10.20.1 General: Underdrain pipe shall be provided with joints which prevent any shifting or misalignment of the line, or joints which in the opinion of the Town Engineer or Director of Public Works will not allow adequate infiltration or exfiltration. The underdrain system shall in no case be constructed with sealed joints. Underdrain pipe shall be installed for the exclusive advantage of the Contractor or Developer. Underdrains shall not be maintained by the Town of Bennett.
- 10.20.2 Vitrified Clay Pipe: Shall conform with ASTM C700, extra-strength nonperforated, with a minimum of three self-centering lugs (except in 4" size) provided in the bells. 4" Extra Strength Vitrified Clay Pipe conforming with ASTM Designation C700 and installed without gaskets may be used for 4" underdrain pipe.
- 10.20.3 Extra Strength Non-Reinforced Concrete: Conforming with ASTM C-14 nonperforated, with rubber joint construction conforming with ASTM C443 rubber gasket joint construction and support shoulders; except the rubber gasket shall not be installed.
- 10.20.4 P.V.C. Pipe: All PVC pipe shall be nonperforated and conform to ASTM Standard D3034-SDR35. The pipe shall be installed without gaskets and in full compliance with ASTM Standard D2321. The system shall not be watertight.
- 10.20.5 Bedding: Bedding for underdrain pipe in trenches shall meet the general requirements of Class B alternate

bedding with the exception that the trench shall be sub-excavated to a depth of 1' below the flowline of the pipe rather than 1/4 of the outside diameter of the pipe. The underdrain pipe shall be placed on the bottom of the trench approximately 6" from the trench sidewall, and the trench backfilled with tamped granular bedding material to 1' above the pipe. In the event that muck is encountered that will not support the pipe, the trench shall be further sub-excavated and backfilled with 1 1/2" uniformly graded washed rock to within 6" of the underdrain pipe flow line and remainder filled with granular bedding material. The underdrain pipe shall not be placed directly on top of 1 1/2" uniformly graded material.

10.20.6 Alignment: The grade of the underdrain pipe shall be parallel to and 1' below the flow line of the main line pipe. The underdrain shall end in a storm sewer or drainage course. At no time shall an underdrain be unable to drain. The underdrain connection shall be properly grouted into a storm sewer pipe. When emptying into a watercourse, the outlet shall be protected with an approved outlet structure.

10.20.7 Clean Outs: Clean outs shall in no case be installed within a sanitary sewer manhole. Clean outs shall not be the responsibility of the Town of Bennett to maintain. Clean outs shall be constructed in accordance with the Standard details. Clean outs shall be constructed so that no surface load will be transferred to the main, wye, 1/8 bend, or riser pipe. The area around a clean out shall be graded so

that water runs away from the clean out.

10.21

HANDLING AND INSTALLATION FOR SANITARY SEWER PIPES

10.21.1 General: Unless otherwise specified all pipe handling, laying and jointing shall be based upon the manufacturer's recommended practice for installation of each specified type of pipe. Provisions of this section shall supercede and augment those recommendations.

10.21.2 Material Handling: Pipe, fittings, and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground. If any part of the coating or lining is damaged, the Contractor shall repair or replace the material affected at his expense as required by the Town Engineer or Director of Public Works. All pipe and culverts shall be handled in accordance with the appropriate AWWA and ASTM Standards.

Proper implements, tools, and facilities satisfactory to the Director of Public Works shall be provided and used by the Contractor for the safe and convenient prosecution of the work. Every precaution shall be taken to prevent foreign material from entering the pipe. If the pipe-laying crew cannot put the pipe in the trench and in place without getting earth in it, the Engineer may require that before lowering the pipe into the trench, a heavy, tightly-woven canvas bag of

suitable size be placed over each end and left there until the connection is to be made to the adjacent pipe.

During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.

- 10.21.3 Progression of Work: The laying of pipe shall commence at the lowest point and proceed upgrade so that the pipe is laid with the bell ends facing in the direction of laying and at the correct grade and alignment. The pipe shall be placed in such a manner that the specified bedding provides a solid, uniform bearing surface for the full length of the barrel. Bell holes shall be provided at all joints. Equipment used in handling and jointing the pipe shall have adequate capacity to handle the pipe smoothly and assure the proper closure of joints.

All pipe shall be carefully constructed so that when joined together they will form a conduit with a smooth, uniform invert. The pipe shall be laid accurately to the grade and alignment specified on the drawings. Blocking or wedging of the pipe to achieve proper positioning and grade shall not be permitted, except where required for proper construction cradles or encasements.

Stub lines shall not extend over one pipe length from a manhole.

Clean-outs shall not be allowed as a substitute for manholes on sanitary sewer mains.

- 10.21.4 Alignment: All piping shall be constructed to the lines and to the

grades and elevations shown on the approved drawings.

10.21.5 Cradles and Encasements: Prior to placing concrete for cradles or encasement, temporary supports consisting of concrete blocks or bricks shall be used to support the pipe in place. Not more than 2 supports shall be used for each pipe length; one adjacent to the shoulder of the bell, and the other near the spigot end.

10.21.6 Clay Pipe Joints: Prior to installation, all bells, spigots and gaskets shall be thoroughly cleaned and free of foreign particles. An approved lubricant shall be spread around the entire periphery of the gasket to prevent rolling or pinching of the gasket, prior to insertion in the bell. A clean, well-lubricated joint is imperative, to prevent infiltration or exfiltration after installation.

Immediately after the joint has set, and has been inspected and approved, backfill shall be placed to a depth of not less than one foot above the pipe, in accordance with the backfill instructions within Chapter 6 of this Manual.

10.21.7 Concrete Pipe Joints and Installation: All concrete pipe joints shall conform to ASTM C443 Type R-4 and Section 10.08 of these Specifications. Just prior to joining the pipes, both spigot and bell ends shall be thoroughly cleaned with a wire brush to remove all foreign substances which may have adhered to the spigot and bell surfaces. All dust and dirt shall be removed with a clean rag. A lubricating solution which is not unjurious to the gasket, concrete

or steel, such as flax soap or water glass, shall be liberally applied to the gasket groove and to the entire surface of the bell ring. Following this operation, a thin film of lubricant shall be applied to the gasket which shall then be snapped into place in the groove, after which a small diameter smooth steel rod shall be inserted between the gasket and groove and run completely around the gasket to equalize gasket tension.

In the event that any foreign material becomes embedded in the lubricant, or the lubricant becomes contaminated by water or other substances, before the joint is started the area affected shall be recleaned and new lubricant applied.

The pipe being jointed shall be carefully moved into position, line and grade checked, and as the spigot end is started into the bell of the section previously laid, the gasket position shall be checked to insure uniform entry into the bell at all points.

The method by which pressure is applied to force the pipe sections together shall be approved by the Director of Public Works. Before the joint is completely coupled, the position of the gasket in the joint shall be determined by means of a feeler gauge supplied by the pipe manufacturer. The gauge shall be used from the inside of the pipe when the pipes shall be separated and the damaged gasket replaced.

10.21.8 Tees, Wyes, and Risers for Service Connections: The Contractor shall place tees, stubs, and risers where required by the approved construction plans. Wyes shall not be used. Tees shall be

angled upwards so that the upper invert of 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 shall be installed where the elevation of the top of the branch is more than 12' below finished ground. Riser connections shall ordinarily reach to a grade 10' below finished ground surface. Watertight plugs shall be installed in each branch pipe or stub. Tee and riser locations shall be marked with a #20 copper wire with yellow insulation run from the plugged end up 12" below the ground surface and tied off to a 24" piece of 2" by 4" lumber. See the Sanitary Sewer Service Line Construction Specifications for details on service stub-ins and house service connections. As-built measurements shall be made to the nearest manhole before backfilling.

- 10.21.9 Cleaning the Line: When all of the pipes have been installed, the line and manholes shall be cleaned and be free of sand, dirt and debris. If the line must be flushed, it shall be done by use of a high pressure jet or sewer balling method. Care shall be taken to insure that no non-sewage water enters the existing sanitary system. Should the Contractor allow water to enter the existing system, damages to the system, costs of treating the water, and fines in accordance with the Town Code shall be at the Contractor's expense.

10.22

TESTING OF SANITARY SEWER CONSTRUCTION

- A) Compaction Testing. Testing of backfill compaction for sanitary sewer line and manhole installation shall be in accordance

with the specifications for Backfilling and Compaction as specified in Chapter 6 in this Manual.

- B) Visual Inspection. All sanitary sewer lines shall be visually inspected for infiltration, misalignment, broken pipes and other deficiencies.
- C) Sanitary Sewer Pipeline Leakage and Infiltration Testing. General. At the option of the Public Works Director, each section of sanitary sewer between two successive manholes shall be tested for leakage and/or infiltration. These tests shall be performed subsequent to acceptance of backfill compaction test results by the Director. Even though a section of sanitary sewer may have previously passed the leakage or infiltration test, each section of sewer may be tested subsequent to the last backfill compaction operation in connection therewith, wherein the opinion of the Director, heavy compaction equipment or any of the operations of the Contractor or others may have damaged or affected the required watertight integrity of the pipe, structure, or appurtenances. The Contractor shall furnish all materials required for the tests. Tests shall be made in the presence of the Public Works Director. If the leakage and/or infiltration rate as shown by the tests specified herein is greater than the amount specified within this section, the pipe joints shall be repaired, or in necessary, the pipe shall be removed and relaid by the Contractor. The sanitary sewer shall not be considered acceptable until the leakage and/or infiltration rate, as determined by testing, is less than that allowable. The Contractor may at his option air test or water test for leakage except where;
- (a) in the opinion of the Director, excessive groundwater is encountered, then the infiltration test shall be performed, or,



- (b) where the difference in elevation between the invert of the upper manhole and the invert of the lower manhole is more than 10', then the air test shall be made.

10.22.1 Leakage Testing

- A) Water Test. Each section of sanitary sewer between two successive manholes, shall be tested by closing the lower end of the sewer to be tested and the inlet sewer of the upper manhole with plugs or stoppers and filling the pipe and manhole with water to a point 4' above the invert of the open sewer in the upper manhole or to a height of 10' above the invert of the sewer in the lower manhole, whichever gives the least hydrostatic pressure on the lower manhole. The total leakage shall be the decrease in volume in water in the upper manhole. The leakage shall not exceed 0.23 gallons per hour per inch of nominal diameter of sanitary sewer pipe per 100' of sewer pipe being tested. The length of service connections shall not be used when computing the length of sewer main being tested. The leakage limits shall exclude exfiltration of manholes.

If the leakage is shown by the water leakage test as greater than allowed, the pipe shall be overhauled and, if necessary, replaced and re-laid until joints and pipes shall hold satisfactorily under this test. All tests shall be completed before street or trench is resurfaced. The Contractor shall furnish all labor and materials for making the tests required. If components of the

existing sanitary sewer system are used for these tests, the Town shall not be responsible for problems encountered in testing of these components. The Contractor assumes all risks and shall be responsible for repair of damages incurred to such existing components.

- B) Air Test Procedure. Each section of sanitary sewer between two successive manholes shall be tested by plugging all pipe outlets with suitable test plugs. Air shall be slowly added until the internal pressure is raised to 4.0 psig. The compressor used to add air to the pipe shall have a blow-off valve set at 5 psig to assure that at no time the internal pressure in the pipe exceeds 5 psig. The internal pressure of 4 psig shall be maintained for at least 2 minutes to allow the earth temperature to stabilize, after which the air supply shall be disconnected and the pressure allowed to decrease to 3.5 psig. The time in minutes that is required for the internal air pressure to drop from 3.5 psig to 2.5 psig shall be measured and the results compared with the values listed in the following table.

Pipe Diameter (inches)	Test Time Minutes	Minimum Distance between Manholes (feet)
8	4	340
10	5	260
12	6	230
15	7	170
18	9	150

The above-tabulated value shall be used for the respective diameter pipes except where the distance between successive manholes is less than the above-tabulated values, in which case the following formula shall be used to determine the test time:

$$T = 0.000183 d^2 L$$

T = test time, in minutes

D = inside diameter of pipe, in Inches

L = distance between successive manholes in feet

If the pressure drop from 3.5 psig to 2.5 psig occurs in less time than the above tabulated or calculated values, the pipe shall be overhauled and, if necessary replaced and re-laid until the joints and pipe shall hold satisfactorily under this test.

An air pressure correction is necessary when the prevailing groundwater is above the sewer line being tested. Under this condition, the air test pressure shall be increased 0.433 psig for each foot the groundwater level is above the invert of the pipe. If the prevailing groundwater is more than 2' above the invert of the pipe, the infiltration test shall be used. Thus, internal air pressure should never exceed 5.0 psig. If components of the existing sanitary sewer system are used for the test, the Town is not responsible for problems encountered in testing of these components. The Contractor assumes all risks and shall be

responsible for repair of damages incurred to such existing components.

10.22.2 Infiltration Testing: If, in the construction of a section of the sanitary sewer between manholes, excessive groundwater is encountered, the test for leakage shall not be used, but instead, the end of the sewer at the upper manhole shall be closed sufficiently to prevent the entrance of water and, pumping of groundwater shall be discontinued for at least three days after which the section of sanitary sewer lines shall be tested for infiltration. The infiltration shall not exceed 0.16 gallons per hour, per inch of diameter, per 100' of sanitary sewer line being tested or as indicated in the following table, where the computed length does not include the length of sewer service laterals entering that section of line. Where any infiltration in excess of this amount is discovered before completion and acceptance of the sewer, the sewer shall be immediately uncovered and repair or modifications shall be made as required to reduce the amount of infiltration a quantity within the specified amount of infiltration before the sewer is accepted, at the expense of the Contractor. Should, however, the infiltration be less than the specified amount, the Contractor shall stop any individual leaks that may be observed when directed to do so by the Director of Public Works. The Contractor shall furnish all labor and materials for making the tests required. All tests shall be completed before street or trench is resurfaced. If components of the existing sanitary sewer system are used for these tests, the Town is not responsible for

problems encountered in testing of these components. The Contractor assumes all risks and shall be responsible for repair of damages incurred to such existing components.

Allowable Limits of Infiltration  
(200 gallon/inch diameter/mile/day or  
0.16 gallon/inch diameter/100  
feet/hour)

Diameter of Sewer (inches)	Infiltration gallons/hour/100 feet (gallons)
8	1.3
10	1.6
12	1.9
15	2.4
18	2.8

10.22.3 Manhole Leakage Test: Manholes shall be tested for leakage separately from the sanitary sewer pipe. The sewer pipes entering the manhole shall be plugged. If the groundwater table is below the invert of the manhole, the manhole shall be filled with water to a depth of 5' above the invert. If the groundwater table is above the invert of the manhole then the manhole shall be filled to a level at least 3' above the groundwater table or to the top of the uppermost precast manhole section, whichever is less, but not less than 5' above the manhole invert. After soaking for one hour, the manhole shall be filled to the original level. It shall then be tested for 2 hours. The allowable drop of water shall be  $\frac{1}{4}$ ". No manhole shall be accepted that has any visible infiltration when empty. At least 20 percent of all manholes shall be tested. Based upon these tests, and visual inspection of all manholes, additional tests may be

required for other manholes. Any manhole testing unsatisfactorily shall be repaired and retested until satisfactory results are obtained.

10.22.4 Tests for Alignment and Grade, and Damaged or Defective Pipe in Place:  
After the sanitary sewer pipe has been installed, tested for leakage, backfilled, manhole raised to grade, the Director of Public Works will "lamp" or television (TV) inspect all lines. All defective portions of the new sanitary sewer facilities will be noted to the Contractor after the lamping or TV operation is complete. All lines shall be flushed and manholes cleaned by the Contractor prior to lamping TV procedure. At the request of the Director, the line shall be "balled" to remove dirt, rocks or other foreign matter not removed during the flushing operation. No flushed water or material shall be discharged to existing sewer lines.

In case there is still some question as to the condition of the sanitary sewer line, the Director may require that pictures be taken of the interior of that portion of the sewer line under question. After pictures have been interpreted by the Director, should the sewer line be interpreted to be defective, the cost of taking the pictures shall be borne by the Contractor. Should the sewer line be interpreted as being acceptable, the cost of taking the pictures shall be borne by the Town. All pictures shall become the property of the Town after interpretation.

Final acceptance of the sanitary sewer lines and related facilities shall not be granted until all tests are

successful and all items listed for correction by the Director have been accomplished by the Contractor.

- 10.22.5 Collaring Procedure: Joints that allow infiltration or exfiltration may be collared in lieu of replacement only by the approval of the Town Engineer or Director of Public Works. If collaring is permitted the following procedure shall be used. The pipe shall be wrapped with an adhesive material to seal the joint. A concrete collar shall then be placed a minimum distance of 8" on either side of the joint and a minimum thickness of 6" around the entire section. Pipes with structural damage such as cracks shall not be collared, but shall be replaced.
- 10.22.6 Acceptance by the Town: The pipeline system may be placed in operation after all required cleaning, testing and inspection have been completed and written permission has been granted by the Director of Public Works. However, final acceptance of the system by the Town will not take place for a period of two (2) years from the date written permission is granted. During this two year period, any defects in the system resulting from defective materials, poor workmanship or any other cause attributed to the Contractor responsible for the construction of the system shall be corrected at his expense, and to the satisfaction of the Director of Public Works. The Town may reinspect a sewer line by closed circuit television prior to final acceptance. Any defects revealed by this inspection shall also be corrected by the Developer prior to final acceptance.

SANITARY SEWER SERVICE LINES

10.23.1 General: All sanitary sewer lines connecting with the Town of Bennett's sanitary sewer system shall adhere to this section, the Sanitary Sewer Main Construction Specifications and the Uniform Plumbing Code.

- A) Location and Connections. Sanitary sewer service lines shall be constructed on the shortest and straightest route possible and in accordance with the specifications contained in the Sanitary Sewer Design Criteria Section. Sanitary sewer lines which are designed for residential subdivisions shall have tees included in the main for service lines. The tees are to be located at approximately the middle of the lot to be served. The service lines are to be constructed in conjunction with the sanitary sewer mains and are to be installed to a point 6' inside the property line and plugged. The sanitary sewer service line shall be laid not less than the minimum grade as required by the Uniform Plumbing Code. Service lines shall enter the main at an angle of 90° or less to the main upstream of the connection, as shown in the Service Wye Detail. No sewer service line shall enter the main against the flow in the main. In the event that there is need for additional service line connections once the sewer main has been installed, or a need to tap into an existing main, such service line connections shall be performed by the Town and the cost billed to the Contractor. The Contractor shall coordinate said



connections with the Director of Public Works. Also see paragraph 10.11 of this Chapter.

- B) Separation. Sanitary sewer service lines shall be located at least 10' measured horizontally from all re-use and water service lines. At no time shall the service line be any closer than 5' to the side property line, and no service line may be constructed through or in front of any adjoining property. Service line shall be located 5' toward the low side of the lot from the centerline of the lot and at least 10' horizontally from the water service.
- C) Staking of Location. The Consultant or Contractor shall place a grade stake locating each sewer service before it is installed. Both the tee and the end of the service shall be so staked. Where all taps are made, the Contractor shall keep accurate records of service connections including location, elevation of the service at the property line, and type of connection provided. Service connections shall be located with respect to the survey line stationing and/or house corners or lot corners, where service lines are not be connected immediately after installation of the tap to the main. The Contractor shall furnish and set 2 marker posts. One marker post shall be buried a minimum of 3' and shall extend a minimum of 2' above the ground surface and shall have a piece of green flagging at the top or painted green. The second marker shall extend from the end of

the stubbed service line to 18" below the existing surface. The marker posts shall be wood 2 x 4's, 4 x 4's or No. 4 Rebar.

- D) Notification. If the sanitary sewer service of any existing customer may be affected by a service connection or reconnection to a new or existing sewer, the existing customer shall be given a 24 hour notice by the Contractor stating when and for how long service may be interrupted.

10.23.2 Tapping the Main

- A) General. Whenever the diameter of the service line is equal to or greater than 75% of the sewer main, a manhole shall be installed in place of a servicetap. The Public Works Representative shall inspect the main, the saddle and the service line up to the building at every tap or tee prior to backfilling. A three-hour notice must be given to the Public Works Inspector prior to an inspection. In the event the tap and service line are covered before it is inspected, it shall be dug out by the Contractor, and any concrete or mortar around the filling shall be removed to allow visual inspection of the tap and the main. If the main sewer line is cracked or broken during the process of locating or tapping, it shall be repaired immediately, either by replacing the broken section or by placing a minimum of 9" of concrete above, at the sides, and below the main pipe parallel for the width of the excavation. Wyes shall not be used at any time.

A manhole shall be installed instead of a service tap when a 6" connection is to be made to an 8", or any time that the service main is equal to or greater than  $\frac{1}{4}$  the diameter of the main, and always when a tap is required on a reinforced concrete line. Service lines shall not empty directly into a manhole unless the manhole has been specifically and exclusively constructed for the serviceline.

- B) V.C.P. Mains. Where tees have not been installed in the main sewer, the main shall be tapped by machine drilling a hole in it the size to fit the saddle for the service line. The drilling machine and method of drilling shall be approved by the Director of Public Works.
- C) P.V.C. Mains. Where P.V.C. tees have not been installed in the main, a P.V.C. saddle tee shall be installed in accordance with the manufacturer's recommendations and these specifications. A keyhole, saber saw or shell cutter shall be used to cut a hole in the P.V.C. main. The hole and saddle shall be installed so that nothing will catch on the connection. All edges shall be filed smooth. The surfaces to be jointed shall be wiped clean, etched and the primer applied. With primer still wet, apply the approved cement and install the saddle. The saddle shall be drawn down with metal straps or other approved means.
- D) Ductile Iron or Cast Iron Mains. Where cast iron tees have not been installed in the sewer main, the main shall be tapped by machine drilling a hole in it of a size

which will fit a saddle for the service line. The drilling machine and method of drilling and the saddle shall be approved by the Director of Public Works. The saddle shall be sealed when attached to the main and held in place with metal straps or other approved means. The saddle and sewer main shall be encased in concrete.

- E) Concrete Mains. Concrete mains shall not be tapped. A manhole in accordance with these Specifications shall be installed to provide sewer service.

10.23.3 Service Line Installations: In general, all installation work shall conform to applicable portions of ASTM C12 and to the pipe manufacturer's installation instructions.

Pipe shall be laid in accordance with the pertaining Town of Bennett Standards and Sewer, re-use and water service lines must be a minimum of 10' apart horizontally or concrete encasement of the sewer line will be required. The pipe shall be protected during handling against impact shocks and the joint material shall be protected from damage at all times. The grooves shall be cleaned so as to be free from all foreign materials prior to assembling the joint and the compression ring shall be placed on the pipe in the trench. The pipe shall be laid with the spigot ends pointing in the direction of flow.

All joints shall be watertight. Jointing dissimilar materials like clay pipe to ductile iron pipe shall be done by means of a "Can-Tex" adapter or other approved method. Trenches shall

be kept free of water during laying and jointing. The minimum grade of a line built with pipe sections 8' long or less shall be 2.00% or ¼" per foot. The minimum grade of a line built with pipe sections over 8' long shall be 1.00% or 1/8" per foot. The Public Works Representative shall have the authority to require that the exact grade of the line be determined prior to backfilling the trench. Lines longer than 50' shall be laid with batter boards, a laser, or other means approved by the Public Works Representative. The grade and alignment on service lines longer than 50' shall be verified to be straight and the exact gradient shall be determined.

Whenever a sanitary sewer service line will be under a paved parking area or under a driveway, the line shall be constructed using only polylined ductile iron pipe.

- 10.23.4 Clean Outs: Clean outs shall be constructed in accordance with the Standard details. Clean outs shall be constructed so that no surface load will be transferred to the main, wye, 1/8 bend, or riser pipe. The area around a clean out shall be graded so that water runs away from the clean out.
- 10.23.5 Sidewalk or Curb Crossing: In no instance, shall a trench extend beneath an existing sidewalk or curb. The pipe must be bored, jacked, or tunneled through the earth under the curb or sidewalk.
- 10.23.6 Service Stub-In to Property Line: Service stub-ins shall be extended at least to property line and be plugged with a compression stop. The end shall

be blocked up to the surface.

10.23.7 Trench Backfilling: Backfilling shall be in accordance with Chapter 6 of this Manual with the exception that the compaction test on the service trench must be approved by authorized Town of Bennett Public Works personnel prior to patching the street.

10.23.8 Discontinuation of Sewer Service: Whenever a sewer service will be discontinued for a period longer than 6 months, the service line shall be uncovered at the sewer main and the service connection removed and sealed with concrete. A Public Works Representative shall inspect the disconnection prior to backfilling the hole. Backfilling shall be in accordance with Chapter 6 of this Manual.

Should the sewer service be scheduled to be returned to service within 6 months, in lieu of disconnection at the main, the service line shall be disconnected by removing a 1' section of the service line directly inside the property line and the end sealed with concrete. The Public Works Representative shall inspect the disconnection prior to backfilling.

10.23.9 Inspection: All work from the sanitary sewer main up to the building shall be inspected by the Public Works Representative who shall have the authority to halt construction when, in his opinion, these Specifications or proper construction practices are not being adhered to. Whenever any portion of these Specifications is violated, the Public Works Representative shall, in writing, order further construction to cease until all deficiencies are

corrected. A copy of the order shall be filed with the Contractor's license application for future reviews. If deficiencies are not corrected, performance shall be required of the Contractor's surety. No pipe fittings or connections shall be covered until approved by the Public Works Inspector. The Town of Bennett's Public Works Department shall be notified 3 hours in advance of the time when inspection is required.

- 10.23.10 Maintenance of Traffic: Interference with traffic shall be avoided at all times. Adequate barricades, signs and warning devices shall be placed and maintained until the site is restored to its condition prior to construction

10.24 CONSTRUCTION SITE RESTORATION

10.24.1 Work in Improved Areas

- 10.24.1.1 General. The Contractor shall restore or replace all removed or damaged paving, curbing, sidewalks, gutters, sod, shrubbery, fences, irrigation ditches, pipe or other structures or surfaces at least equal to the condition before the work began and to the satisfaction of the Director of Public Works. Surplus materials, tools, and temporary structures shall be removed by the Contractor. All dirt, rubbish, and excess earth from excavations shall be disposed of by the Contractor and the construction site shall be left clean and orderly. Construction done on private property shall be restored to a condition at least equal to that before the work began and to the approval of the Director of

Public Works. Prior to replacement, all broken edges of paving and concrete shall be saw cut as directed by the Director of Public Works. The subgrade for all restored surfaces shall be thoroughly compacted. The cost of replacement work and removal of all debris from the site of the work shall be at the expense of the Contractor.

10.24.1.2 Concrete Work. All concrete used in the restoration work including all curb, gutter and sidewalk replacement work shall conform to the requirements set forth in the Town of Bennett, Roadway Design and Construction Standards, or to the requirements of the Street or Highway Department having jurisdiction.

10.24.1.3 Pavement Replacement. All street pavement removed during a day's operation shall be repaired by the end of the day. In lieu of permanent surfacing a 1 1/2" temporary cold mix patch may be installed. Pavement removed on local streets only may be maintained to surface grade with road base material. This may only be done if

- (1) the permanent surfacing is installed within 2 weeks;
- (2) dust or mud does not become a problem; and
- (3) no condition exists which would cause discontent to motorists, pedestrians or residents.

Permanent or temporary surfacing shall be installed and maintained as required by the Director of Public Works. If the Contractor



fails to give timely response to the Director's request for installation or maintenance of the surfacing, the Director shall arrange for the required work to be done at the Contractor's expense.

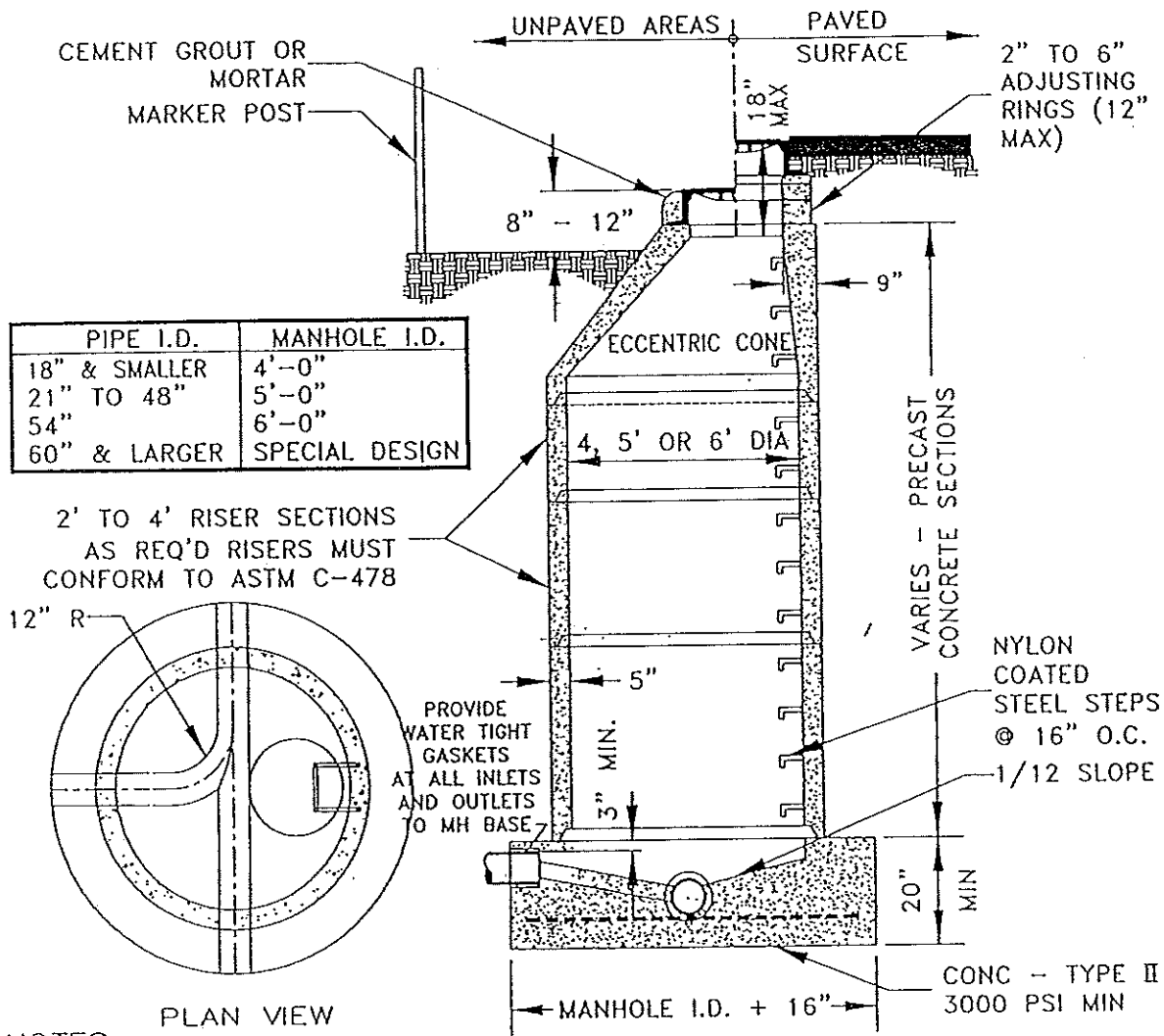
10.24.2 Unfavorable Weather Conditions:  
Whenever weather conditions are not favorable for permanent surfacing, the Director of Public Works may require that temporary bituminous cold mix street surfacing 1 1/2" thick be placed over the backfilled and compacted trench in all paved streets and leveled with the existing pavement. This surfacing shall be removed by the Contractor at a later date when weather conditions permit and replaced with permanent hot mix bituminous paving. The permanent work shall not be started until favorable weather conditions exist. As the temporary cold mix surface settles or is displaced by traffic, it shall be replaced immediately and the surface maintained level with the existing pavement until such time as the Contractor is permitted to place the permanent surface.

10.24.3 Permanent Street Surfacing: Where applicable, permanent street surfacing shall consist of an approved concrete mix or of a hot mix asphalt. The permanent asphalt surface replacement will have an asphalt depth 1" or more greater than the sum of the existing surface course and the base course section, but shall, in no case, be less than 9". If the sum of the existing surface course and the base course section is in excess of 12", the Director of Public Works will be notified and the replacement asphalt

depth will be installed as required by the Director. The hot mix asphalt surface shall be placed in 3 or more lifts not to exceed 4" per lift. Each lift shall be compacted to a minimum density of 140 pcf. The final lift shall be feathered 1' on both sides of the street cut. All permanent asphalt of concrete work shall conform to the requirements set forth in the Town of Bennett, Roadway Design and Construction Standards, or to the requirements of the street or highway department having jurisdiction. All manholes and valve boxes shall be brought to final street grade prior to surfacing.

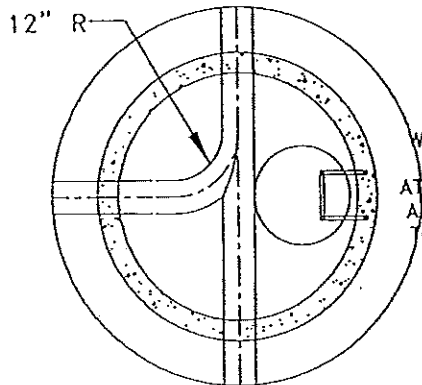
The permanent concrete patch shall be doweled into the existing concrete road surface by means at 16" long. #4 rebar sections spaced at intervals of 12".

All manholes and valve boxes shall be brought to final street grade prior to surfacing.



PIPE I.D.	MANHOLE I.D.
18" & SMALLER	4'-0"
21" TO 48"	5'-0"
54"	6'-0"
60" & LARGER	SPECIAL DESIGN

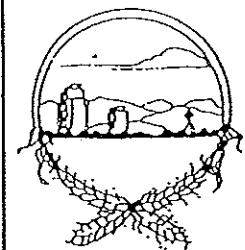
2' TO 4' RISER SECTIONS  
AS REQ'D RISERS MUST  
CONFORM TO ASTM C-478



PLAN VIEW

NOTES:

1. BARREL DIAMETER SHALL CONFORM TO THE TABLE ABOVE.
2. FLAT CONCRETE MANHOLE TOPS MAY BE USED INSTEAD OF CONE SECTIONS WHERE RIM TO INVERT IS 7'-0" OR LESS.
3. SET EACH ADJUSTING RING IN A FULL BED OF BITUMINOUS MASTIC (RAMNECK) OR PLASTIC SEALING COMPOUND.
4. MANHOLE STEPS SHALL BE POSITIONED OVER THE BENCH IN A VERTICAL LINE.
5. ON STRAIGHT THROUGH GRADES, SEWER MAINS MAY BE LAID THROUGH THE MANHOLE & USED AS THE INVERT. THE TOP 1/2 PORTION OF THE PIPE SHALL BE CUT AWAY TO A NEAT LINE. ANY BROKEN EDGES SHALL BE PLASTERED SMOOTH WITH CONCRETE MORTAR. IF GRADE IS NOT STRAIGHT THROUGH, THE FLOWLINES AT THE BASE SHALL BE HAND FORMED WHEN THE BASE IS POURED. FLOWLINES SHALL BE GROUND SMOOTH WITH A CONCRETE FINISHING STONE.
6. GROUT ALL INSIDE JOINTS WITH CONCRETE MORTAR.
7. MANHOLE LID SHALL BE 1/4" TO 1/2" BELOW ASPHALT AND TIPPED TO CONFORM WITH PAVEMENT SLOPES.



SEWER MANHOLE

Town of Bennett

Issued: \_\_\_\_\_

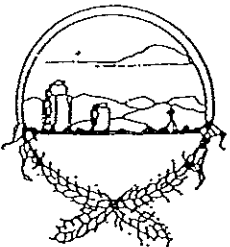
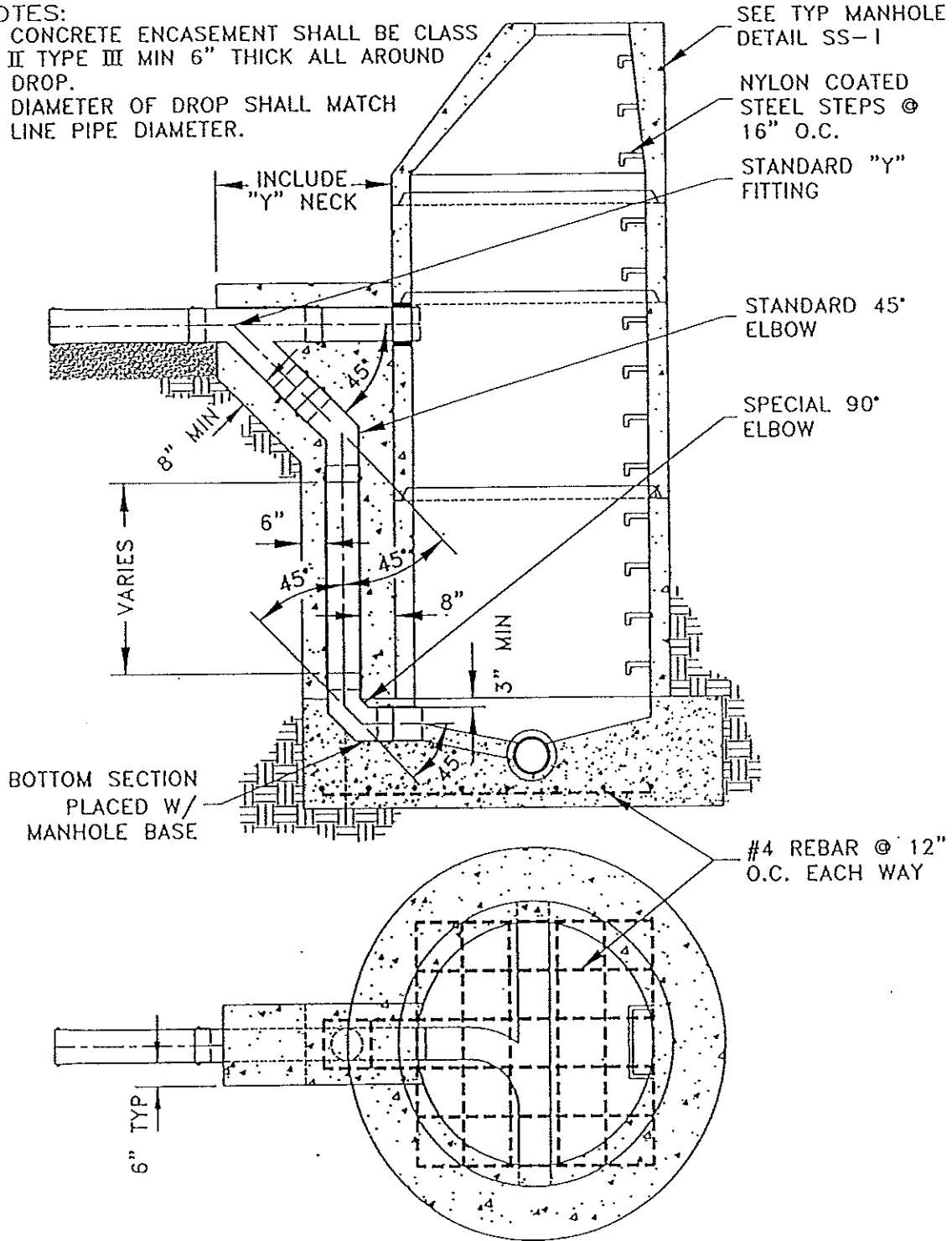
Revised: \_\_\_\_\_

Drawing No.

SS-1

NOTES:

1. CONCRETE ENCASEMENT SHALL BE CLASS II TYPE III MIN 6" THICK ALL AROUND DROP.
2. DIAMETER OF DROP SHALL MATCH LINE PIPE DIAMETER.



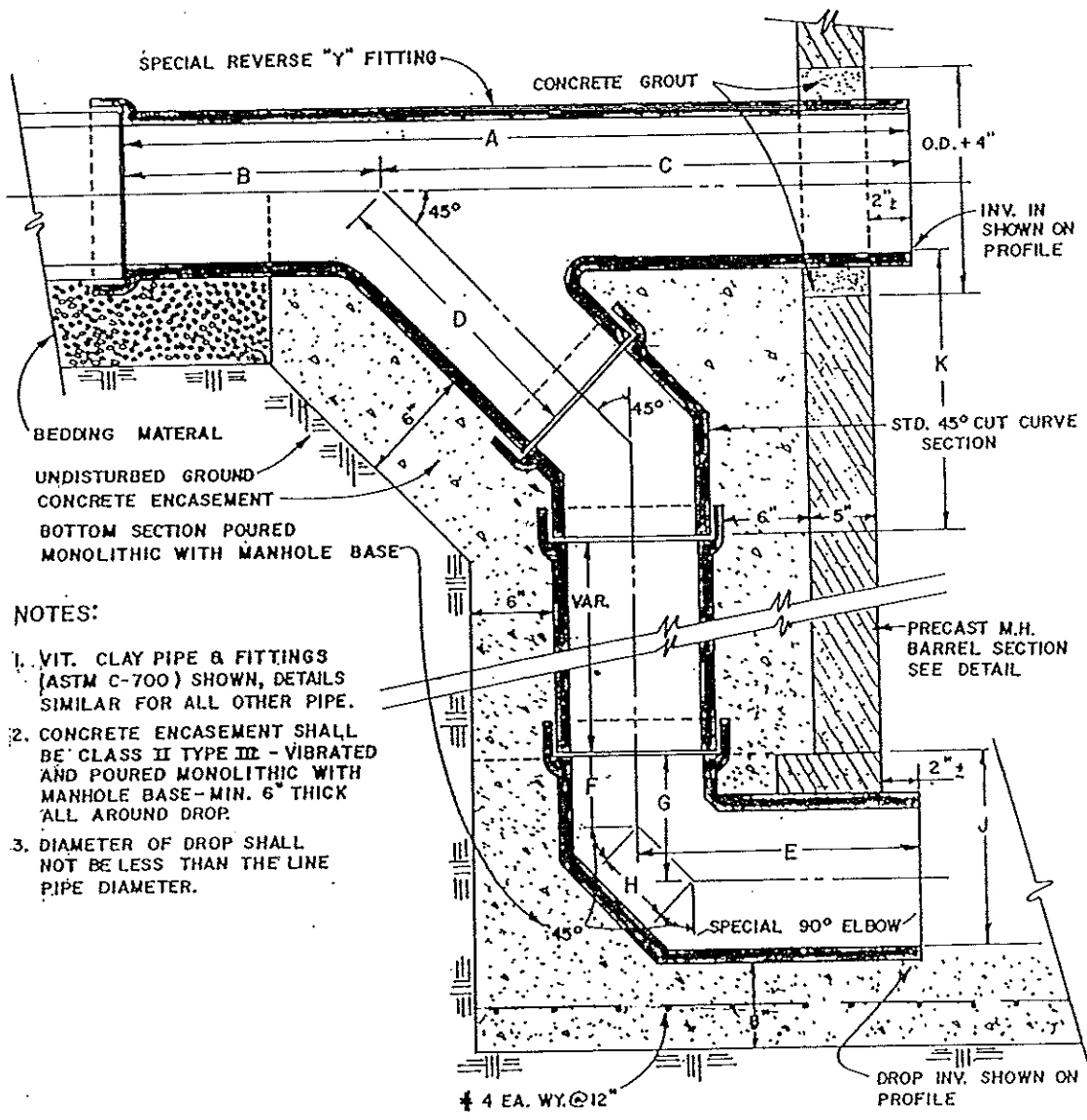
OUTSIDE DROP MANHOLE

Town of Bennett

Issued: \_\_\_\_\_

Revised: \_\_\_\_\_

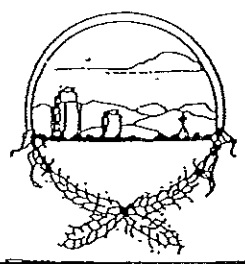
Drawing No.  
SS-2



**NOTES:**

1. VIT. CLAY PIPE & FITTINGS (ASTM C-700) SHOWN, DETAILS SIMILAR FOR ALL OTHER PIPE.
2. CONCRETE ENCASEMENT SHALL BE CLASS II TYPE III - VIBRATED AND POURED MONOLITHIC WITH MANHOLE BASE - MIN. 6" THICK ALL AROUND DROP.
3. DIAMETER OF DROP SHALL NOT BE LESS THAN THE LINE PIPE DIAMETER.

PIPE I.D.	A	B	C	D	E	F	G	H	J	K	J+K
8"	60"	26"	34"	18"	21"	4 1/2"	8"	4 3/8"	12"	15 7/8"	27 1/8"
10"	60"	20"	40"	21"	21"	5 1/8"	9"	5 1/2"	14"	18 1/2"	32 1/2"
12"	60"	18"	42"	24"	21"	5 7/8"	10 3/4"	5 7/8"	16 3/4"	21"	37 3/4"
15"	78"	38"	50"	30"	24"	7"	12 1/2"	7 3/4"	20"	25 7/8"	45 7/8"

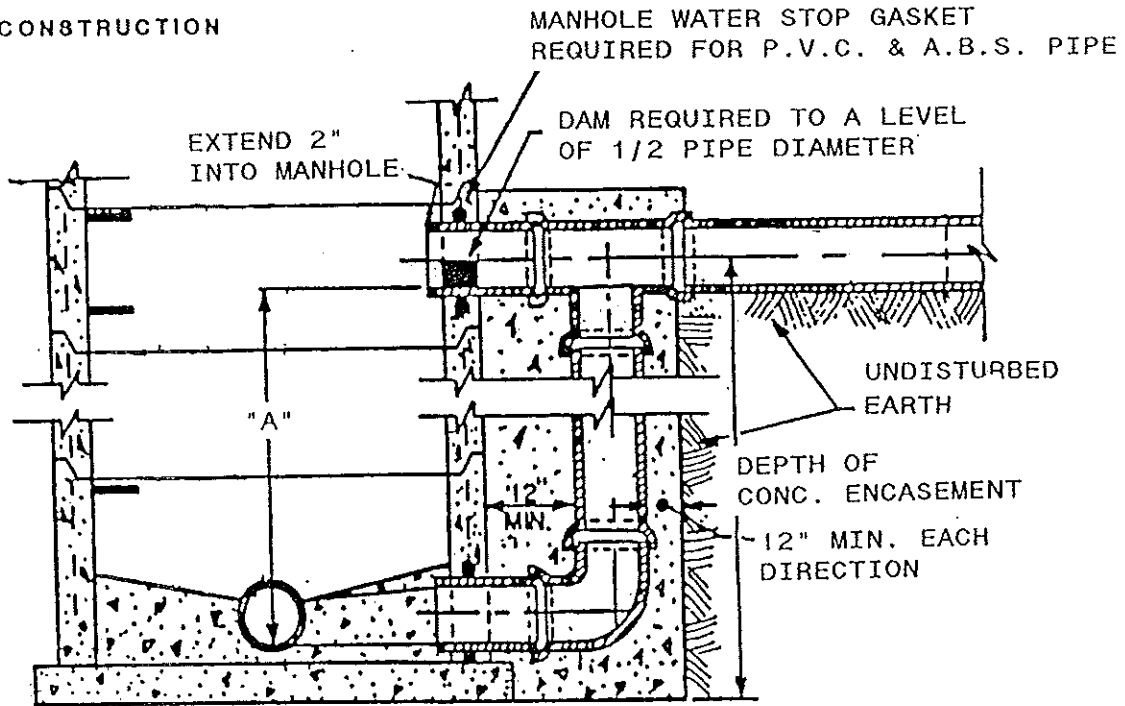


OUTSIDE DROP MANHOLE  
FOR PIPE 15" & SMALLER

Town of Bennett

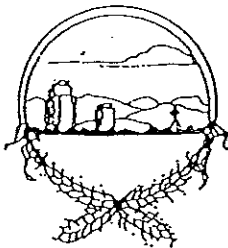
Issued: \_\_\_\_\_  
 Revised: \_\_\_\_\_  
 Drawing No. SS-3

SEE TYPICAL MANHOLE DETAIL  
FOR DETAILS OF MANHOLE  
CONSTRUCTION



NOTE:

DROP MANHOLES ARE REQUIRED  
WHEN "A" EQUALS OR EXCEEDS 2 FT.



DROP MANHOLE DETAIL

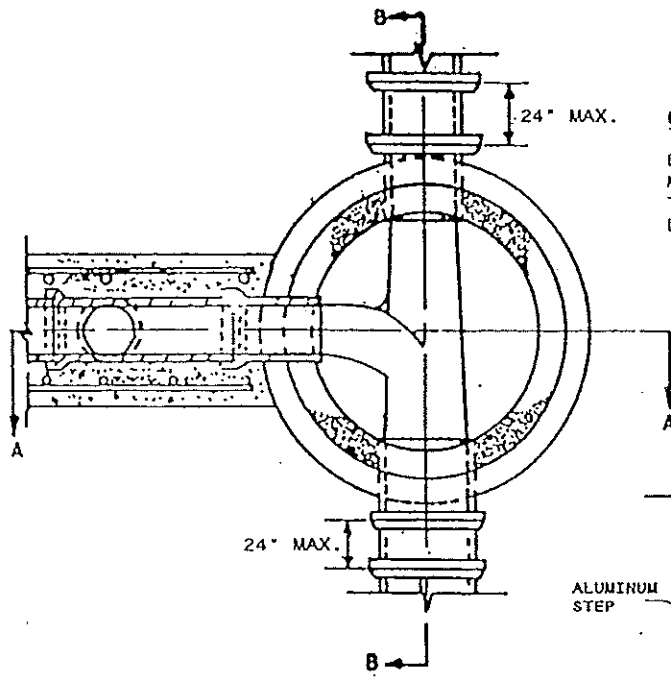
Town of Bennett

Issued: \_\_\_\_\_

Revised: \_\_\_\_\_

Drawing No.

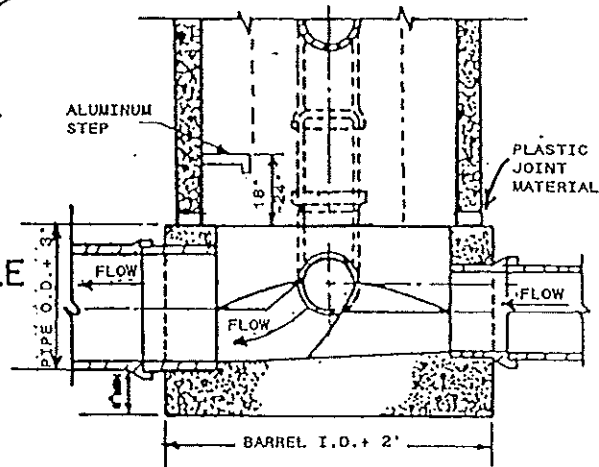
SS-4



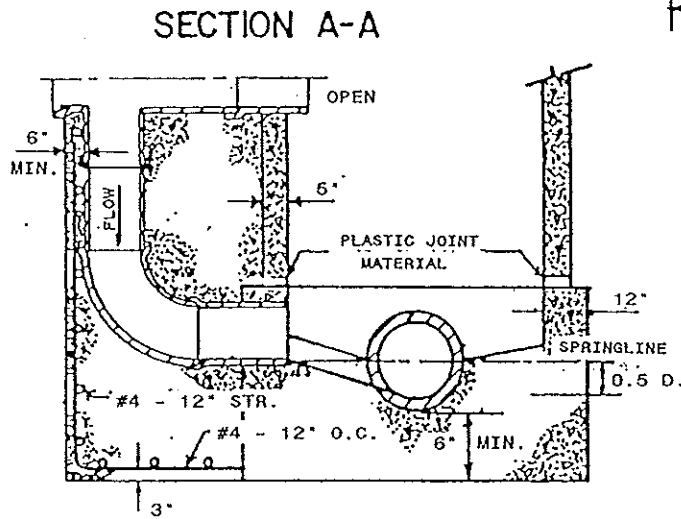
PLAN OF  
DROP MANHOLE  
BASE

DROP MANHOLE ALTERNATE

DUCTILE OR CAST IRON FITTINGS AND PIPE  
MAY BE USED IN PLACE OF ENCASEMENT.  
THE DUCTILE OR CAST IRON SHALL EXTEND ONE  
LENGTH FROM THE MANHOLE.



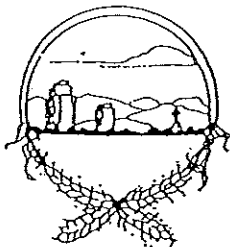
SECTION B-B



SECTION A-A

NOTES

1. STRAIGHT SECTIONS MAY BE LAID THROUGH THE MANHOLE WITH THE CROWN REMOVED.
2. SECTIONS NOT LAID THROUGH THE MANHOLE SHALL DROP A MIN. OF 0.2 FT.
3. BENCHES SHALL SLOPE 2 in.
4. THERE SHALL BE A JOINT MADE AT THE EDGE OF THE MANHOLE BASE.
5. THE OUTSIDE WALLS SHALL BE FORMED TO THE DESIGNED SHAPE.
6. THE TOP OF THE BASE SHALL BE LEVEL IN ALL CASES.



MANHOLE BASE DETAIL

Town of Bennett

Issued: \_\_\_\_\_

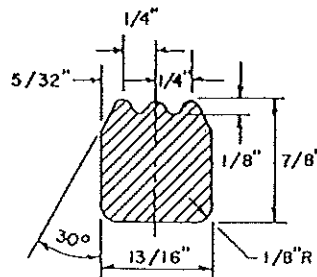
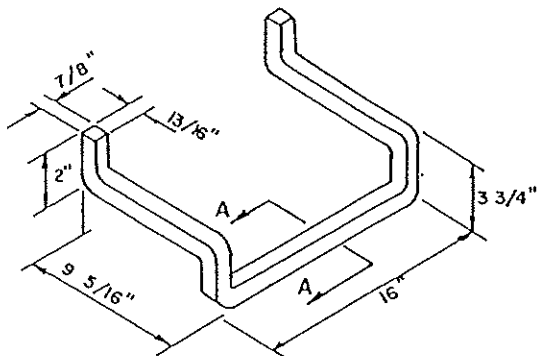
Revised: \_\_\_\_\_

Drawing No.

SS-5

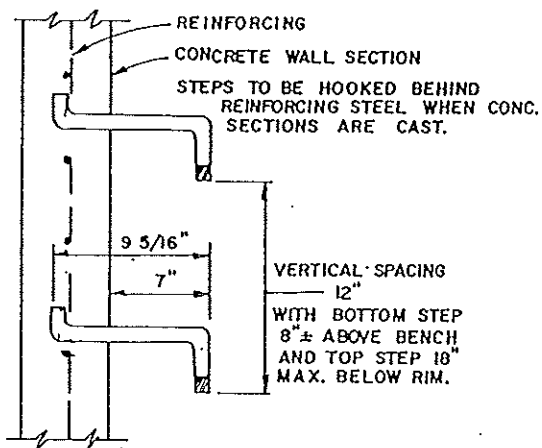






SECTION A-A

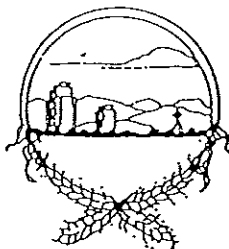
ALUMINUM STEP



TYPICAL INSTALLATION

NOTES:

1. ALUMINUM ALLOY SPECIFICATIONS
  - A. FED. SPEC. QQ-A-200/B
  - B. MIN. TENSILE STRENGTH = 38,000 PSI
  - C. MIN. YIELD STRENGTH = 35,000 PSI
  - D. MIN. ELONGATION = 10% IN 2"
2. MIN. LOAD CAPACITY (APPLIED CENTER OF STEP)
  - A. 1,000 LB. WITH 6" PROJECTION FROM WALL
  - B. 1,500 LB. WITH 4" PROJECTION FROM WALL
3. WEIGHT PER STEP = 2.23 LBS.
4. STEPS TO BE CAST, UNALTERED, IN MANHOLE WALL IN A STRAIGHT LINE, VERTICALLY, AT THE SAME TIME THE BARREL OR CONE SECTIONS ARE CAST.
5. THE PORTION OF THE STEPS EMBEDDED IN THE CONCRETE SHALL BE COATED WITH BITUMINOUS MATL. AS SPECIFIED OR APPROVED.



STANDARD ALUMINUM  
MANHOLE STEPS

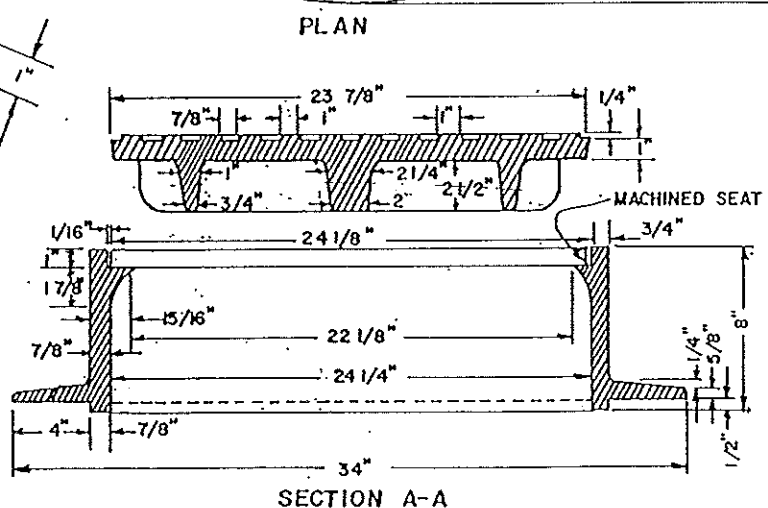
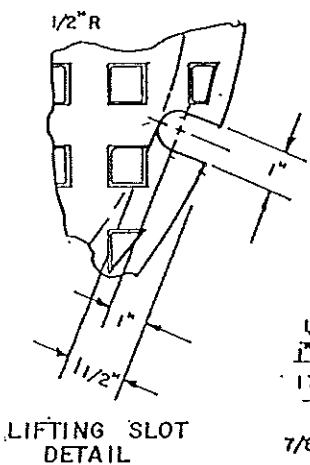
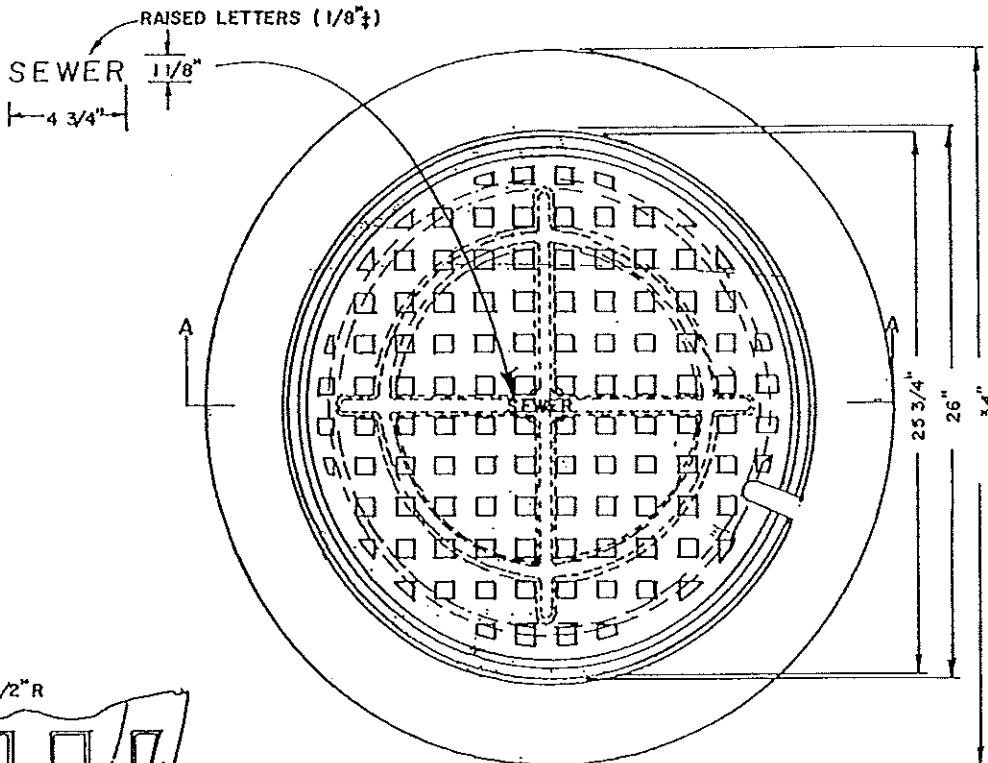
Town of Bennett

Issued: \_\_\_\_\_

Revised: \_\_\_\_\_

Drawing No.

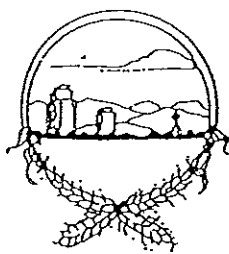
SS-7



**NOTE:**

1. CASTING SPECIFICATIONS: ASTM A-48 WITH A MINIMUM TENSILE STRENGTH OF 25 KSI (CLASS 25)
2. ALL CASTINGS TO BE DIPPED IN ASPHALT BASE PAINT (OR APPROVED EQUAL)
3. CASTINGS SHALL BE AS SPECIFIED BELOW OR EQUAL:

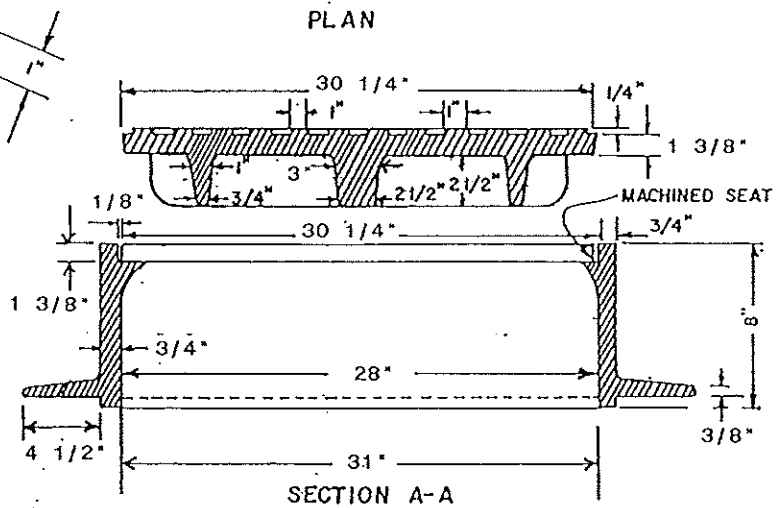
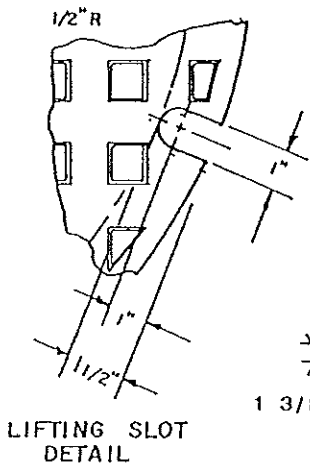
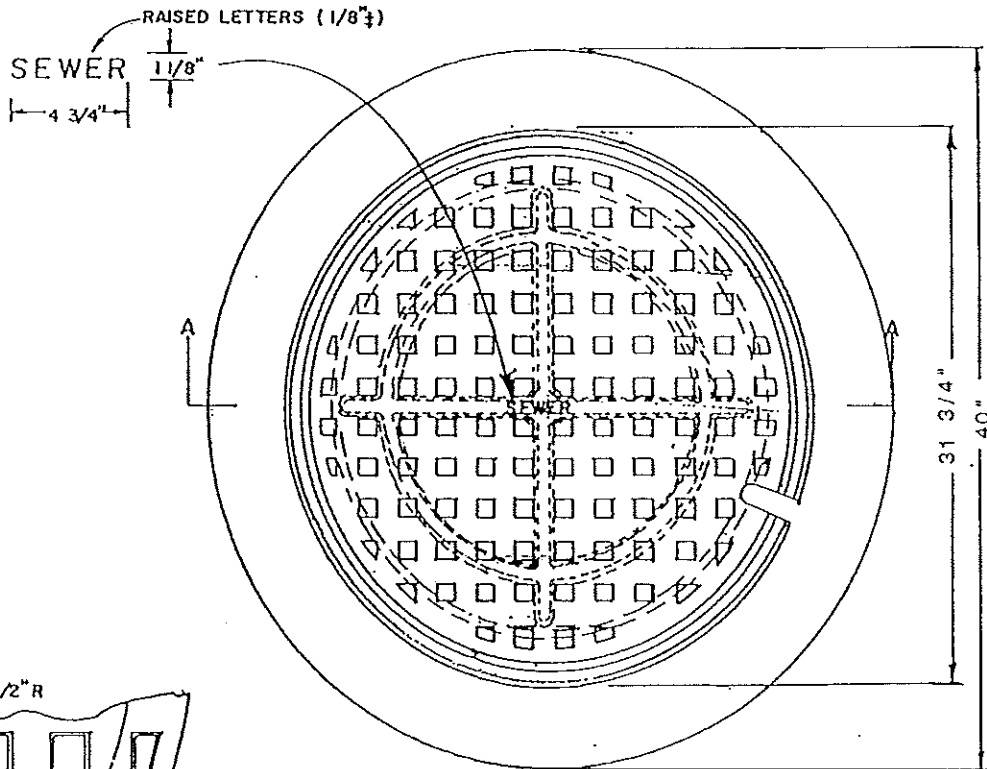
MANUFACTURER	CATALOG
COMCO FOUNDRY INC.	C-1161
HUTCHINSON FOUNDRY & STEEL INC.	MH-400



**24" MANHOLE RING AND COVER**

**Town of Bennett**

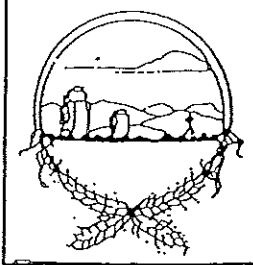
Issued: \_\_\_\_\_  
 Revised: \_\_\_\_\_  
 Drawing No. **SS-8**



**NOTE:**

1. CASTING SPECIFICATIONS: ASTM A-48 WITH A MINIMUM TENSILE STRENGTH OF 25 KSI (CLASS 25)
2. ALL CASTINGS TO BE DIPPED IN ASPHALT BASE PAINT (OR APPROVED EQUAL)
3. CASTINGS SHALL BE AS SPECIFIED BELOW OR EQUAL:

MANUFACTURER	CATALOG
COMCO FOUNDRY INC.	C-1360
HUTCHINSON FOUNDRY & STEEL INC.	



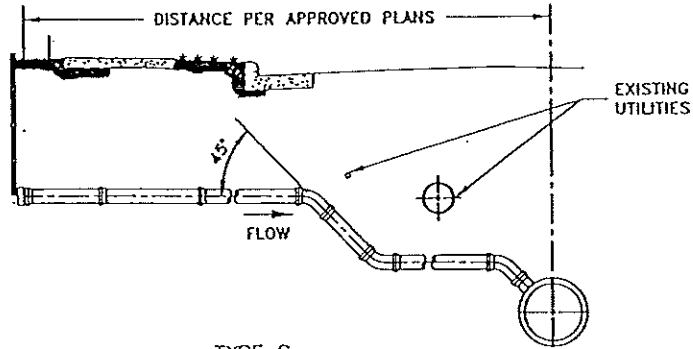
30" MANHOLE  
RING AND COVER

Town of Bennett

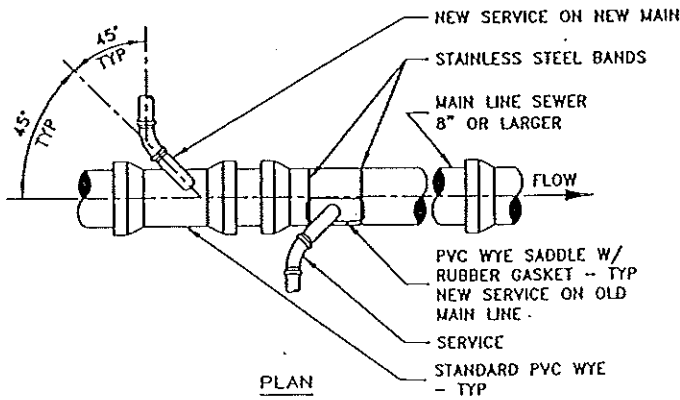
Issued: \_\_\_\_\_  
 Revised: \_\_\_\_\_  
 Drawing No.  
 SS-9

**NOTES:**

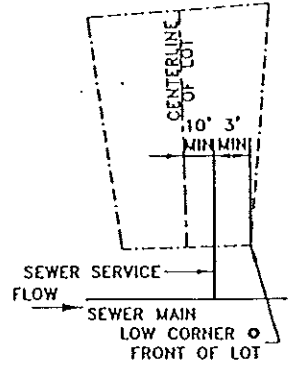
1. TYPE "A" ELEMENTS ARE TYPICAL FOR ALL TYPES UNLESS SPECIFICALLY NOTED OTHERWISE.
2. ALL LATERALS SHALL BE LOCATED 10' MINIMUM DISTANCE FROM THE DOWNHILL PROPERTY LINE OF THE SERVICE SIDE OF THE LOT, UNLESS OTHERWISE APPROVED BY THE TOWN PRIOR TO INSTALLATION.
3. ALL SEWER LATERAL CONNECTIONS SHALL BE TYPE "A" AND SHALL BE CONSTRUCTED ON A STRAIGHT LINE AND GRADE BETWEEN CONTROL POINTS EXCEPT AS OTHERWISE INDICATED ON THE APPROVED PROJECT PLANS.



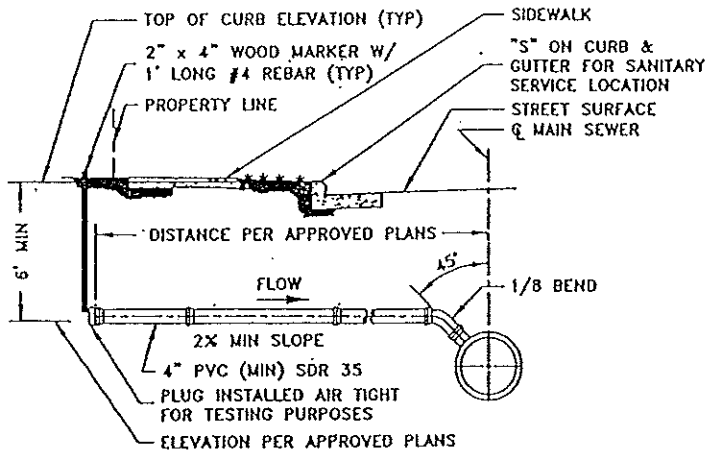
**TYPE C**



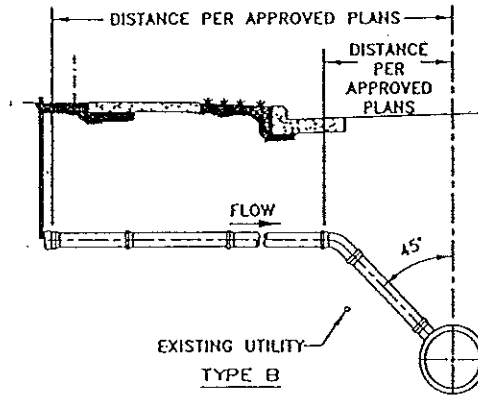
**PLAN**



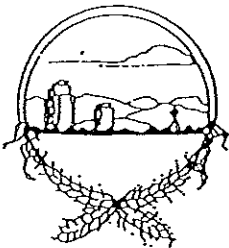
**SERVICE LOCATION DETAIL**



**TYPE A**



**TYPE B**



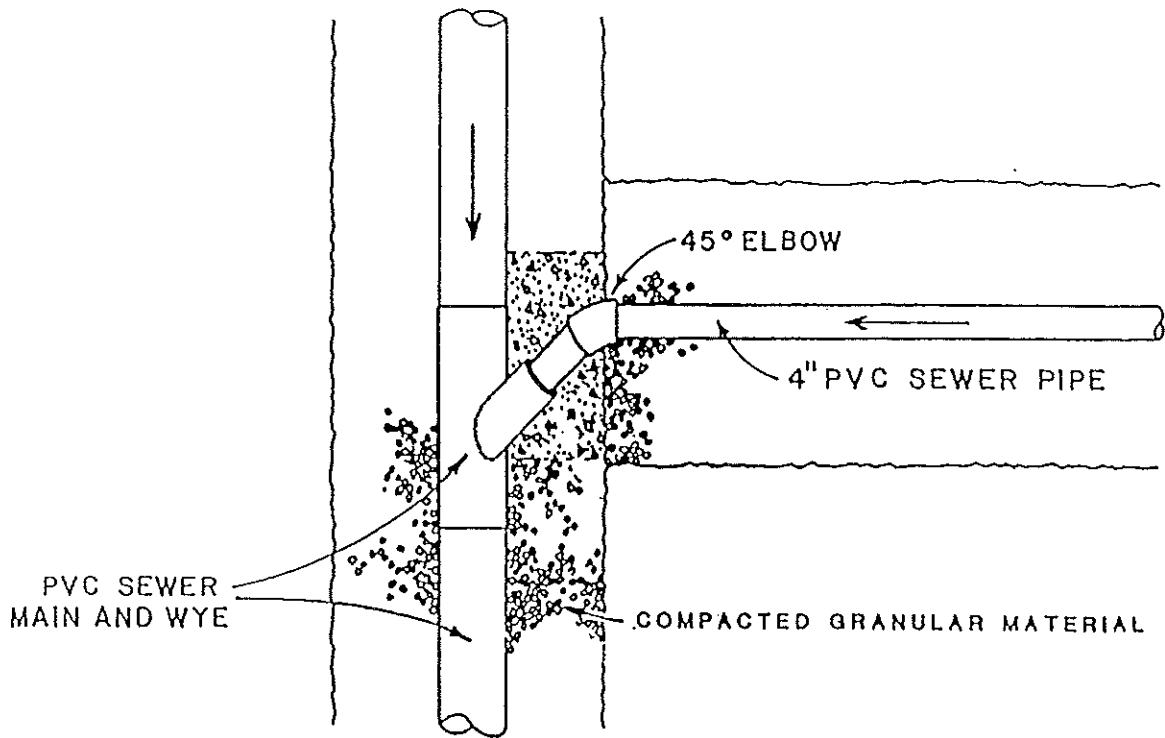
**SEWER LATERAL CONNECTIONS**

**Town of Bennett**

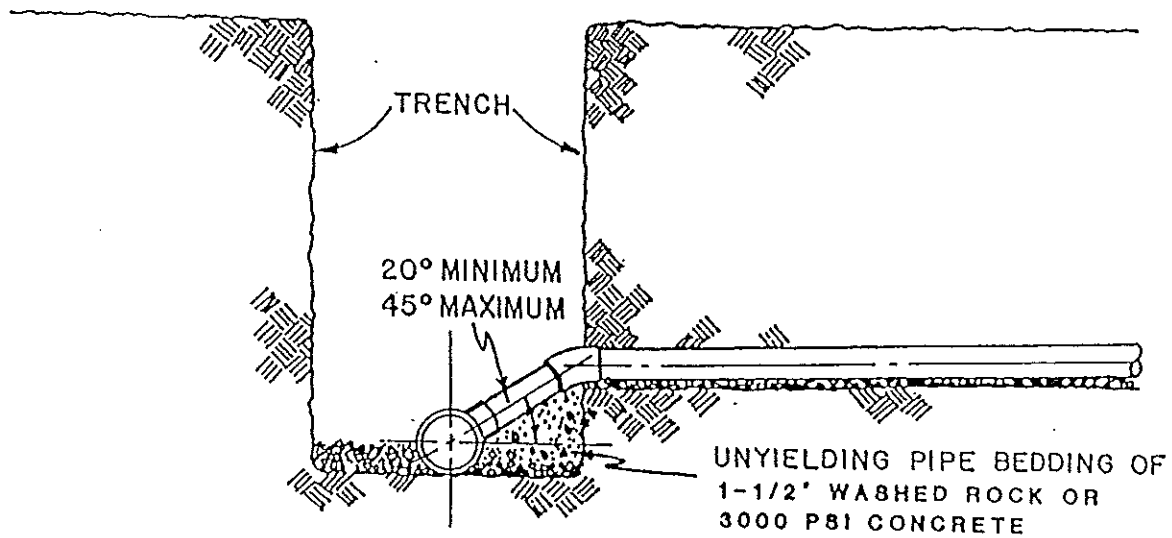
Issued: \_\_\_\_\_

Revised: \_\_\_\_\_

Drawing No.  
**SS-10**

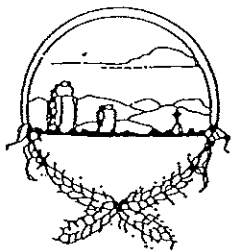


PLAN



CROSS SECTION

NOTE: WYES NOT PERMITTED ON VCP SERVICES.



SEWER SERVICE WYE DETAIL

Town of Bennett

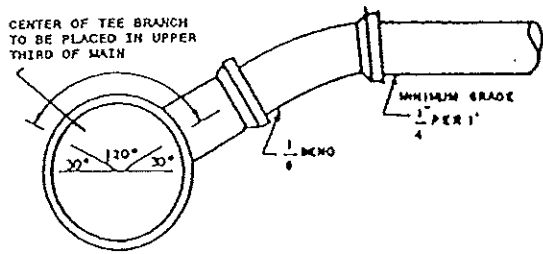
Issued: \_\_\_\_\_

Revised: \_\_\_\_\_

Drawing No.

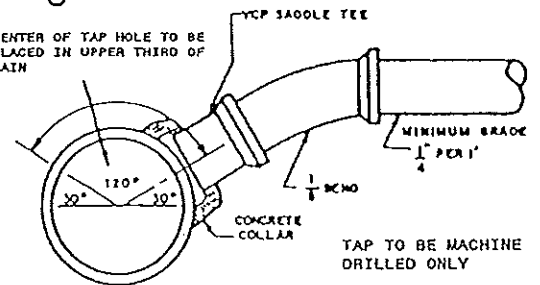
SS-11

CENTER OF TEE BRANCH TO BE PLACED IN UPPER THIRD OF MAIN

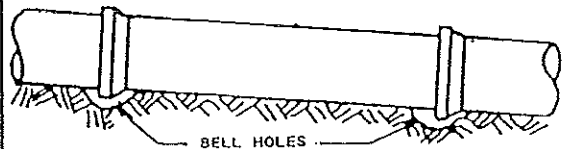


$\frac{1}{8}$  BEND CONNECTION TO TEE

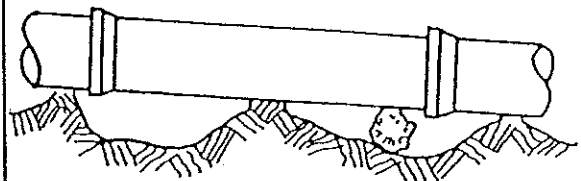
CENTER OF TAP HOLE TO BE PLACED IN UPPER THIRD OF MAIN



$\frac{1}{8}$  BEND & SADDLE CONNECTION



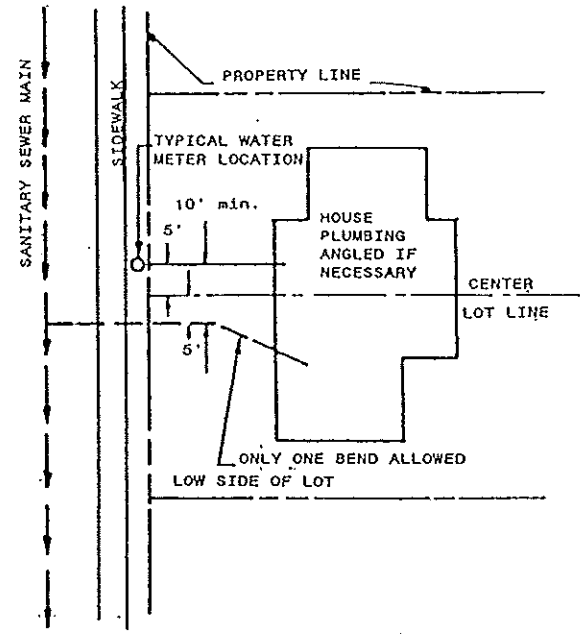
ACCEPTABLE BEDDING



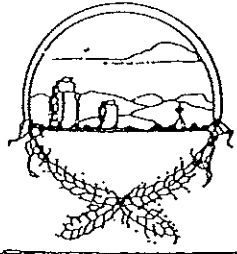
UNACCEPTABLE BEDDING

NOTES

1. BELLS SHALL NOT TOUCH THE SIDES OR BOTTOM OF THE BELL HOLE.
2. THE BARREL SECTION SHALL BE SUPPORTED THROUGHOUT ITS LENGTH.
3. SERVICE TAPS SHALL BE IN LINE TEE OR MACHINE TAPPED. HAND TAPS SHALL NOT BE ALLOWED.
4. SERVICE LINES SHALL BE LOCATED FIVE FEET DOWNHILL FROM CENTERLINE OF THE LOT.
5. THE CURB SHALL BE MARKED WITH "S" WHERE THE SEWER SERVICE LINE CROSSES THE CURB.
6. THE MIN. SERVICE LINE GRADE SHALL BE  $\frac{1}{4}$ " PER FT. CAST IRON SHALL BE USED IF GRADE IS FROM  $\frac{1}{4}$ " PER FT. TO  $\frac{1}{8}$ " PER FT.
7. JOINTS SHALL BE WATER TIGHT.



RESIDENTIAL SEWER SERVICE



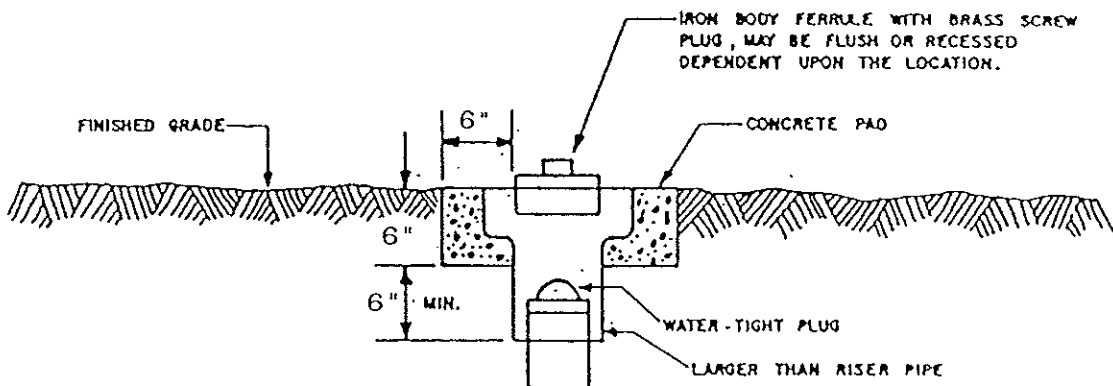
SANITARY SEWER SERVICE DETAIL

Town of Bennett

Issued: \_\_\_\_\_

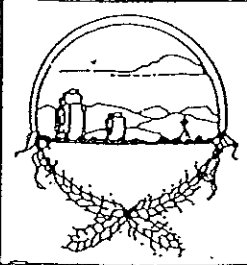
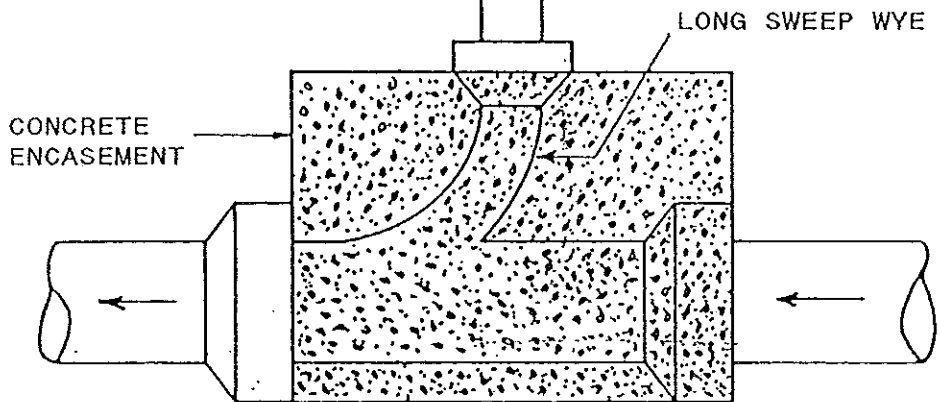
Revised: \_\_\_\_\_

Drawing No.  
SS-12



NOTES :

1. CLEAN-OUT SHALL BE CONSTRUCTED SO THAT THE SURFACE LOAD WILL NOT BE TRANSFERED TO THE MAIN.
2. CONCRETE PAD SHALL BE INSTALLED SO THAT THE WATER WILL RUN AWAY FROM THE INSTALLATION.



CLEAN - OUT DETAIL  
 SANITARY SEWER SERVICE LINES  
 AND UNDER DRAINS

Town of Bennett

Issued: \_\_\_\_\_

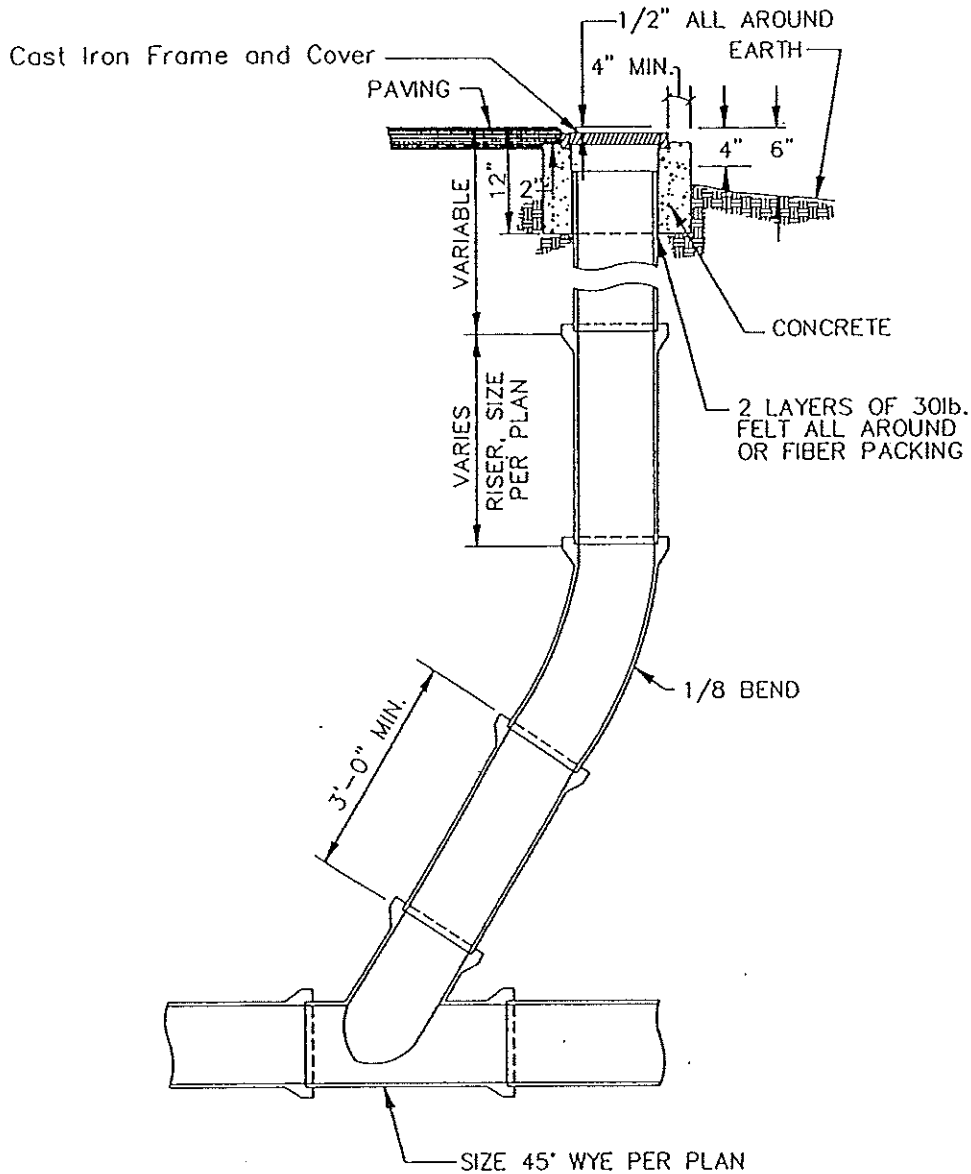
Revised: \_\_\_\_\_

Drawing No.

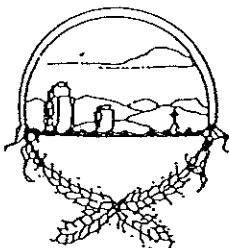
SS-13

DETAIL FOR CLEANOUTS  
IN PAVED SURFACES

DETAIL FOR CLEANOUTS  
IN EASEMENTS



Note: Cleanout pipe diameter shall be the same size as the sewer line at the wye.



SANITARY SEWER CLEANOUT

Town of Bennett

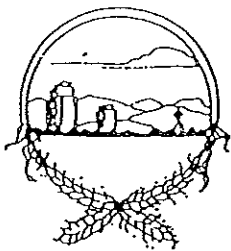
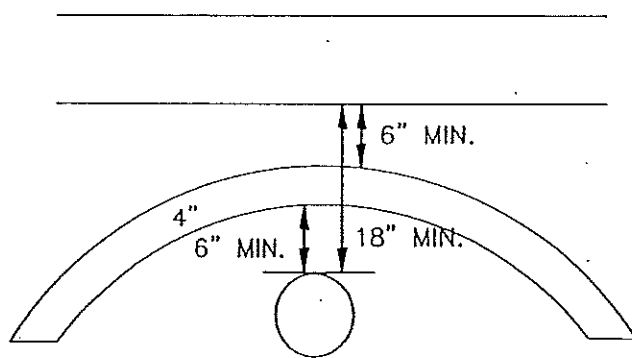
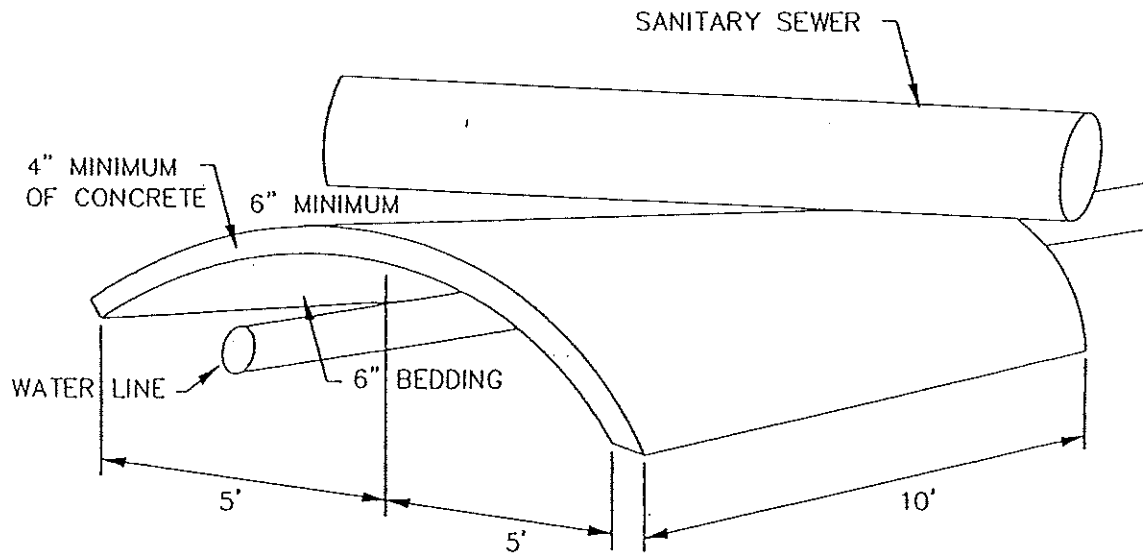
Issued: \_\_\_\_\_

Revised: \_\_\_\_\_

Drawing No.

SS-14





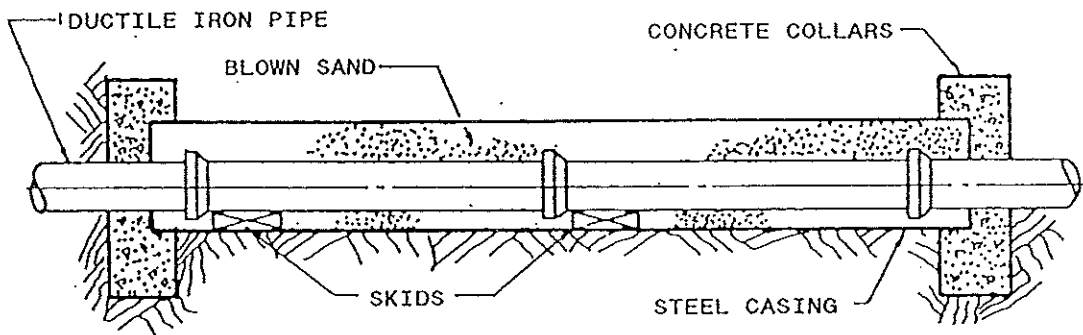
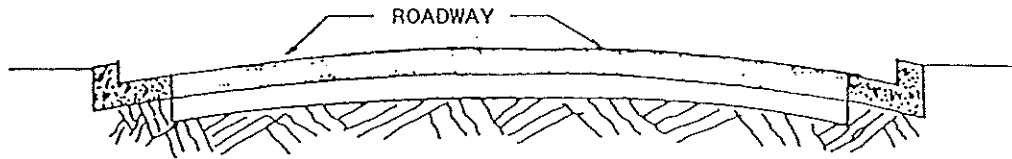
PIPE CROSSING-CONCRETE BLANKET

Town of Bennett

Issued: \_\_\_\_\_

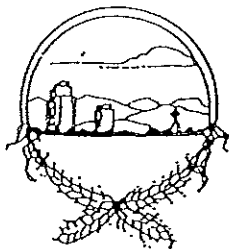
Revised: \_\_\_\_\_

Drawing No.  
SS-15



NOTES

1. ONLY DUCTILE IRON PIPES SHALL BE USED THROUGH ALL BORES.
2. IF THE BORE IS NOT CONSTRUCTED TO THE PROPER GRADE AN ADDITIONAL MANHOLE SHALL BE INSTALLED AT THE GRADE CHANGE.
3. THE CASING SHALL BE BLOWN FULL OF SAND.
4. THE CASING SHALL BE SEALED WITH CONCRETE COLLARS.
5. THE PIPE AND CASING SHALL BE INSULATED BY USE OF REDWOOD SKIDS ATTACHED TO THE BELL SECTION.



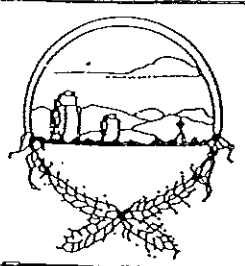
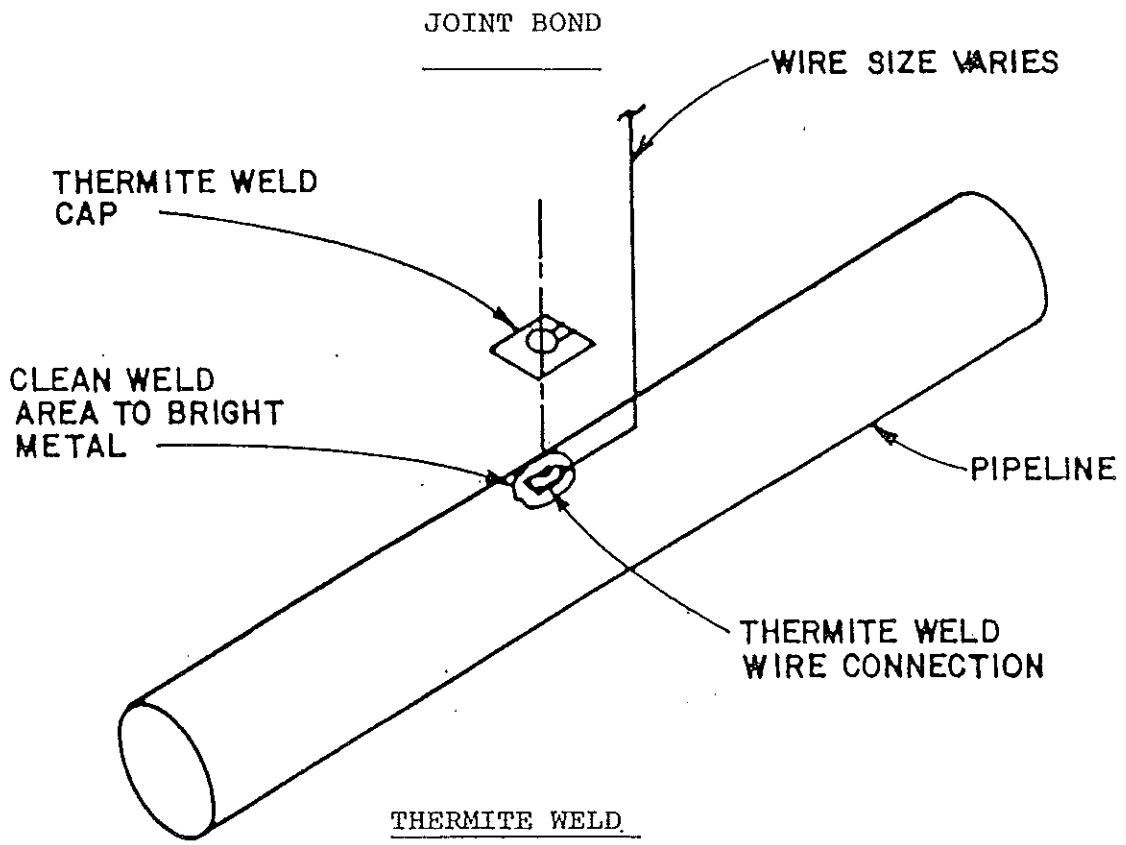
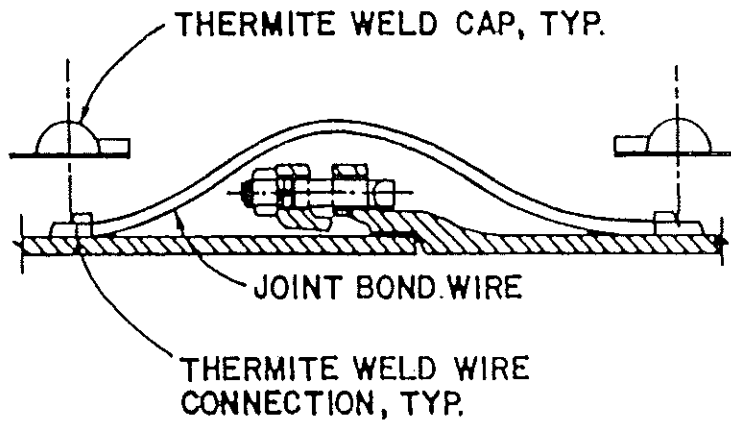
TYPICAL BORE CONSTRUCTION

Town of Bennett

Issued: \_\_\_\_\_

Revised: \_\_\_\_\_

Drawing No.  
SS-16



THERMITE WELD DETAIL  
AND JOINT BOND DETAIL

Town of Bennett

Issued: \_\_\_\_\_

Revised: \_\_\_\_\_

Drawing No.  
SS-17