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SECTION 1 AUTHORITY

The Board of Selectmen of the town of Millis, Massachusetts has adopted these guidelines governing the design and construction of sewers within the Town.

SECTION 2 GENERAL

A. DEFINITIONS

For the purpose of the guidelines, the following shall have the meaning hereunder assigned to them:

Applicant: The person who applies for the approval of a proposed sewer extension or connection. An applicant must be the owner of record who is requesting the extension or connection. An agent or his assigns may act for an owner provided that written evidence of such fact is submitted. A list of the stockholders and officers and a certified copy of the corporation resolution conferring authority to execute and deliver documents binding upon the corporation shall be submitted by every corporate applicant.

Department: The Department of Public Works

Final Plan: A final plan of the proposed sewer delineating existing information, utilities and proposed sewers. Plan shall be drawn in ink on polyester film (4 mil mylar, double matte) and prints thereof.

Profile: A complete and accurate representation of the finished vertical profile of proposed sewers to be constructed, drawn on plan/profile polyester film and prints thereof; on the plan portion, there shall be a plan of the sewer with stationing corresponding to the stationing on the profile.

Record As-Built Plan: A plan/profile, drawn on polyester film with prints thereof, showing the actual location and elevation of all improvements installed and stamped by a Massachusetts Registered Professional Engineer.

B. SUBMISSION OF CONSTRUCTION DRAWINGS & SPECIFICATIONS

All requests for sewer extension/connections shall be filed with the appropriate application forms and required documentation in the Department's office where required in these guidelines.

To be complete and properly submitted, each application must have all the required documentation and the required filing fee. The Department is empowered to reject, or return any application he deems to be non-conforming to the requirements, and shall specify those reasons, in writing, to the applicant.

Plans which have been properly submitted will be reviewed by the Town Sewer Consultant.

C. FEE SCHEDULE

Permit Fee (See Appendix B)

SECTION 3 PROCEDURES FOR APPROVAL OF SEWER

A. SUBMITTALS

Any person who desires approval of a sewer extension shall submit five copies of the following to the Department.

- a) The plan drawing
 - b) Application Form
 - c) Filing Fee as retainer for consultant to review and comment on documents.

B. PLANS AND SPECIFICATION CONTENTS

The sewer plans shall be prepared by a registered professional engineer and shall be clearly and legibly drawn in black ink upon mylar. The plan shall be at a scale of 1"=40', 1"=4' vertical or other such scale may be acceptable to show details clearly and adequately. Sheet sizes shall be 24"x36". The sewer plans shall contain the following:

a) A title stating the date, scale, bench mark; name and address of owner, engineer; name of project, if any; names of streets.

1. Sewer Mains: An applicant shall show the size and location of the existing sewer facilities which the proposed system will tie into and shall put them on Preliminary and Definitive Plans, and show that the existing system will support the new addition to the system. Where adjacent property is not sub-divided provision shall be made for proper projection of the system by continuing appropriate sewer mains to the exterior boundaries of the subdivisions at such size and grade that may be deemed necessary by the Director of Public Works. Sewer lines and related equipment shall be constructed to serve all lots on each street in the subdivision, whether or not there is a building thereon. In some instances an applicant will be required to bring a sewer service to the property line of abutting lots of a subdivision. Before construction begins the Department may require that the existing sewer be T.V. scoped and studied for needed repairs and to upgrade the existing system by the applicant. Before a new development is approved, the Department of Public Works requires applicants to have the new sewer T.V. scoped and studied for needed repairs.

b) Geographical Features

1. Topography and Elevations: Existing or proposed streets and all streams or water surfaces shall be clearly shown. Contour lines at suitable intervals should be included.

2. Streams: The direction of flow in all streams, and high and low water elevations of all water surfaces at sewer outlets and overflows shall be shown.

3. Boundaries: The boundary lines of the municipality and the sewer district or area to be sewerred shall be shown.

c) Location and ownership of abutting property.

d) Location and character of all rights of way, or other easements existing or proposed.

e) Location of all permanent monuments properly identified as to whether existing or proposed.

f) Location of existing and proposed utilities which are in the proximity of the sewer.

g) Details showing sewer trench, manholes, concrete encasement, services, etc.

h) Location of streets and sewers. Line of ground surface, size, material and type of pipe, length between manholes, invert and surface elevation at each manhole, and grade of sewer between each two adjacent manholes. All manholes shall be numbered on the plan and correspondingly numbered on the profile.

Where there is any question of the sewer being sufficiently deep to serve any residence, the elevation and location of the basement floor, or slab elevation shall be plotted on the profile of the sewer which is to serve the house in question. The engineer shall state that all sewers are sufficiently deep to serve adjacent basements except where otherwise noted on the plans.

Locations of all special features such as depressed sewers (inverted siphons), concrete encasements, elevated sewers, etc.

All known existing structures and their material construction above and below ground which might interfere with the proposed construction, particularly water mains, gas mains, storm drains, etc.

i) Where unusual site conditions require additional details where the applicant is proposing a unique construction solution or where the consultant or DPW requests additional information, details shall be submitted by the applicant. Special detail drawings, made to a scale to clearly show the nature of the design, shall be furnished to show the following particulars:

1) All stream crossings and sewer outlets, with elevations of the stream bed and of normal and extreme high and low water levels.

2) Details of all special sewer joints and cross-sections.

3) Details of all sewer appurtenances such as manholes, inspection chambers, depressed sewers (inverted siphons), overflows, regulators, tide gates and elevated sewers.

j) Complete technical specifications for the construction of sewers, waste water pumping stations, and all appurtenances, shall accompany the plans.

The specifications accompanying construction drawings shall include, but not be limited to, all construction information not shown on the drawings which is necessary to inform the builder in detail of the design requirements as to the quality of materials, workmanship and fabrication of the project. They shall also include: the type, size, strength, operating characteristics and rating of equipment; the complete requirements for all mechanical and electrical apparatus, wiring, and meters; laboratory fixtures and equipment; operating tools; construction materials, special filter materials such as stone, sand or gravel; installation specifications for sewers; miscellaneous appurtenances; chemicals when used; instructions for testing materials and equipment as necessary to meet design standards; and operating tests for the completed works and component units.

C. REVIEW BY TOWN SEWER CONSULTANT

The consultant shall review the plans submitted and comment on their completeness and acceptability to the Town. The consultant shall recommend acceptance to the Town once in conformance with design and construction standards. Review is based upon all standards herein and DEP guidelines, Guidelines for Design of Wastewater Treatment Works, TR16 requirement, federal guidelines and Town sewer regulations.

D. APPROVAL

The consultant may give approval with or without modifications. Such approval does not constitute approval from the Town but does facilitate the procedure in securing final approval of the Town.

SECTION 4 DESIGN STANDARDS

A. DESIGN GUIDELINES

a) GRAVITY SEWER MAINS

Minimum Size: No public gravity sewer shall be less than eight inches in diameter.

Depth of cover: In general, sewers should be designed deep enough to drain basement fixtures and to prevent freezing. Insulation shall be provided for sewers that cannot be placed at a depth sufficient to prevent freezing.

Critical Depths

Of Cover: Sewers designed with a depth of cover of thirteen vertical feet or greater shall be constructed of Class 52 - ductile iron pipe. For material specifications refer to the "Water Main Construction Guidelines" for the Town of Millis.

Sewers designed with a depth of cover of four vertical feet or less may be required to be constructed of Class 52 - ductile iron pipe if constructed under a traveled way. For material specifications refer to the "Water Main Construction Guidelines" for the Town of Millis.

Materials: All materials shall be new and in accordance with Section 4 "Construction Specifications".

Bedding: Trench specifications shall be as specified in Section 4 "Standard Specifications and in Appendix A "Standard Details"

Slope: All sewers should be so designed and constructed to give a velocity when flowing full of not less than 2.0 feet per second based on Manning's formula using an "n" value of 0.013 constant with depth. Use of other "n" values may be permitted by the reviewing agency if deemed justifiable on the basis of research or field data presented. The following minimum slopes may be used only if absolutely necessary because of grade restrictions.

Sewer Size (Inches)	Minimum Slope (Feet/Foot)
8	0.004
10	0.0028

12	0.0022
14	0.0017
15	0.0015
16	0.0014
18	0.0012
21	0.0010
24	0.0008

Increasing Size: When a sewer joins one of a large diameter, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient.

Separation of Sewers: Whenever possible, a minimum ten foot horizontal separation shall be maintained from water mains. When conditions prevent the minimum ten foot horizontal separation, the sewer may be laid below the water main in a separate trench on undisturbed earth if a minimum eighteen inch vertical separation between sewer and water is maintained. Whenever it is impossible to maintain the minimum vertical and horizontal separations, the sewer and/or water main shall be encased in concrete according to the standard details in Appendix A.

Separation of Other Buried Utilities: A minimum five foot horizontal separation shall be maintained from any other buried utility (gas, electric, telephone, cable, fire, etc.). When conditions prevent the minimum five foot horizontal separation, the sewer main may be laid below the other buried utility in a separate trench on undisturbed earth if an eighteen inch minimum vertical separation between the other buried utility and sewer is maintained. Whenever it is impossible to maintain the minimum vertical and horizontal separations, the sewer and/or utility shall be encased in concrete according to the standard details in Appendix A.

Testing: All sewer mains shall be tested, cleaned and video inspected according to Section 4 "Construction Specifications".

b) SEWER MANHOLES

Location: Manholes shall be installed at the end of each line; at all changes in grade, size or alignment; at all intersections; and distances not greater than 300 feet for sewers 15 inches or less in diameter, and 400 feet for sewers 18 to 30 inches in diameter.

Drop Type: A drop pipe should be provided for a sewer entering a manhole at an elevation of 24 inches or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches the invert should be filleted to prevent solids deposition.

Diameter: The minimum inside diameter of manholes shall be 48 inches. A minimum access diameter of 30 inches shall be provided.

Flow Channel: The flow channel through manholes shall be made to conform in shape and slope to that of the sewers entering and leaving the

manholes. The top of the flow channel shall be constructed so that under peak design conditions the flow will remain in the channel.

- Watertightness:** Solid manhole covers shall be used in areas subject to flooding. Precast concrete manholes with O-ring gasketed joints are the preferred type, although other types are allowable subject to the approval of the reviewing agency. Special provisions for backfilling shall be made for manholes subjected to frost action.
- Testing:** All manholes shall be tested according to Section 4 "Construction Specifications".

c) **PRESSURE SEWER MAINS**

Pressure sewer systems shall be considered by the Town when shown by the designer to be absolutely necessary to provide sewer service. The design must utilize as much gravity sewer as possible. Systems shall be designed in like to pressure sewer systems already in use in the Town.

Minimum Size: No pressure sewer main shall be less than 4 inches in diameter when used in an effluent pump system. Effluent pumps shall be capable of passing a minimum solids size of three (3) inches in diameter.

No pressure sewer main shall be less than two (2) inches in diameter when used in a grinder pump system. Grinders shall be capable of reducing solids to pass through the passages of the pump and a minimum one and a quarter (1 ¼) inch diameter discharge piping.

Standby Power: All pressure sewer systems shall be designed with standby generators and remain fully functional during power outages or have sufficient storage capacity for a 24 hour outage.

Depth of Cover: In general, a pressure sewer main shall be designed with a minimum depth of cover of five feet unless approved. Insulation shall be provided for pressure sewer main that cannot be placed with a minimum depth of cover of four feet to prevent freezing.

Critical Depths Of Cover: A pressure sewer main designed with a depth of cover of four vertical feet or less may be required to be constructed of Class 52 - ductile iron pipe or equal if constructed under a traveled way. For material specifications refer to the "Water Main Construction Guidelines" for the Town of Millis.

Materials: All materials shall be new and in accordance with Section 4 "Construction Specifications".

Bedding: Trench specifications shall be as specified in Section 4 "Standard Specifications and in Appendix A "Standard Details". GREEN TRACER TAPE marked "Caution - Sewer Line Below" must be placed in the sewer trench 16" below finish grade.

Slope: Pressure sewer mains shall be designed with a continuous uphill slope from the pump whenever possible. When a continuous uphill

slope cannot be maintained, air/vacuum release and clean out manholes shall be added at high and low points along the pipe line.

Separation of
Sewers:

Whenever possible, a minimum ten foot horizontal separation shall be maintained from water mains. When conditions prevent the minimum ten foot horizontal separation, the sewer may be laid below the water main in a separate trench on undisturbed earth if a minimum eighteen inch vertical separation between sewer and water is maintained. Whenever it is impossible to maintain the minimum vertical and horizontal separations, the sewer shall be encased in concrete according to the standard details in Appendix A.

Separation of
Other Buried Utilities:

A minimum five foot horizontal separation shall be maintained from any other buried utility (gas, electric, telephone, cable, fire, etc.). When conditions prevent the minimum five foot horizontal separation, the sewer may be laid below the other buried utility in a separate trench on undisturbed earth if an eighteen inch minimum vertical separation between the other buried utility and sewer is maintained. Whenever it is impossible to maintain the minimum vertical and horizontal separations, the sewer shall be encased in concrete according to the standard details in Appendix A.

Testing:

All pressure sewer mains shall be tested and cleaned according to Section 4 "Construction Specifications".

d) GRAVITY BUILDING SEWER SERVICE

Minimum Size: No gravity sewer service shall be less than six inches in diameter.

Depth of cover: In general, sewers should be designed deep enough to drain basement fixtures and to prevent freezing. Insulation shall be provided for sewers that cannot be placed at a depth sufficient to prevent freezing.

Critical Depth
Of Cover:

Sewers designed with a depth of cover of thirteen vertical feet or greater shall be constructed of Class 52 - ductile iron pipe. For material specifications refer to the "Water Main Construction Guidelines" for the Town of Millis.

Sewers designed with a depth of cover of four vertical feet or less may be required to be constructed of Class 52 - ductile iron pipe if constructed under a traveled way. For material specifications refer to the "Water Main Construction Guidelines" for the Town of Millis.

Materials: All materials shall be new and in accordance with Section 4 "Construction Specifications".

Bedding: Trench specifications shall be as specified in Section 4 "Standard Specifications and in Appendix A "Standard Details". GREEN TRACER TAPE marked "Caution - Sewer Line Below" must be placed in the sewer-service trench (from the municipal main to each residence 16" below finish grade.)

- Slope: Residential, commercial, industrial, and institutional sewer services shall have its own separate minimum 6" sewer service line with a minimum acceptable grade of .01 or 1.0%.
- Separation of Sewers: There must be at least a 10 foot horizontal separation between water service pipes and sewer service pipes.
- Connection to Sewer Stub: Connections to a sewer service stub shall be made with like materials or when required a suitable watertight adapter coupling. If a flexible connection is required (i.e., "Fernco" adapter), the connection shall be encased in cement concrete. Building service pipe connections shall be a minimum of 6" P.V.C. meeting SDR-35/ASTM-D-3034 standards laid in straight lines with only one-eighth (22-1/2 degree) bends used for changes in direction. Wye connectors must be at least 7' apart.
- Direct Connection To Existing Sewer Main: Connection to an existing sewer main shall be made into a manhole whenever possible otherwise the sewer connection shall be made with a 6" PVC wye connector saddle (not tee connector) encased in cement concrete. Openings for saddles shall be clean cut and smooth. Building service pipe connections shall be a minimum of 6" P.V.C. meeting SDR-35/ASTM-D-3034 standards laid in straight lines with only one-eighth (22-1/2 degree) bends used for the changes in direction. Wye connectors must be at least 7' apart.
- Connection to Building Plumbing: Connection between the 6 inch sewer service and the 4 inch plumbing exiting the building shall be made with an elastomeric reducer secured with stainless - screw bands and encased in cement concrete.
- Inspection: Municipal personnel will inspect the sewer service and approval will not be made if a sewer permit is not on file in the DPW; all trenches shall be inspected and must be open at the time of inspection.

e) **GRAVITY BUILDING SEWER SERVICE CLEANOUTS**

All sewer service lines shall have a six (6) inch clean out installed at a minimum distance of ten (10) feet from the outside of the foundation wall, facing in the direction of the sewer main, unless there is a clean out immediately inside the building. Sewer service lines that change in direction, 45 degrees or more, in addition to the above clean out shall have a six (6) inch clean out installed, facing the direction of the flow, at each change of direction (see detail in Appendix A).

All sewer service lines that are one hundred (100) feet long or longer shall have a six (6) inch clean out installed, facing the direction of the flow, at the fifty (50) foot point for one hundred (100) foot services, or every one hundred (100) feet for longer services, in addition to the clean outs designated above. A sewer manhole shall be required in place of a clean out when two or more services join together. The pipe size from this manhole to the main will be increased to a minimum of 8 inches.

All sewer clean outs shall be brought up to finished grade and equipped with a

watertight removable cap. Any sewer service clean out that ends up in a driveway, walk or roadway shall be equipped with a Genco #DWG R-3212-C Riser and #CCS Genco metal cap, or approved equal brought up to grade.

f) **PRESSURE BUILDING SEWER SERVICE**

Individual pressure sewer systems shall be considered by the Town when shown by the designer to be absolutely necessary to provide individual sewer service. The design must utilize as much gravity sewer as possible. Systems shall be designed in like to pressure sewer systems already in use in the Town.

Minimum Size: No pressure sewer service shall be less than one and a quarter (1 ¼) inch diameter.

Grinder pump systems shall be capable of reducing solids to pass through the passages of the pump and a minimum one and a quarter (1 ¼) inch diameter discharge piping.

Effluent pump systems shall only be considered when used in a two tank system. The first tank shall be capable of separating the solids from wastewater flow (i.e. septic tank) and be equipped with a suitable effluent filter. The clarified effluent shall then flow into the second tank (i.e. pump chamber) where the effluent pump system shall be placed. Pumps shall be capable of passing solids of a minimum one and a quarter (1 ¼) inch diameter.

Standby Power: All individual pressure sewer systems shall be designed with standby generators and remain fully functional during power outages.

Depth of Cover: In general, a pressure sewer service shall be designed with a minimum depth of cover of five feet unless approved. Insulation shall be provided for pressure sewer service that cannot be placed with a minimum depth of cover of four feet to prevent freezing.

Critical Depths

Of Cover: A pressure sewer service designed with a depth of cover of four vertical feet or less may be required to be constructed of Class 52 - ductile iron pipe or equal if constructed under a traveled way. For material specifications refer to the "Water Main Construction Guidelines" for the Town of Millis.

Materials: All materials shall be new and in accordance with Section 4 "Construction Specifications".

Bedding: Trench specifications shall be as specified in Section 4 "Standard Specifications and in Appendix A "Standard Details". GREEN TRACER TAPE marked "Caution - Sewer Line Below" must be placed in the sewer-service trench (from the municipal main to each residence 16" below finish grade.)

Slope: Pressure sewer mains shall be designed with a continuous uphill slope from the pump whenever possible. When a continuous uphill slope cannot be maintained, air/vacuum release and clean out manholes shall be added at high and low points along the pipe line.

Separation of
Sewers:

There must be at least a 10 foot horizontal separation between water service pipes and sewer service pipes.

Testing:

All pressure sewer services shall be tested and cleaned according to Section 4 "Construction Specifications".

B. EASEMENTS

Easements for municipal sewers outside of the street layout shall be provided where necessary. Easements shall be at least 20 feet wide and centered on lot lines where practical.

C. CONSTRUCTION SPECIFICATIONS

1. POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

PART 1 MATERIALS

- 1.01 PVC - PRESSURE PIPE AND FITTINGS
- 1.02 PVC - GRAVITY SEWER AND FITTINGS
- 1.03 PUSH - ON JOINTS
- 1.04 PVC BELL (INTEGRALLY CAST)
- 1.05 SOLVENT WELD JOINT
- 1.06 PIPE MARKINGS

PART 2 EXECUTION OF WORK

- 2.01 HANDLING AND CUTTING PIPE
- 2.02 PIPE BEDDING
- 2.03 INSTALLATION OF PIPE
- 2.04 PIPE ENCASEMENT

PART 1 MATERIALS

1.01 PVC - PRESSURE PIPE AND FITTINGS

A. 4" THROUGH 16" DIAMETER

- a. The PVC pressure pipe shall be Class 150-SDR18 unless otherwise specified and conform to ANSI/AWWA C-900 standard for PVC Pressure Pipe. PVC pipe shall meet the criteria of ASTM D-2241 "Poly Vinyl Chloride (PVC) Plastic Pipe (SDR-PR)". PVC Class 150 Pipe shall be manufactured to dimensions of standard Cast Iron Pipe outside diameters instead of dimensioning according to Iron Pipe Standards (I.P.S.). PVC pipe (SDR-18) shall meet all requirements of Uni-Bell Standard Uni-B-2-72. Class 150 pipe & couplings shall meet the following requirements:

<u>PHYSICAL PROPERTY</u>	<u>REQUIREMENT</u>	<u>TEST METHOD</u>
90 second Minimum Burst Pressure	755 PSI	ASTM D-1599
Sustained Pressure	500 PSI	ASTM D-1598 ASTM D-2241
Impact	100 Ft. - lbs.	ASTM D-2244
Hydrostatic Integrity	Non-Failure	ANSI/AWWA C 900-81 Section 3.1.1
Flattening	Non-Failure	ASTM D-2412
Extrusion Quality	Non-Failure	ASTM D-2152
Coupling Pressure Seal	Non-Failure of Seal	ASTM D-3139

- b. Pipe fittings shall conform in all respects to ANSI 21.10 and 21.11 (AWWA C110 and C111) and shall be mechanical joint. Compact fittings 4 inches through 16 inches shall conform to ANSI/AWWA C153/A21.53 and shall be mechanical joint. Compact fittings larger than 16 inches shall not be used. All fittings shall be restrained with retainer glands or bolted restrainers ("Mega-lug" or equal).
- c. Pipe shall be of the push-on type, mechanical joint or flanged.
- d. All pipe and fittings shall be furnished with a cement lining on the inside of the pipe. The lining shall be twice the thickness as specified in ANSI A21.4 (AWWA C104). Cement lining shall be double thickness. The cement lining shall be given a seal coat of asphalt material.
- e. All fittings shall be Class 350 and all fittings shall conform to the weights and dimensions shown in the latest edition of the CIPRA Handbook of Ductile Iron Pipe and Cast Iron Pipe.
- f. When required, flanged fittings shall be furnished and installed.
- g. Retainer glands or bolted restrainers ("Mega-lug" or equal and acceptable for PVC) with double heat treated set screws and break away nuts shall be furnished for all fittings, valves, caps and plugs.
- h. Joint accessories shall consist of high strength ductile iron glands ("Mega-lug" or equal and acceptable for PVC), rubber gaskets, tee head or hex head bolts and nuts. Nuts and bolts shall be made of low alloy steel or stainless steel. Where corrosive soils and/or saltwater conditions exist, bolts and set screws shall be tightened in accordance with the manufacturer's recommendations.

B. 1 ¼" THROUGH 3" DIAMETER

Pressure pipe shall be Class 200-SDR 21 PVC pipe.

- a. COMPRESSION JOINT PVC CLASS 200 SDR 21 IPS PIPE. Each pipe shall be 20' in length and shall be furnished with an integral elastomeric-gasket bell end and one gasket. Valves, Curb stops, air/vacuum valves, check valves, etc. shall be brass and be rated for 200-psi. Fittings must meet ASTM D3139: SDR17 250 psi. Fittings must be gasketed compression: male adapter must be MIPT to gasket. Compression couplings must be SDR21, 200-psi. Service clamps must be brass or stainless steel hardware with grade 60 O-ring cemented in place.
- b. HIGH DENSITY POLYETHYLENE (HDPE) or SCH 40/SCH 80 PVC pipe and fittings will be considered depending on the application and shall be equal to Class 200 SDR 21 pipe system.
- c. Solvent weld pipe and fittings shall not be allowed for buried piping unless approved by the engineer.

1.02 PVC PIPE - GRAVITY SEWER AND FITTINGS

- A. PVC gravity sewer 8" through 15" shall be SDR 35 unless otherwise specified and shall conform to ASTM D3034 Standard for PVC pipe. PVC gravity Sewer pipe 18" through 27" shall be Type 1 heavy wall unless otherwise specified and shall conform

to ASTM F679-80 standard for PVC pipe. The PVC pipe shall be supplied in standard lengths as commonly manufactured.

- B. Gravity sewer pipe shall be furnished with standard integral bell and spigot ends and elastomeric gasket joint.
- C. PVC gravity sewer tees, wyes and tee wyes to be used for service connections shall be PVC SDR 35 fittings with ring-tite joints. All fittings shall be capped.

1.03 PUSH-ON JOINTS

- A. Push-on joints shall be used shall consist of:
 - 1. A single continuous, molded, rubber, ring gasket.
 - 2. A bell socket cast integrally with the pipe or fitting
 - 3. A pipe or fitting plain end. The configuration shall be such that when the plain end is inserted into the pipe fitting socket the gasket shall compressed radially to form a positive seal. The gasket and annular space shall be so designed and shaped that the gasket is locked in place after the plain end is inserted into the fitting socket.
- B. Push-on joints shall have the same pressure rating as the pipe or fitting of which they are a part.
- C. Gaskets for push-on joints shall be vulcanized natural or synthetic rubber. All gaskets shall be free of porous areas, foreign material and visible defects.

1.04 PVC BELL (INTEGRALLY CAST)

- A. The bell shall consist of an integral wall section with locked-in, solid cross section elastomeric ring which meets the requirements of ASTM F-477. The bell section shall be designed to be at least as hydrostatically strong as the pipe wall and meet the requirements of AWWA C-900.

1.05 SOLVENT WELD JOINTS

- A. Where solvent weld joints are required they shall be made with solvent supplied by the pipe manufacturer's specifications or with ASTM Recommended Practice D2855. The dry fit of joints shall be primed and snug; pipe and fittings that afford loose fits will be rejected by the Engineer. The use of multiple layers of filler solvent to overcome a loose fit will not be permitted. Solvent cements shall conform to ASTM D-2564.
- B. Solvent weld pipe and fittings shall not be allowed for buried piping unless approved by the engineer.

1.06 PIPE MARKINGS

- A. Pipe and couplings shall bear identification markings that will remain legible during normal handling, storage, installation and during the life of the pipe. Markings shall have been applied to the pipe and couplings in a manner which will not reduce strength or durability or otherwise damage the pipe.

- B. Markings for pressure pipe shall be applied at intervals of not more than 5 Feet and shall include the following: nominal size and OD base, "PVC", dimension-ratio number, AWWA pressure class, AWWA designation number for AWWA C-900, manufacturer's name or trademark and production record code, and mark or seal of pipe testing agency

PART 2 EXECUTION OF WORK

2.01 HANDLING AND CUTTING PIPE

- A. Every care shall be taken in handling and laying pipe and fittings to avoid damaging the pipe, scratching or marring its surfaces and ends.
- B. Any fitting showing a crack and any fitting or pipe which has received a severe blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.
- C. In any pipe showing a distinct crack and in which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portion, if so approved, may be cut off before the pipe is laid so that the pipe used may be perfectly sound. The cut shall be at least 12 inches from the visible limits of the crack.
- D. All cutting of PVC pipe is to be square. The pipe to be cut shall be marked around its entire circumference prior to cutting.
- E. Using a factory finished beveled end as a guide to determine the angle and length of the taper, the end of a freshly cut pipe shall be beveled similarly.

2.02 PIPE BEDDING

- A. Pipe bedding and foundation design shall be as specified on the construction details

2.03 INSTALLATION OF PIPE

- A. Standard laying lengths shall be 20 feet for pressure pipe with 85% of the total footage of pipe being full lengths and the remaining 15% being furnished as random lengths. Random lengths shall not be less than 10 feet long. Standard laying lengths for gravity sewer shall be 14 feet.
- B. Prior to assembling, the bell and plain end shall be cleaned of all foreign matter. Push-on joints shall be made up by uniformly applying a thin film of special non-toxic gasket lubricant to the factory preinstalled gasket in the bell which will be in contact with the spigot end of the pipe. The end of the plain pipe shall be chamfered to facilitate assembly and prelubed for the first 6" of length. The end shall be inserted into the gasket, given ¼ turn and then forced passed it until it seats against the bottom of the socket.
- C. Pipe shall be installed in such a manner that will ensure that external loads will not subsequently cause a deflection of greater than 5% in the vertical cross-section dimension.
- D. For PVC pressure pipe horizontal deflection from joint to joint shall be limited to 12 inches for PVC pipe sizes 6 inches to 12 inches based on 20 foot length.

- E. The bedding of the pipe shall conform to the standard trench detail. Installation precautions are also given in ASTM D 2774.
- F. Installed pipe shall rest flat and straight on the bedding at all locations without bridging or binding. Backfill shall be carefully placed to avoid damage to the pipe.
- G. Only laborers competent in laying plastic pipe and suitable equipment shall be employed. Pipe and fittings shall be handled with care so as to prevent scratching or other damage to the materials. All joints shall be properly cleaned and free of foreign matter. The installation instructions of the manufacturer shall be strictly followed with the exception that the pipe bedding shall be as shown on the Construction Details in Appendix A.
- H. The pipe shall not be driven down to grade by striking it with a shovel handle, timber, hammer, or other unyielding object. When each pipe has been properly bedded, enough of the backfill material shall be placed and compacted between the pipe and the sides of the trench to hold the pipe in correct alignment.
- I. Before a joint is made, the pipe shall be checked to insure that a close joint with the next adjoining pipe has been maintained and that inverts are matched and conform to the required grade.
- J. When pipe laying is not actually in progress, the open ends of pipe shall be closed by temporary water-tight plugs or by other approved means. If water is in the trench when work is resumed, the plug shall not be removed until the trench is properly dewatered. Groundwater shall not be allowed to enter the pipeline.
- K. Any defective pipe or fitting found in the line shall be removed and replaced at the contractor's expense. All pipes and fittings shall be kept clean of all dirt and debris before being laid, and shall be kept clean until acceptance.

2.04 PIPE ENCASEMENT

- A. Concrete encasement of the PVC Pipe shall be conducted as specified herein or as shown on the Construction Details in Appendix A.

2. GRAVITY SEWER AND FORCE MAIN PIPE - GENERAL

PART 1 EXECUTION OF WORK

- 1.01 GENERAL
- 1.02 LINES AND GRADES
- 1.03 PIPE FOUNDATION
- 1.04 NORMAL SOIL CONDITIONS
- 1.05 UNSTABLE SOIL CONDITIONS
- 1.06 CONCRETE ENCASEMENT
- 1.07 INSPECTION OF PIPE BEFORE INSTALLATION
- 1.08 INSTALLATION OF PIPE AND FITTINGS
- 1.09 FINAL INSPECTION
- 1.10 FINAL TESTING
- 1.11 LOW PRESSURE AIR TEST - GRAVITY SEWER
- 1.12 TEMPORARY PLUGS
- 1.13 CONNECTION TO EXISTING STRUCTURES
- 1.14 PRESSURE TEST - FORCE MAIN
- 1.15 SEWER MAHOLE – VACUUM TESTING
- 1.16 SEWER LINE – MANDREL TESTING
- 1.17 SEWER LINE – TELEVISION INSPECTION OF LINES

PART 1 EXECUTION OF WORK

- 1.01 GENERAL
 - A. The specifications in this section are applicable to the installation of gravity sewer and force main pipe.
- 1.02 LINES AND GRADES
 - A. The grade shown on the profile is that of the invert of the pipe. The work shall conform to this grade. A variation of one-eighth (1/8) inch or more from the true invert grade on gravity sewers laid on a one percent or less grade and one-fourth (1/4) inch or more on sewers laid on grades above one percent will be deemed sufficient reason to cause the work to be rejected.
 - B. The grade and alignment of the pipe may be maintained by the use of laser beams.
- 1.03 PIPE FOUNDATION
 - A. All pipes to be laid in open trench excavation shall be bedded and uniformly supported over their full length on foundations of the types specified and shown on the detail in Appendix A. Flat-bottomed trenches shall be excavated and dewatered prior to preparing the specified foundation. All work shall be performed in a dry trench.
- 1.04 NORMAL SOIL CONDITIONS
 - A. All pipes shall be supported on a normal soil condition foundation. The trench shall be excavated to a depth equal to 1/4 of the outside diameter of the pipe to be installed (4" minimum) below the bottom of the pipe. Screened gravel bedding shall be furnished and placed in the trench for its full width to uniformly support the

pipe at the required line and grade. Suitable recesses shall be provided in the bedding to permit adequate clearance for bells, couplings, or similar projections. The bedding shall extend upward around the pipe barrel. Bedding material shall be spread in 6 inch layers, and each layer shall be compacted with twenty pound hand tampers or pneumatic tampers until the required total depth of bedding has been built up.

1.05 UNSTABLE SOIL CONDITIONS

- A. Where unstable soil conditions are encountered, the pipe shall be supported on a special foundation. The foundation shall be installed where a suitable supporting soil or rock stratum occurs at a depth greater than 1/4 of the outside diameter or 4" minimum. The trench shall be excavated to the depth necessary to reach the suitable supporting stratum (3'-0" minimum). The trench bottom and walls shall be covered with a geotextile fabric. Screened gravel of the type selected shall then be furnished as bedding and placed in the trench for its full width. The bedding shall be spread in 12 inch layers, and each layer shall be compacted with twenty pound hand or pneumatic tampers. The bedding shall carry vertically from the supporting stratum up to an elevation 1/4 of the outside diameter (12" minimum) above the top of the pipe. The special foundation shall extend for a minimum of 5'-0" beyond poor subgrade conditions.

1.06 CONCRETE ENCASEMENT

- A. Where required, the pipe shall be supported on foundation. The foundation shall be installed where excavations have been carried outside the normal limits. The trench shall be excavated to 1/4 of the outside diameter (6 inch minimum and a 12 inch maximum depth) below the bottom of the pipe. The excavated space shall then be completely filled with concrete, and the entire pipe encased in concrete such that the minimum concrete encasement at any point around the outside barrel of the pipe measures 4 inches thick. The depth of encasement over the pipe shall be 1/4 of the outside diameter (12" minimum). The total minimum width of the concrete encasement shall equal the width of trench excavation. Concrete shall be 3,000 psi. Concrete mix, formwork, curing, etc., shall be in accordance with the requirements of appropriate sections. Freshly poured concrete shall be maintained free from ground water for at least the first four hours. No backfilling of the trench shall begin until a minimum time period of 24 hours has elapsed after the encasement has been poured.

1.07 INSPECTION OF PIPE BEFORE INSTALLATION

- A. All pipes and fittings shall be carefully inspected in the field before placing the trench. Cracked, broken, warped, out-of-round or otherwise defective pipe, fittings shall be pulled and not installed. Such rejected pipe shall then be removed from the job site.

1.08 INSTALLATION OF PIPE AND FITTINGS

- A. After the trench has been brought to the proper grade, as hereinbefore specified, the pipe shall be laid.
- B. All pipe and fittings shall be carefully lowered into the trench with ropes, slings and proper equipment.

- C. Any pipe that has its alignment disturbed after laying shall be taken up and relayed. The interior and ends of all pipes shall be thoroughly cleaned during laying operations by means of plugs or other approved methods.

1.09 FINAL INSPECTION

- A. Each section of installed sewer lines shall be visually inspected by DPW personnel prior to any backfilling or final testing. The pipe shall be true to both line and grade, shall contain no broken pipe, shall show no leaks, shall show neither obstructions nor the projection of connecting pipes into the main pipe, and shall contain no debris or other deposits which will in any way reduce the full cross-section area of the pipe.
- B. Any section of sewer pipe which does not comply with these inspection criteria shall be promptly corrected, replaced or repaired.

1.10 FINAL TESTING

- A. All debris shall be removed from manholes and shall thoroughly flush from sewers and force mains prior to testing for watertightness. All sewers and force mains, (not including manholes), service connections and sewer laterals constructed shall be tested under this section and shall satisfactorily meet the test requirements prior to final acceptance of the work. An exfiltration, infiltration, or low pressure air tests for gravity sewers and shall perform water pressure test for the force main.

1.11 LOW PRESSURE AIR TEST - GRAVITY SEWERS

- A. The low pressure air test shall be performed with AIR-LOC equipment manufactured by Cherne Industrial Inc., Hopkins, Minnesota; New Britain Prod., New Britain, Pa., or equal.
- B. All wyes, tees, or ends of lateral stubs, shall be capped to withstand the internal test pressures. Caps shall be easily removable for future lateral connections or extensions.
- C. After a manhole-to-manhole section of sewer has been backfilled and cleaned, it shall be plugged at each manhole with pneumatic plugs. The pneumatic plugs shall be such that they will hold against the line test pressure without requiring external blocking or bracing. One of the plugs shall have three hose connections. Air for inflation of the triple connection pneumatic plug shall be supplied through a factory-equipped control panel. One hose shall be used for inflation of the plug. The second hose shall be used for continuously reading the air pressure in the sealed line. The third hose shall be used for introducing low pressure air into the sealed line.
- D. There shall be a 3 1/2" or larger diameter, 0-30psi gauge mounted on the control panel for reading of the internal pressure in the line being tested. Calibrations from 0-10 psi shall cover 90% of the complete dial range.
- E. Low pressure air shall be introduced into the sealed line until the internal air pressure reaches 4 psi greater than the average backpressure of any ground water that may be over the pipe. At least two (2) minutes shall be allowed for the air pressure to stabilize. After the stabilization period, the third hose shall be quickly disconnected from the control panel.
- F. The portion of line being tested shall be accepted if the portion under test does not lose air at a rate greater than 0.003 cfm per square foot of internal pipe surface when

tested at an average pressure of 3.0 psig greater than any back pressure exerted by ground water that may be over the pipe at the time of the test.

- G. The requirements shall be accomplished by performing the test as follows:

The time required in minutes for the pressure to decrease from 3.5 to 2.5 psig (greater than the average back pressure of any ground water over the pipe) shall not be less than the time shown for the given diameters in the following tables:

<u>Pipe Diameter in Inches</u>	<u>Minutes</u>
4	2.0
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5
21	10.0
24	11.5

- H. In areas where ground water is known to exist, a one-half inch diameter capped pipe nipple, approximately 10" long, shall be installed through the manhole. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the line acceptance test the ground water level shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to the pipe nipple. The hose shall be held vertically and a measurement of the height in feet of water shall be taken after the water stops rising in this plastic tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings.
- I. If leakage exceeds the specified amount make the necessary repairs or re-placements required to permanently reduce the leak-age to within the specified limit, and the test shall be repeated until the leakage requirement is met.

1.12 TEMPORARY PLUGS

- A. At all times when sewer and force main pipe laying is not actually in progress, the open ends of pipe shall be closed by temporary plugs or by other approved means. If water is in the trench when work is resumed, the plug shall not be removed until all danger of earth or other materials entering the pipe has passed.

1.13 CONNECTION TO EXISTING STRUCTURES

- A. Piping to be connected to existing manholes where no stub or other opening has been provided shall be made through an opening of minimum diameter cut in the wall of the structure at the required elevation and location. All penetrations shall be made by core boring unless otherwise approved.
- B. The annular space outside of the pipe stub shall be filled and sealed with non-shrinking grout. The outer surface of the sealing mortar shall be given a coating of heavy bit mastic waterproofing compound of a type approved. Kor N Seal watertight boots are required.