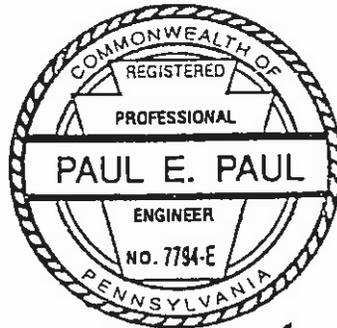


STANDARD MATERIAL  
AND CONSTRUCTION SPECIFICATIONS  
FOR  
PUBLIC IMPROVEMENTS  
EAST PENNSBORO TOWNSHIP  
CUMBERLAND COUNTY, PENNSYLVANIA

1995



1-20-95

*Paul E. Paul*

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NOTE: These Specifications are arranged in the nationally recognized CSI (Construction Specifications Institute) Format. However, only the applicable Sections of certain Divisions are included which results in the Section numbering not being consecutive. Also, this Table of Contents is included for convenience only. Its accuracy is not guaranteed.

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SECTION 1 - GENERAL INSTRUCTIONS

1.01 DEFINITIONS. Wherever in these Specifications the following words, terms and expressions, or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

Township: TOWNSHIP OF EAST PENNSBORO, acting directly or through any agent, officer or employee duly authorized to act for the said party in the execution of the work required by the Contract.

Completion Certificate: The certificate of the Engineer approved by the Township indicating the completion and acceptance of all work specified and performed under the Contract.

Contract: The written agreement executed by and between the Developer, or other entity, and a Contractor, covering the performance of the work and the furnishing of labor, materials and service in the construction of underground pipeline utilities and stormwater systems, and roadway systems in the TOWNSHIP OF EAST PENNSBORO. The Contract also includes the Drawings as defined hereinafter.

Contractor: Party of the Second Part or Second Party to the Contract, acting directly or through his authorized lawful agents, legal representatives, superintendents, or employees, appointed to act for said party in the performance of the work under Contract.

Developer: Party of the First Part or First Party to the Contract; the corporation, partnership, or individual intending to develop for residential or other purposes, a certain tract of land situated within the area of the Township, acting directly or through any authorized lawful agents, legal representatives or employees appointed to act for said party in the execution of the work of the Contract.

Drawings : Collectively, all of the Drawings (or reproductions of them) pertaining to the construction of the project and attached to the Contract or otherwise made a part thereof; and also such supplementary drawings as may be issued from time to time in order to elucidate or clarify said Drawings, or for showing details which are not shown thereon.

Engineer: The person or organization duly employed by the Township as consultant and authorized to inspect the results of the performance of the work under Contract by the Contractor, acting directly or through properly authorized agents, engineers, assistants, inspectors, or other representatives acting severally within the scope of the particular duties entrusted to them. The word "Engineer", shall include the officers, agents and employees of the Engineer. In cases where the Township does not employ a consultant, the word "Township" is substituted for "Engineer" throughout these Specifications.

Inspection: The examination of the work performed by the Contractor to ascertain its conformity with the Specifications.

Project: All the necessary performance, services and materials required for the satisfactory completion of the work under Contract as described in the Specifications and indicated on the Drawings.

Specifications: Collectively, all of the definitions, descriptions, directions, provisions, requirements, terms and stipulations contained in these Standard Specifications; and all written supplements thereto, made or to be made, pertaining to the Contract, and the materials and workmanship to be furnished under the Contract.

Subcontractor: A person, firm or corporation having a direct contact with the Contractor to perform part of the latter's contract; such as one who installs or furnishes and installs equipment forming a permanent part of the Contract work, or who furnishes labor for work required by the Contract in accordance with the Drawings and there specifications. This term does not include individual workmen furnishing labor only, nor one who merely furnished material not worked to a special design.

AASHTO: American Association of State Highway and Transportation Officials

ACI: American Concrete Institute.

AISC: American Institute of Steel Construction.

ANSI: American National Standards Institute.

ASTM: American Society for Testing Materials.

Fed. Spec: Federal Specifications, United States Government.

"Approved", etc. The words "approved", "acceptable", "satisfactory", or words of like import, shall mean approved by, or acceptable, or satisfactory, to the Engineer, unless another meaning is plainly intended or otherwise specifically stated.

1.02 DRAWINGS AND SPECIFICATIONS. The Drawings and Specifications are complementary, and the requirements of any one shall be considered as the requirements of all.

(a) The Specifications in this Township document are written as if they were included in the Contract Documents executed by and between the Developer and the Contractor. Whether they are so used is at the discretion of the Developer; however, the Township will not accept the wastewater sewer extensions, storm sewers, and roadways provided by the Developer unless and until they conform to the requirements of these Standard Specifications.

(b) All Drawings pertaining to the Project shall be submitted by the Developer to the Township for review. After review of these Drawings by the Township, the Developer shall make any corrections required, and submit

corrected copies thereof to the Township. The Township's approval of the Drawings shall not relieve the Developer from responsibility for errors or discrepancies in such Drawings. Drawings shall be prepared and submitted in conformance with the requirements set forth in Section 01300.

(c) Deviations from the Drawings or Specifications required by the exigencies of construction will be determined by the Engineer only, and authorized in writing.

(d) At all times the Contractor shall keep on the Project site, available to the Engineer and his representatives, one (1) copy of the Drawings, and Specifications.

1.03 PRELIMINARY INSPECTION. Unless the requirement is waived by the Engineer prior to the start of actual construction operations, the Contractor, or his authorized representative, shall go over the Project accompanied by the Engineer, or his designated representative, and shall observe for himself, with the approved Drawings before him, all pertinent conditions relative to the Contract, including the status of rights-of-way and structures, obstructions, or other objects to be removed, altered and changed.

1.04 COMPETENT WORKMEN. The Contractor shall employ only competent and efficient superintendents, foreman, clerks, timekeepers, equipment operators, laborers, and mechanics or artisans, for every kind of work. These requirements shall not operate against the employment of physically handicapped persons otherwise employable, where such persons may be safely assigned to work which they can ably perform. No person under the age of sixteen (16) years, and no person currently serving sentence in a penal or correctional institution, shall be employed to perform any work under the Contract.

The Contractor shall provide a competent and reliable person, who is delegated to be readily available and have full authority to act in the behalf of the Contractor, in case it is necessary to deal with any emergency situations which may arise in connection with the project during off working hours, evenings, weekends or holidays.

1.05 WORKING CONDITIONS.

(a) No night, Sunday, or legal holiday work, requiring the presence of the Engineer or his representative, will be permitted, except in cases of emergency and then only with the written consent of the Engineer, and to such an extent as he may judge necessary.

(b) Roadway paving work shall not be performed on Saturdays without one week prior arrangements with the Township. The Contractor will be required to pay for a Township Inspector on site and at the paving manufacturing plant, at Township determined premium-time rates.

(c) No work shall be done when, in the opinion of the Engineer, the weather is unsuitable for good and careful work to be performed. Should the severity of the weather continue, such that the work cannot be prosecuted successfully, the Contractor, upon order of the Engineer, shall cease all such work until directed to resume the same.

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(d) The Contractor shall arrange for, and be responsible for, a sufficient amount of illumination at all times subject to the approval of the Engineer, to carry on all phases of the work.

### 1.06 MATERIALS.

(a) The Developer and the Contractor shall furnish the Engineer, promptly after the award or execution of the Contract, with a complete statement of the origin, composition, and manufacture of all materials to be used in the construction of the Project. Only materials conforming to the requirements of these Specifications and approved by the Engineer shall be used in the work.

(b) Representative preliminary samples of the materials, of the character and quality prescribed in the Contract shall be submitted when indicated or directed, for advance examination or test. Written approval of the quality of such samples shall be received by the Contractor prior to obtaining materials from the respective sources of supply.

(c) Samples of all materials requiring laboratory tests shall be taken under the direction or supervision of, or in the manner prescribed by the Engineer. Such materials shall not be used until accepted as the result of such tests. Materials will be used only so long as the quality of the material remains equal to that of the accepted sample. The acceptance at any time of any material shall not be a bar to its future rejection, if it is subsequently found to be defective or inferior in quality to the material specified.

(d) Required laboratory tests of materials shall be made by a testing laboratory or agency selected or approved by the Engineer and in accordance with the methods indicated herein. When standard Specifications and serial numbers of technical societies and associations are stipulated, the reference shall be construed to be the latest of such Specifications and serial numbers.

(e) The Contractor shall furnish all labor, materials, and equipment necessary for collecting, packaging and identifying, representative samples of materials, and the shipping of such samples to the testing laboratory.

(f) For tests or inspections conducted by, and at the options of, the Engineer, at sites other than the testing laboratory and not under the jurisdiction thereof, the Contractor shall furnish or arrange with the producer to furnish material, labor, tools, and equipment, and every facility for the verification of the accuracy of scales, measures and testing equipment, necessary for tests or inspections.

(g) The Contractor shall permit or arrange with the producer to permit the Engineer or any agent of the testing laboratory to inspect or test material being used or to be used, at any time before, during or after its preparation, or while being used during the progress of the work or after the work has been completed.

(h) Materials shall be stored so as to insure preservation of their specified quality and fitness for the work. When considered necessary they shall be placed on wooden platforms or other hard and clean surfaces, and not on the ground, and shall be placed under cover when directed. Stored materials shall be located so as to facilitate prompt inspection. Private property shall not be used for storage purposes without permission of the owner or lessee of the property.

(i) If any material intended for use in the construction of the Project has been inspected and rejected after such material has been delivered to the Site, all such rejected material shall be immediately removed from the property by the Contractor.

1.07 ADVERTISING. No advertising will be permitted on any part of structures, scaffolding, fences, materials, obstructions, barricades or on any other areas of the work.

1.08 PERMITS AND LICENSES. With the exception of the PennDOT Highway Occupancy Permit (if applicable) and the Water Quality Management Permit (if applicable) the Contractor or Developer shall, unless otherwise specified, procure the necessary permits and licenses, pay the required charges and fees therefore, and shall give notices necessary and incident to the proper and lawful prosecution of the work. Any fees and charges associated with the Highway Occupancy and the Water Quality Management Permit shall be paid by the Developer or Contractor.

The Highway Occupancy and Water Quality Management Permit applications shall be prepared by the Developer in the name of the Township and submitted to the Township along with the application fees. After review of the applications by the Township, the Developer shall make any corrections, if required, and submit corrected copies to the Township. The Township will forward the applications and fees to the Pennsylvania Department of Transportation and the Department of Environmental Resources.

Payment for personnel from State Agencies, as required to be on hand during the construction of work on Highways under their jurisdiction, shall be borne by the Contractor or Developer.

Where work is to be done by the Contractor, in placing any pipe or other construction under railroad tracks, within the right-of-way of any railroad company, the Contractor shall be governed by the requirements of the railroad company involved, and shall consult with the officials thereof relative to the installation. If the railroad company requires any of their personnel to be on hand during the construction of the work, payment for such personnel shall be borne by the Contractor or Developer.

1.09 CARE OF PUBLIC AND PRIVATE PROPERTY. The Contractor shall take necessary precaution to prevent damage to overhead and underground structures and to protect and preserve property within or adjacent to the Project and shall be responsible for damage thereto. Special care must be used by the Contractor in the prosecution of the work in order to avoid interference or damage to any operating utilities or plants; however, where there is any possibility of such interference or damage, the Contractor shall make satisfactory arrangements with responsible officers or with the owners of the

utilities or plants, covering the necessary precautions to be used as safeguards during the performance of the work by the Contractor. Such arrangement shall be made before the work is started and shall be subject to the approval of the Engineer, which approval will not be considered as releasing the Contractor from any responsibility for the acts of himself or his employees or representatives. The Contractor shall protect land monuments and property markers which will be affected by the construction until they have been correctly referenced. Monuments and markers which are disturbed by the Contractor during the construction of the Project or otherwise, shall be satisfactorily reset by him when directed.

If proposed new utility pipelines cross telephone, telegraph, electric, television cables, gas, oil or water lines, no excavation or pipe laying shall be done at those crossings without the presence of an authorized representative from the office of the authority having jurisdiction. Attention is directed to the provisions of Act No. 287 (1974), as amended by Act No. 172 (1986) of the Commonwealth of Pennsylvania, and full compliance therewith is required.

1.10 SAFETY REQUIREMENTS.

(a) The Contractor shall furnish, erect and maintain at closures, intersections and throughout the Project, the necessary approved barricades, suitable and sufficient red lights, approved reflectors, danger signals, warning, and closure signs, provide a sufficient number of watchmen and take all necessary and legal precautions for the protection of the work and safety of the public. Barricades, danger signals, warning signs and obstructions shall be illuminated at night and the lights kept operating from sunset until sunrise. Materials and safety devices (i.e., barricades, flashing warning lights, reflectors and signs) which the Contractor provides for the purpose of protecting the work and the safety of the public and for maintaining and protecting traffic shall conform to the requirements specified in Section 901 of the current edition of the Commonwealth of Pennsylvania Department of Transportation Specifications Publication 408, as supplemented and to the requirements specified in the current edition of PA Code Title 67, Transportation Chapter 203 - Work Zone Traffic Control which complements Section 901.

(b) If, and when the use of explosives is necessary for the prosecution of the work, the Contractor shall observe special care, so as not to endanger life or property. Store explosives in a secure and safe manner in strict conformity to State and local regulations with such storage clearly marked "DANGEROUS EXPLOSIVES", and in the care of a competent watchman at all times.

(c) The safety provisions or applicable laws, and regulations of the Pennsylvania Department of Labor and Industry, and building and construction codes shall be observed. Machinery, equipment, and other hazards shall be guarded in accordance with the safety provisions of the "Manual of Accident Prevention in Construction", published by the Associated General Contractors of America, to the extent that such provisions are not in contradiction of applicable state and local laws.

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Observance of, and compliance with, said regulations shall be solely and without qualification, the responsibility of the Contractor, without any responsibility whatsoever on the part of the Township or Engineer. The duty of enforcing such laws and regulations lies with the said Department, not with the Township or Engineer.

(d) The provisions of the "OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970" of the U.S. Department of Labor shall be complied with in the performance of the work. Observance of, and compliance with, said Act shall be solely and without qualification the responsibility of the Contractor, without reliance on superintendence of, or direction by, the Township or Engineer. The duty of enforcement of the provisions of the Act lies with the U.S. Department of Labor, not with the Township or Engineer.

1.11 REGULATIONS OF THE DEPARTMENT OF LABOR AND INDUSTRY. The regulations of the Pennsylvania Department of Labor and Industry relating to wage scales, trenches and excavations, tunnel construction, equipment, materials, labor, safety, sanitation, and other regulations on which the Contractor shall be fully informed and with which he shall fully comply. Observance of and compliance with said regulations shall be solely and without qualification, the responsibility of the Contractor, without reliance or superintendence of, or direction by, the Township or Engineer. The duty of enforcing such laws and regulations lies with the said Department.

1.12 REGULATIONS AND REQUIREMENTS OF THE DEPARTMENT OF ENVIRONMENTAL RESOURCES. The Contractor and the Developer are advised that they will be required to design and conduct their work in compliance with the rules, regulations and requirements of the Pennsylvania Department of Environmental Resources.

1.13 OBSERVANCE OF LAWS. The Contractor shall observe and comply with Federal and State laws and regulations, and local bylaws, ordinances and regulations in any manner affecting the conduct of the work or applying to employees on the Project, as well as safety precautions and orders or decrees which have been promulgated or enacted, or which may be promulgated or enacted, by any legal bodies or tribunals having authority or jurisdiction over the work, materials, equipment, employees or the Contract; such observance and compliance shall be solely and without reliance on superintendence or direction by the Township or Engineer. The duty of enforcement of said laws, ordinances, regulations, orders or decrees lies with the body or agency promulgating them, not with Township or Engineer.

1.14 CLEANING SITE. The Contractor shall keep the Project Site free from accumulations of waste material or rubbish caused by the work. Before the work will be considered as having been completed, the Contractor shall clean and remove from the Project and adjacent property, surplus and discarded materials, equipment and temporary structures. The Contractor shall also restore cultivated lawns and shrubbery which he may have damaged in the course of construction.

1.15 ENGINEER'S DUTIES, EXAMINATION AND INSPECTION. The work shall be subject to the examination and inspection of the Engineer and his authorized assistants, who shall have free access to the work, and be furnished by the Contractor with every reasonable facility for examination of the work, to the

extent of uncovering, testing or removing finished portions thereof. The Contractor shall provide labor and equipment necessary for such examinations. The Engineer may require the Contractor to uncover for examination, or to remove any work done or placed in violation or disregard of instructions issued to the Contractor by the Engineer or his representative.

The Engineer and his assistants are the representatives of the Township during the construction of the work. When so authorized by the Township, it shall be the duty of the Engineer to see that the materials and work are properly inspected and that such materials and work conform fully to the requirements of the Standard Material and Construction Specifications. The Engineer shall perform such other duties as may be assigned him from time to time and shall have such additional authority as may be defined elsewhere in these General Instructions. The Engineer shall in no case act as foreman or perform other duties for the Contractor nor interfere with the management of the work by the Contractor.

Inspections and tests shall be performed without unnecessarily delaying the work. Material and workmanship, if not otherwise designated by the Specifications shall be subject to inspection, examination and test by the Engineer or his duly authorized representatives. The Engineer shall have the right to reject defective material or workmanship, or require its correction. Rejected workmanship shall be satisfactorily replaced with proper material and the Contractor shall promptly segregate and remove rejected material from the premises. If the Specifications, the Engineer's instructions, laws, ordinances, or any public authority require the work to be specially tested or approved, the Contractor shall give the Engineer timely notice of its readiness for inspection.

The Engineer shall, within a reasonable time after presentation to him, respond to questions in relation to the construction of the Project, and in all cases decide every question which may arise relative to the performance of the work covered by the Contract.

The Engineer shall have full authority to decide questions which may arise under the Contract relative to the quality and acceptability of materials furnished and the manner, rate of progress, quality and acceptability of work performed, and the interpretation of Drawings and Specifications.

Any verbal opinion or suggestion which the Engineer may give the Contractor shall in no way be construed as binding the Township in any way.

In case of any dispute relative to the quality of materials or work, the Engineer shall have authority to reject materials and to advise the Township to suspend the work. He shall not be authorized to revoke, alter, enlarge, relax or release any requirements of the Standard Material and Construction Specifications, nor to approve or accept any portion of the work, or issue instructions contrary to the Specifications.

Where work subject to the Engineer's inspection is being performed after the Township's normal business hours, or on Sunday or legal holiday, the contractor will be required to pay for the Engineer's time at Township determined premium-time rates.

1.16 DEFECTIVE WORK. When any material not conforming to the requirements of the Specifications and Drawings, has been delivered upon the Site of the Project, or incorporated in the Work, or when any work performed is of inferior quality, such material or work shall be considered as defective and shall be immediately removed and renewed or made satisfactory as directed by the Engineer. Failure or neglect on the part of the Engineer to condemn or reject any bad or inferior work or materials, shall not be construed as to imply an acceptance of such work or materials, if such bad or inferior material or work becomes evident at any time prior to the delivery of the Completion Certificate by the Township to the Developer.

The Contractor shall remove any work or material condemned, and shall rebuild and replace the same.

The Contractor shall promptly move from the premises materials condemned by the Engineer as failing to conform to the Specifications, whether incorporated in the structure or not, and the Contractor shall promptly replace his own work in accordance with the Contract.

1.17 NOTICE. The service of any notice, by the Township or Engineer to the Developer or Contractor, shall be considered accomplished upon completion of any one of the following procedures.

(a) When delivered, in writing, to the person in charge of the office used by the addressee to conduct business;

(b) When delivered, in writing, to the addressee or any of his authorized agents in person;

(c) When delivered, in writing, to the addressee or any of his agents at the office used by the addressee to conduct the business of the Contractor at or near the Site of the work;

(d) When deposited in the United States Mail, postpaid, and addressed to the party intended for such service at his office used for conducting the business of the Contract at the Site of the work, or his last known place of business; or

(e) When filed at any company operated office of the Western Union Telegraph Company and addressed to the party intended for such service at his last known place of business or for conducting the business of the Contract at the Site of the work.

1.18 ENGINEERING STAKES. The Contractor shall furnish, set and maintain suitable stakes, grade boards, temporary structures, templates, and other materials for establishing and maintaining points, marks, and lines. The Contractor shall be held responsible for the preservation of all stakes and marks.

(a) The Township at its discretion may elect to provide stake out of the proposed work. If so, the Contractor is responsible to maintain the stake out and control points.

1.19 INSURANCE AND INDEMNITY REQUIREMENTS. The Developer shall not commence work until all protection required under this section are in full effect and verified to the satisfaction of the Township.

(a) Duties of The Developer. Four (4) copies of the original certificates must be prepared as indicated in the following subparagraphs and forwarded to the Engineer. In addition, the Township or its representative, shall have the right to reject any form of security which does not meet nationally recognized standards for financial strength as indicated below. Contractors and subcontractors must satisfy all conditions to the same extent unless otherwise specified herein. Protection as described shall be maintained until work in connection with the Project has been accepted by the Township. In the case of wrap up policies or claims made policies, coverages shall be maintained for a minimum of two years after the project has been completed.

(b) Coverages to be Maintained by the Developer. The insurance types to be provided are General Liability, Automobile Liability, and Workers' Compensation, and Railroad Protective Liability when Contract includes work on, under or adjacent to Railroad rights-of-way or properties. The specific insurance coverages and limits of liability shall be those normally carried by the Developer and/or his Contractors and Subcontractors and subject to the review and approval of the Township.

(c) Coverage Modifications Which Must be Obtained: Township and Engineer and each of their Officers, Agents and Employees shall be named as additional insurers with respect to all work performed in connection with this Project. This applies to General Liability, Automobile Liability and Railroad Protective Liability coverages.

Township shall be notified by Registered Mail thirty (30) days in advance of any cancellation or any material change resulting in the elimination or reduction of any protection.

Waiver of Subrogation in favor of the Township and Engineer and each of their Officers, Agents, and Employees applying to all Workers' Compensation coverages must be provided by the Developer unless not permitted by laws of the state in which this Project is constructed.

(d) Indemnification of Authority and Engineer by Developer: Developer is responsible for all liabilities and duties assumed by Developer including but not limited to the indemnity liability in the Agreement between Township and Developer and the provisions of this subparagraph (d) and shall provide such protection for the Township and Engineer whether or not such claims, losses, liabilities or expenses are covered by insurance.

The Developer shall at all times, indemnify and save harmless and Township and Engineer, of and from all claims of whatsoever nature, including without limitation claims which may be made by any of the employees of the Developer or by any employees of any Contractor or Subcontractor to whom the Developer may have let the performance of any part of the work and the Developer will appear for and defend the Township and Engineer against any and all such claims.

The status of the Developer in the work to be performed by him is that of an Independent Contractor and as such he shall properly safeguard against any and all personal injury including death, or damage to the public, to public and private property, materials and things; and as such, he alone shall be responsible for any and all damage, loss or injury to persons or property that may arise, or be incurred, in or during the conduct or progress of said work without regard to whether or not the Developer, Contractor, his Subcontractors, Agents, or Employees have been negligent; and the Developer shall keep the Township and Engineer indemnified from and discharged of, and from any and all responsibility and liability for risks and casualties of every description, as provided in the Agreement between the Township and Developer.

The Developer shall assume and be liable for all blame and loss of whatsoever nature by reason of neglect or violation of any federal, state, county, or local laws, regulations or ordinances.

(e) Minimum Standards of Financial Strength and Policyholder Service Required of Insurance Carriers Providing Coverage for the Work: Insurance Companies used shall be admitted carriers authorized to transact business in the Commonwealth of Pennsylvania unless the Township is notified and waives this requirement.

Insurance Companies used must be rated (A 10) or better by Best's Rating Service unless the Township is notified and waives this requirement.

1.20 TOWNSHIP STREET CUT PERMIT. The Contractor or Developer will be required to make submission for and pay for the Township Street Cut Permit. Application forms for the permit may be obtained from the Township Office. The application forms shall be submitted in duplicate; a file copy will be retained by the Township and the applicant copy will be validated and a permit number issued contingent upon Township review. A copy of the approved permit shall be kept at the project site and shall be made available to the Township representatives or Police Officer upon request.

(a) Township permit fees are as follows:

First 8 sq. ft . . . . .	\$10.00
Next 100 sq. ft . . . . .	\$0.50 per sq. ft.
Next 100 sq. ft . . . . .	\$0.25 per sq. ft.
Remainder . . . . .	\$0.10 per sq. ft.

(b) For openings on berm or unpaved surface . . \$0.10 per sq. ft. Square footage is taken from surface area of the proposed cut. All fees must be submitted prior to the issuance of a permit. All fees should be rounded off to the closest dollar.

(c) Openings/Cuts in Excess of Approved Application: If the opening should actually exceed the permitted size, an amendment as to the actual size of the opening must be made. A letter to this effect will suffice. The appropriate additional fee must accompany this letter.

(d) Emergency Repairs/Opening: If any emergency occurs during a normal working day between the hours of 8 am and 4 pm, the Township office

shall be notified immediately as to where an opening must be made, for what reason, and the Company name declaring the emergency condition.

If the emergency should occur during other hours, weekends, or holidays, work may be started immediately to correct the situation. The Township office shall be notified by telephone as soon as possible.

OFFICE TELEPHONE NUMBER . . . 732-0711

In any event, a formal application for a permit shall be made within 48 hours of the start of emergency repairs.

1.21 FEE REQUIREMENTS. The Developer will be required to pay the following fees applicable to wastewater sewer extension.

(a) Sewer Connection Permit Fee. The Developer shall submit to the Township. Sewer connection permit(s) and fee(s) as may be required by the Township's.

(b) Township Inspection Fee. The Developer shall submit to the Township inspection fee(s) as may be required by the Township.

(c) DER Filing Fee. A fee of \$100.00 must accompany the permit application to DER. The check should be made payable to Pennsylvania Department of Environmental Resources.

(d) Any other fees, inspection costs and bonds associated with other permits or licenses that are applicable to the extension.

1.22 ITEMS REQUIRED PRIOR TO BEGINNING CONSTRUCTION

(a) Sewer Connection Permit(s) applicable to the Project.

(b) Evidence that the final subdivision plan has been filed by the Municipality at the county courthouse, Recorder of Deeds office, if applicable.

(c) Performance and Payment Bonds or other financial security to assure completion of the wastewater sewer extension and to cover the warranty period.

(d) Receipt of a letter from the Developer stating the name of the Contractor who will be installing the wastewater sewer extension.

(e) Certificates of public liability and property damage, auto liability and worker's compensation insurance. The Township and Engineer shall be certificate holders and shall be named by endorsement as additional insurers.

(f) Receipt from the Township of a copy of the Water quality Management Permit issued by DER, if applicable.

(g) A list of suppliers for the materials to be used in the wastewater sewer construction.

(h) Shop drawings of manhole bases, manhole risers, manhole frames and covers, pipe and other necessary construction materials approved by the Township.

(i) Certification from the pipe manufacturer that the pipe meets or exceeds the requirements of the Township's Standard Specifications.

(j) Written approval by the Township to proceed with construction.

1.23 DEDICATION OF WASTEWATER SEWER EXTENSION TO THE TOWNSHIP. The Developer shall deliver a deed of conveyance transferring ownership of the wastewater sewer extension to the Township. Attached to the deed shall be a plat which accurately describes the location of the facilities to be dedicated. The description shall include bearings and distances which are tied to permanent features shown on a recorded plan of the property. If the Developer is a corporate entity, the deed of conveyance must be accompanied by a corporate resolution authorizing said conveyance. Upon receipt of the executed deed of conveyance from the Developer, the Township will release the Developer from all obligations to the Township with respect to the extension, except that the Developer shall guarantee the extension installation including materials and workmanship for a period of one year from the date of the deed, or in the case of work on PennDOT right-of-way, for a period of two years from the date of the deed.

END OF SECTION

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS, that a DEVELOPER known as

\_\_\_\_\_ hereinafter called PRINCIPAL, and \_\_\_\_\_

\_\_\_\_\_ of the City of \_\_\_\_\_, State of \_\_\_\_\_ a corporation created and existing under the laws of the State of \_\_\_\_\_, hereinafter called SURETY, are held and firmly bound unto the EAST PENNSBORO TOWNSHIP, Pennsylvania, as Obligee in the full and just sum of

\_\_\_\_\_ Dollars (\$\_\_\_\_\_), lawful money of the United States of America, for the payment of which sum we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents,

WITNESSETH THAT:

WHEREAS, The Principal heretofore has entered into an Agreement with the Obligee, dated \_\_\_\_\_, 19\_\_\_\_, (the "Agreement"), to construct Public Improvements at the Principal's expense; and

WHEREAS, It is a condition of the Agreement that this Bond shall be furnished by the Principal to the Obligee.

NOW, THEREFORE, the terms and conditions of this Bond are and shall be that if: (a) the Principal well, truly and faithfully shall comply with and shall perform the work in accordance with the Agreement, and if the Principal shall satisfy all claims and demands incurred in or related to the performance of the Agreement by the Principal or growing out of the performance of the Agreement by the Principal, and if the Principal shall indemnify completely and shall save harmless the Obligee and all of its officers, agents and employees from any and all costs and damages which the Obligee and all of its officers, agents and employees may sustain or suffer by reason of the failure

## Gonnett Fleming

of the Principal to do so, and if the Principal shall reimburse completely and shall pay to the Obligee any and all costs and expenses which the Obligee and all of its officers, agents and employees may incur by reason of any such default or failure of the Principal; and (b) if the Principal shall remedy, without cost to the Obligee, all defects which may develop during the period of one (1) year from the date of acceptance of the Obligee of the work to be performed under the Agreement, which defects, in the sole judgment of the Obligee or its legal successors in interest, shall be caused by or shall result from defective or inferior materials or workmanship, then this Bond shall be void; otherwise, this Bond shall be and shall remain in force and effect.

Provided however, that: (i) to the extent the work to be performed under the Agreement is required to be performed under permit from the Department of Transportation of the Commonwealth of Pennsylvania, the Principal shall make, without cost to the Obligee, all temporary and permanent restoration of any failure of a highway, including the slope or any other appurtenance thereto, during the period of two (2) years from date of completion of such work; and (ii) to the extent the work to be performed under this Agreement is required to be performed under permit from the Department of Transportation of the Commonwealth of Pennsylvania, the Principal shall make, without cost to the Obligee, all temporary and permanent restoration of any failure of a highway, including the slope or any other appurtenances thereto, or of the area adjacent to such highway or of the area beyond such adjacent area, to the extent such work shall be determined to be the proximate cause of such failure, during the period of two (2) years from the date of completion of such work; then this Bond shall be void; otherwise, this Bond shall be and shall remain in force and effect.

The Principal and the Surety agree that any amendments to the Agreement, and/or any act of forbearance of either the Principal, or the Obligee toward the other with respect to the Agreement shall not release, in any manner whatsoever, the Principal and the Surety, or either of them, or their heirs, executors, administrators, successors and assigns, from liability and obligations under this Bond; and the Surety, for value received, does waive notice of any such amendments and/or acts of forbearance.

If the Principal is a foreign corporation (incorporated under any laws other than those of the Commonwealth of Pennsylvania) then further terms and conditions of this Bond are and shall be that the Principal or the Surety shall not be discharged from liability on this Bond, nor this Bond surrendered until such Principal files with the Obligee a certificate from the Pennsylvania Department of Revenue evidencing the payment in full of all bonus taxes, penalties and interest, and a certificate from the Bureau of Employment and Unemployment Compensation of the Pennsylvania Department of Labor and Industry, evidencing the payment of all unemployment compensation, contributions, penalties, and interest due the Commonwealth from said Principal or any foreign corporation, and interest due the Commonwealth from said Principal or any foreign corporation, subcontractor thereunder or for which liability has occurred but the time for payment has not arrived, all in accordance with provisions of the Act of June 10, 1947, P.L. 493, of the Commonwealth of Pennsylvania.



PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS, that a DEVELOPER known as

\_\_\_\_\_ hereinafter called PRINCIPAL, and \_\_\_\_\_

\_\_\_\_\_ of the City of \_\_\_\_\_, State of \_\_\_\_\_ a corporation created and existing under the laws of the State of \_\_\_\_\_, hereinafter called SURETY, are held and firmly bound unto the TOWNSHIP OF EAST PENNSBORO, Pennsylvania, as Obligee in the full and just sum of

\_\_\_\_\_ Dollars (\$\_\_\_\_\_). lawful money of the United States of America, for the payment of which we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents,

WITNESSETH THAT:

WHEREAS, The Principal heretofore has entered into an Agreement with the Obligee, dated \_\_\_\_\_, 19\_\_\_\_, (the "Agreement"), to construct Public Improvements at the Principal's expenses; and

WHEREAS, It is a condition of the Agreement that this Bond shall be furnished by the Principal to the Obligee.

NOW, THEREFORE, the terms and conditions of this Bond are and shall be that if the Principal and any subcontractor of the Principal to whom any portion of the work under the Agreement shall be subcontracted, and if all assignees of the Principal and of any such subcontractor, promptly shall pay or shall cause to be paid, in full, all money which may be due any claimant supplying labor or materials in the prosecution and performance of the work in accordance with the Agreement including any amendments to the Agreement, for material furnished or labor supplied or labor performed, then this Bond shall be void; otherwise, this Bond shall be and shall remain in force and effect.

This Bond shall be solely for the protection of claimants supplying labor or materials to the Principal or to any subcontractor of the Principal in the prosecution of the work covered by the Agreement, including any amendments to the Agreement. The term "claimant", when used herein, shall include public utility services and reasonable rentals of equipment, but only for periods when the equipment rented is actually used at the site of the work covered by the Agreement. The provisions of this Bond shall be applicable whether or not the material furnished or labor performed enters into and becomes a component part of the public work or public improvement contemplated by the Agreement.

The Principal and the Surety agree that any claimant, who has performed labor or furnished material in the prosecution of the work in accordance with the Agreement, including any amendments to the Agreement, and who has not been paid therefor, in full, before the expiration of ninety (90) days after the day on which such claimant performed the last of such labor or furnished the last of such materials for which payment is claimed, may institute an action upon this Bond, in the name of the claimant, in assumpsit, to recover any amount due the claimant for such labor or material, and may prosecute such action to final judgement and may have execution upon the judgment; Provided, however, that: (a) any claimant who has a direct contractual relationship with any subcontractor of the Principal, but has no contractual relationship, express or implied, with the Principal, may institute an action upon this Bond only if such claimant first shall have given written notice, serviced in the manner provided in the Act, to the Principal, within ninety (90) days from the date upon which such claimant performed the last of the labor or furnished the last of the materials for which payment is claimed, stating, with substantial accuracy, the amount claimed and the name of the person for whom the work was performed or to whom the material was furnished; and (b) no action upon this Bond shall be commenced after the expiration of one (1) year from the day upon which the last of the labor was performed or material was supplied, for the payment of which such action is instituted by the claimant; and (c) every action upon this Bond be instituted either in the appropriate court of the County where the work is to be performed or of such other County as Pennsylvania statutes shall provide, or in the United States district court for the district in which the work is situated, and not elsewhere.

The Principal and the Surety agree that any amendments to the Agreement and/or any act of forbearance of either the Principal or the Obligee toward the other with respect to the Agreement shall not release, in any manner whatsoever, the Principal and the Surety, or either of them, or their heirs, executors, administrators, successors and assigns, from liability and obligations under this Bond; and the Surety, for value received, does waive notice of any such amendments and/or acts of forbearance.

If the Principal is a foreign corporation (incorporated under any laws other than those of the Commonwealth of Pennsylvania) then further terms and conditions of this Bond are and shall be that the Principal or the Surety shall not be discharged from liability on this Bond, nor this Bond surrendered until such Principal files with the Obligee a certificate from the Pennsylvania Department of Revenue evidencing the payment in full of all bonus taxes, penalties and interest, and a certificate from the Bureau of Employment and Unemployment Compensation of the Pennsylvania Department of Labor and Industry, evidencing the payment of all unemployment compensation,



DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01010 - SUMMARY OF WORK

PART 1 - GENERAL

1.01 SITE LOCATIONS

- A. Project site locations, as covered by the requirements of these Standard Material and Construction Specifications, are in East Pennsboro Township, Cumberland County, Pennsylvania.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

- A. Without intending to limit or restrict the extent of Work which shall meet the requirements of these Specifications, the Work in general comprises construction of extensions to existing underground utility pipelines as well as roadway systems.
- B. Detail Drawings: The following listed Detail Drawings represent the standards of construction of the Township and are bound in the back of this Standard Material and Construction Specifications.
  - 1. On the Detail Drawings, the words "Project Manual" are to be defined as these Standard Specifications.

<u>Detail No.</u>	<u>Drawing No.</u>	<u>Title</u>
1	A-35876	Simplex Grinder Pump
2	A-35877	Duplex Grinder Pump
3	A-35878	In-Line Valve, Pressure Wastewater Sewer
4	A-35879	Terminal Cleanout, Pressure Wastewater Sewer
5	A-35880	In-Line Cleanout, Pressure Wastewater Sewer
6	A-35881	Air Release Junction Chamber, Junction Cleanout, Pressure Wastewater Sewer
7	A-35882	Air Release Chamber, Pressure Wastewater Sewer
8	A-35957	Air Release Chamber, Pressure Wastewater Sewer
9	A-36174	Pressure Lateral
10	A-36175	Low Pressure Drop Connection
17	A-31731	Cleanout Chamber
18	A-28778	Concrete Anchor
26	A-27016	Concrete Thrust Blocks
33	A-28777	Earth Dam
34	A-23528	Embankment
35	A-23526	Encasing Conduit
36	A-29977	Encasing Conduit
36A	A-38783	Encasing Conduit (Removable Carrier Pipe)
60	A-27030	Drop Manhole - Type "A"

<u>Detail No.</u>	<u>Drawing No.</u>	<u>Title</u>
61	A-27031	Drop Manhole - Type "B"
63	A-27065	Precast Reinforced Concrete Manhole Bases
64	A-27080	Standard Manhole - Type "A"
65	A-27081	Standard Manhole - Type "B"
67A	A-27056A	Standard and Watertight Manhole Frame and Cover
70	A-27057	Manhole Steps
73	A-27017	Concrete Cradle
74	A-27019	Concrete Encasement
75	A-27038	First Class Bedding and Initial Backfill
92	A-26074	Service Connection Shallow Sewer
94	A-31498	Service Connection Deep Sewer
121	A-34280	Air Release Chamber
133	A-36181	Tunnel Work Pit & Tunnel Liner Plate

1.03 PRELIMINARY REQUIREMENTS

- A. Before any work is started, the Developer shall ascertain from the Township whether or not the latter intends to employ a consultant as Engineer for the Project. If the Township indicates that no Engineer will be employed, the word "Township" is substituted for the word "Engineer" throughout these Specifications, and the Developer and Contractor shall be guided accordingly.
- B. Where wastewater and storm sewers are to be installed within the limits of existing streets, all removal and protection of street paving, backfilling of trenches, temporary and permanent replacement of street paving, restoration of shoulders and the maintenance and protection of traffic will be performed in strict conformance with the requirements of East Pennsboro Township, other governing municipality or the Commonwealth of Pennsylvania Department of Transportation, as applicable. The cost of inspection by personnel of the Commonwealth of Pennsylvania Department of Transportation shall be paid by the Developer. Perform work within the right-of-way of State Highways in accordance with the requirements of the latest edition of the Commonwealth of Pennsylvania, Pennsylvania Code, Title 67, Transportation, Department of Transportation, Chapter 459, Occupancy of Highways by Utilities. The Regulations are made a part of these Specifications.
- C. When wastewater sewer service connections are required as work of the project, construct them from the test tee to the building using materials required by the current edition of the BOCA Basic Plumbing Code, as amended.
- D. Where feasible, and to the maximum extent possible, locate new wastewater and storm sewers in streets and paved areas to facilitate access for maintenance purposes.

- E. Do not connect stormwater or groundwater drainage to any wastewater sewer extension or existing portion of the Township's wastewater sewer system. No rain water leaders, roof drainage, area or yard drainage, basement, surface or water from fire hydrants, ground water or water from underground drainage fields shall be permitted to drain into or be admitted into the wastewater sewer system, nor shall any of these be admitted to the wastewater sewer system by the use of pumps of any type. The wastewater sewer system, and all extensions, are intended to convey wastewater sewage only.
  
- F. Interfacing Existing Wastewater Sewer Construction:
  - 1. Do not permit ground or surface water to enter the existing wastewater sewer facilities through the new sewer piping connection.
  - 2. Do not flush, drain or deposit water or debris from the newly installed sewer piping or related construction into the existing wastewater sewer facilities.
  - 3. Install a watertight plug in new wastewater sewer piping entering a new or existing manhole that is directly connected to the existing sewer system. Maintain the plug until all debris and accumulated water have been removed from the new sewer facilities and the new sewer facilities have passed all specified acceptance tests.

END OF SECTION

DIVISION - GENERAL REQUIREMENTS

SECTION 01300 - SUBMITTALS

PART 1 - GENERAL

1.01 SUBMISSIONS REQUIRED

- A. General: The descriptions under the SUBMITTALS Article in each Specifications Section indicates the type of submission required. In addition, submit copies of Developer's Drawings and a Construction Progress Schedule.
  - 1. Make all submissions to the office of the Township unless otherwise directed by the Township.
  
- B. Definition: The term shop drawing used throughout this Section includes manufacturer's product data in the forms of descriptive literature, specifications and published detail drawings, and also Contractor prepared drawings, certified test records or reports and such other certificates required by the Specifications.

1.02 DEVELOPER DRAWINGS SUBMISSION

- A. General:
  - 1. Submit two copies of drawings for review. After review of these drawings, make any corrections required and submit six corrected copies.
  - 2. Sheet Size: 24 by 36 inches.
  - 3. Base all elevations on the datum of the existing sewers.
  - 4. Include a note on each drawing that materials used and construction methods employed are in accordance with the latest standards of the Township of East Pennsboro.
  - 5. For details of manholes, bedding, encasement, service connections, etc., make reference to the appropriate "Sewer Detail Drawing" bound herein.
  - 6. Bind drawings in sets and number them consecutively.
  
- B. Indicate on the drawings the following general items:
  - 1. Name of the Design Engineer.
  - 2. Seal of the Design Engineer.
  - 3. Signature of the Design Engineer.
  - 4. Name of the development and the owners.
  - 5. Date.
  - 6. Indicate by note on the Index Map(s) or Plan and Profile sheet(s) the Water Quality Management Permit Number of the existing facility that the proposed wastewater sewers are connecting into.
  - 7. Act 287 (172) list of utilities.
  
- C. Include the following Drawings:
  - 1. Location Plan: Showing approximate area of the municipality in which the project is located. No particular scale is required.

2. Index Map(s): Drawn to a scale of 1" = 400' and having the following items included thereon:
    - a. Sewer sizes other than 8" sewers.
    - b. Names of all streets.
    - c. Number designation of each manhole.
  
  3. Detail Sheets (Plan and Profile): Plan View drawn to a scale of 1" = 50' and Profile View drawn to a horizontal scale of 1" = 50' and a vertical scale of 1" = 10' and having the following items included thereon:
    - a. Location of each existing or proposed building with elevation of the existing or proposed basement (Plan View). If proposed basement elevations are not known, the drawings must include a note stating which lots are not intended to be provided with gravity basement drainage.
    - b. Sewer ties to existing permanent and semi-permanent features (Plan View).
    - c. Top elevations of manholes (Profile View).
    - d. Invert elevations of manholes (Profile View).
    - e. Manhole numbers corresponding to those on Index Map (Plan View and Profile View).
    - f. Distance between manholes (Profile View).
    - g. Grade of proposed sewer (Profile View).
    - h. Size of proposed sewer (Profile View).
    - i. Location, size and elevation of all existing and proposed underground utilities (Plan View and Profile View).
    - j. Service Connection Ties:
      - 1) The measurement to locate the wye or tee branch is the horizontal distance measured along the centerline of the main sewer from the downstream manhole to the centerline of wye or tee branch.
      - 2) The ties and measurements necessary to locate the upper free end of the wastewater sewer service connections are:
        - a) The horizontal distance measured to the closest tenth of a foot from the downstream and upstream property markers or house corners to the end of the service connection.
        - b) The horizontal distance from the center line of the main wastewater sewer to the end of the service connection.
        - c) The depth from the ground surface or the top surface of curb to the invert of the service connection.
- D. Submit the following information as a supplement to the construction drawings:
1. Number of persons to be served initially.
  2. Number of persons to be served in the future.
  3. Number of acres to be served initially.
  4. Number of acres to be served in the future.
  5. Initial and future wastewater sewer flows if the development is other than residential.
- E. Record Drawings: Before the work will be accepted by the Township, submit reproducibles of all Drawings, modified as necessary to show the facilities as constructed. Submit a certificate with the record reproducibles attesting to the correctness of all information shown on

the Drawings. The Township intends to use prints of the reproducibles to provide information to designers and contractors as required by the Commonwealth of Pennsylvania Act 287 as amended by Act 172.

1.03 RIGHT-OF-WAY DRAWINGS

- A. Provide 6 copies of all required plats and descriptions for rights-of-way.
- B. Provide a deed of conveyance transferring ownership of the wastewater sewer or storm sewer extension to the Township.

1.04 CONSTRUCTION PROGRESS SCHEDULE - CONTRACTOR SUBMISSION

- A. At least seven days before work is commenced, submit three copies of a practicable and feasible progress schedule showing the order in which the Work is to be carried on, the dates on which salient features will start (including procurement of materials and equipment), and the contemplated dates for completing same.
- B. Prepare the schedule in chart form and of a suitable scale so as to appropriately indicate the percentage of Work completed at any time.
- C. At the end of each month, update the Construction Progress Schedule by entering the actual progress of the Work on the schedule. Deliver three copies of the updated Construction Progress Schedule immediately after its completion.

1.05 SHOP DRAWINGS - CONTRACTOR SUBMISSION

- A. Submit five copies of each shop drawing with such promptness as to avoid delay in the work.
- B. Each submission of shop drawings must be accompanied by a letter of transmittal listing the items in the submission. Each shop drawing must be marked with the name of the Project and the name of the Contractor and be numbered consecutively.
- C. When making a submission for approval, the Contractor shall do so with the understanding that he is considered to have checked the items in the shop drawing before submitting them and that he is satisfied that, in their present state, they not only meet the requirements of the Specifications, but will present no difficulties in construction and completing his Contract, and shall clearly note his approval on all shop drawings prior to their submission to the Engineer. Failure of the Contractor to note his approval will be reason for the Engineer to return such submission to the Contractor unchecked.
  - 1. If it appears that shop drawings submitted by the Contractor to the Engineer have not been properly checked, even though the Contractor's approval has been noted thereon, it will also be considered reason for the Engineer to return such submission to the Contractor unchecked.
  - 2. Markings, written or otherwise, made by the Contractor or by his suppliers or manufacturers must be made on the Submittal in a color

other than red. RED is reserved for the exclusive use of the Engineer in marking Submittals.

- D. If shop drawings show variations from the Specifications requirements because of standard shop practice or other reasons, the Contractor shall make specific mention of such variations in his letter of submission in order that (if accepted) suitable action may be taken for proper adjustment in the Contract; otherwise the Contractor will not be relieved of the responsibility for executing the Work in accordance with the Specifications even though the shop drawings have been approved.
- E. The approval of shop drawings will be general and shall not relieve the Contractor from the responsibility for proper fitting and construction of the Work nor from furnishing materials and work required by the Specifications which may not be indicated on the shop drawings when approved.
- F. After review by the Engineer, shop drawings will be returned marked as follows: Approved, Approved With Changes Noted, Returned for Correction or Not Approved.
  - 1. Approved: When shop drawings are returned "Approved", that means the shop drawings have been found to be in conformance with the Specifications. The Engineer's approval of the shop drawings does not relieve the Contractor from responsibility for errors or discrepancies in such shop drawings.
  - 2. Approved with Changes Noted: When shop drawings are returned "Approved With Changes Noted" that means the shop drawings have been found to be in conformance with the Specifications, provided the changes noted by the Engineer are incorporated in the shop drawings. Shop drawings returned "Approved With Changes Noted" will not require resubmission.
  - 3. Returned For Correction: When shop drawings are returned noted "Returned For Correction" that means the Contractor shall make the required corrections and resubmit five copies of corrected shop drawings to the Engineer.
  - 4. Not Approved: When shop drawings are returned "Not Approved" that means the Contractor shall make completely new shop drawings and submit five copies to the Engineer for review.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

NOT APPLICABLE TO THIS SECTION

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01500 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 TEMPORARY SERVICES

- A. General: Provide temporary services at the site of the Work throughout the entire period of construction and until the Work of the Contract is completed and the new facilities are placed in operation of the Township's personnel.
  
- B. Temporary Water Control:
  - 1. At all times during the construction of work of this Contract maintain the flow of storm water, naturally occurring water and wastewater in existing facilities and channels affected by the Work.
  - 2. Particular attention is directed to above requirement in regard to the maintenance of flow in existing wastewater sewer service connections during removal and replacement of the wastewater sewer main.
  - 3. Contractor assumes risk from floods or other causes, and any damages done to the work in progress or to work completed under Contract. Make repairs and replacements to the satisfaction of the Engineer.
  - 4. Contractor assumes responsibility for damages to property caused by flooding or backflooding of property due to blocking or restriction of storm water passages, natural waterways and wastewater facilities capacity during normal or excessive periods of water flow.
  - 5. At any time do not permit wastewater flow from existing sewers to flow into nearby waterways or to flow on surface areas. Furthermore, should an accidental discharge occur, notify the Department of Environmental Resources immediately at (717) 787-4343.
  - 6. The means and methods the Contractor employs to meet above requirements are at his discretion but will be subject to the Engineer's approval.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

**PART 3 - EXECUTION**

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**3.01 REMOVAL**

- A. Contractor shall dismantle (if required) and remove such temporary facilities as required during construction of the project.

**END OF SECTION**

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01570 - TRAFFIC REGULATION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Purpose: The purpose of this Section is to provide the Contractor with general guidelines for the control of traffic while the work of the Project within street right-of-way is being performed. The goal is to help ensure safe and efficient traffic movement through work areas and provide safety for the Contractor's work force.

1.02 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
1. Furnish, erect and maintain at closures, intersections, and throughout the Project, the necessary approved barricades, suitable and sufficient lights, approved reflectors, danger signals, warning, detour and closure signs. Provide a sufficient number of watchmen and take the necessary and legal precautions for protection of work and safety of the public. Barricades, danger signals, signs and obstructions shall be illuminated from sunset until sunrise. Materials and safety devices (i.e., barricades, flashing warning lights, reflectors and signs) shall conform to the State Department of Transportation Specifications.
  2. Traffic regulation on streets other than State Highways shall be performed in accordance with the requirements of the Township of East Pennsboro or other governing agency or Authority having jurisdiction.
  3. State Highways:
    - a. The Contractor is advised that he is required to provide traffic control in complete compliance with the rules and regulations of the Pennsylvania Department of Transportation (PDT), including but not necessarily limited to the following:
      - 1) PA Code Title 67, Transportation: Chapter 203 - Work Zone Traffic Control.
      - 2) PA Code Title 67, Transportation: Chapter 441 - Access to and Occupancy of Highways by Driveways and Local Roads.
      - 3) PA Code Title 67, Transportation: Chapter 459 - Occupancy of Highways by Utilities.
      - 4) Section 901 "Maintenance and Protection of Traffic During Construction" of the Commonwealth of Pennsylvania Department of Transportation Specifications Publication 408, as supplemented, and such other sections therein which complement this Section.
    - b. Fines and related costs resulting from the Contractor's failure to provide adequate traffic control shall be borne solely by the Contractor.

**PART 2 - PRODUCTS**

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**2.01 MATERIALS**

- A. Materials and safety devices such as barricades, flashing warning lights, reflectors and signs, provided for the purpose of protecting the work and the safety of the public, and for maintaining and protecting traffic, shall conform to the requirements specified in Section 901 of the current edition of the Commonwealth of Pennsylvania Department of Transportation Specifications Publication 408 (as supplemented) and to the requirements specified in the current edition of PA Code Title 67, Transportation: Chapter 203 - Work Zone Traffic Control which complements Section 901.
  
- B. Provide danger signals and warning signs in the approved orange color.

**PART 3 - EXECUTION**

---

NOT APPLICABLE TO THIS SECTION

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02010 - SUBSURFACE EXPLORATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Digging Test Pits:

1. In locations where new underground utilities are to be connected to existing underground utilities, the Contractor will not be permitted to proceed with the new construction until he has dug test pits and determined the exact location and elevation of the existing underground utilities. Dig such test pits only at the locations agreed to by the Engineer.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

NOT APPLICABLE TO THIS SECTION

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02151 - SHORING

PART 1 - GENERAL

1.01 RELATED WORK

- A. Division 2 Sections involving excavations.

1.02 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
  - 1. Shoring materials and installation work shall conform to Federal, State and local laws, rules, regulations, requirements, precautions, orders and decrees.
  - 2. The duty or responsibility for inspection, determination, compliance and enforcement of Federal, State, local laws, rules, regulations, requirements, precautions, orders and decrees rests with such department or agency and not with the Owner or Engineer.

1.03 SITE CONDITIONS

- A. Responsibility for Condition of Excavation:
  - 1. The Contractor is solely responsible for the condition of his excavations.
  - 2. The failure or refusal of the Engineer to suggest the use of Shoring, or a better quality, grade, or section, or larger sizes of Shoring materials, or to suggest Shoring to be left in place, shall not in any way or to any extent relieve the Contractor of any responsibility concerning the condition of excavation or of any of his obligations under the Contract, nor impose any liability on the Engineer or the Township; nor shall any delay, whether caused by any action or want of action on the part of the Contractor, or by any act of the Engineer, Township, or their agents, or employees, resulting in the keeping of any excavation open longer than would otherwise have been necessary, relieve the Contractor from the necessity of properly and adequately protecting the excavation from caving or slipping, nor from any of his obligations under the Contract relating to injury to persons or property.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Shoring materials shall conform to Federal, State and local laws, rules, regulations, requirements, precautions, orders and decrees.

PART 3 - EXECUTION

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3.01 INSTALLATION

- A. Shoring installation shall conform to Federal, State and local laws, rules, regulations, requirements, precautions, orders and decrees.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02221 - TRENCHING, BACKFILLING AND COMPACTING

PART 1 - GENERAL

1.01 RELATED WORK

- A. Subsurface Exploration: Section 02010.
- B. Shoring: Section 02151
- C. Erosion and Sediment Pollution Control: Section 02270.
- D. Division 3 - Concrete.

1.02. DEFINITIONS:

- A. Rock Excavation: Removal of consolidated hard mineral material mass exceeding one-half cubic yard in volume which, in the opinion of the Engineer, cannot be excavated except by drilling and blasting or drilling and wedging. Structure foundations of concrete or of masonry or stone laid in cement-mortar will also be considered rock if the volume requiring removal at any single location exceeds one-half cubic yard. No soft or disintegrated rock which can be removed with a pick, nor any material which can be broken down by sledge hammers, nor any ledge or single boulder less than one-half cubic yard in volume, nor loose, shaken, or previously blasted rock, nor broken stone in rock filling or elsewhere, nor rock exterior to the line of measurement as hereinafter specified, will be considered rock.
- B. Items involved in the excavation such as sidewalks, curbs and street or roadway paving of whatever material shall not be considered rock excavation.
- C. Earth Excavation: Removal of materials of any kind in the excavation which, in the opinion of the Engineer, cannot be considered rock excavation.
- D. Earth Excavation Below Subgrade: Same as earth excavation except such excavation is performed below elevations given as subgrade.
- E. Subgrade: Trench bottom prepared as specified to receive first class bedding, concrete cradle or concrete encasement or the bottom of excavations prepared to receive pipe line structures.

1.03 QUALITY ASSURANCE

- A. Source Quality Control:
  - 1. Laboratory Tests: In accordance with Article 1.06 of the General Instructions, materials stated herein require advance examination

or testing according to methods referenced, or as required by the Engineer.

- a. Testing laboratory shall furnish both Engineer and Contractor two (2) copies of test result reports. Same reports will be considered as sufficient evidence of acceptance or rejection of materials represented.
- b. Conduct aggregate quality tests in accordance with requirements of appropriate Referenced Standard for such materials.
- c. The Engineer reserves the right to accept certificates of approved quality materials from an approved source in lieu of laboratory testing, or to require both.

1.04 REFERENCES

- A. East Pennsboro Township excerpt from Ordinance Number 11-54, as amended (Bound in immediately following this Section) with the following exception:
  1. Article 12 Backfilling of Openings/Excavations is not applicable.
- B. American Society for Testing and Materials:
  1. ASTM D 698; Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb (2.49-kg) Rammer and 12-in. (304.8mm) Drop.
  2. ASTM D 1556; Test Method for Density of Soil in Place by the Sand-Cone Method.
  3. ASTM D 2321, Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
  4. ASTM D 2922; Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- C. Commonwealth of Pennsylvania Department of Transportation (PDT), Specifications Publication 408, as supplemented.
  1. PDT Section 703.1 Fine Aggregate.
  2. PDT Section 703.2 Coarse Aggregate.
  3. PDT Section 703.3 Select Granular Material (2RC).

1.05 SUBMITTALS

- A. Samples: Make all required submissions to the Engineer's Office.
  1. Aggregates: If requested by the Engineer, submit a 10 lb. sample, packaged in container of suitable strength, for Engineer's verification and certification for submission to testing laboratory.
- B. Test Reports:
  1. Submit testing laboratory aggregate test reports based on requirements stated in Source Quality Control.
  2. Compaction density test reports based on method of density determination as specified in Reference Standards and the method as approved by the Engineer.
- C. Certificates: Submit certificate from aggregate supplier based on requirements stated in Source Quality Control, when requested by Engineer.

1.06 SITE CONDITIONS

A. Removal of Obstructions:

1. Remove, realign or change the direction of above or below ground utilities and their appurtenant supports, if such is required in the opinion of the Engineer. Perform such work unless such work is done by the Owner of the obstruction. However, the Contractor shall uncover and sustain the obstruction prior to the final disposition of obstruction. Additional precautions concerning obstructions as follows:
  - a. Do not interfere with persons, firms, corporations or utilities employing protective measures, removing, changing or replacing their property or structures, but allow said persons, firms, corporations or utilities to take such measures as they may consider necessary or advisable under the circumstances.
  - b. Break through and reconstruct if necessary, the invert or arch of any sewer, culvert or conduit that may be encountered if the said structure is in such a position, in the judgment of the Engineer, as not to require its removal, realignment or complete reconstruction.
  - c. Expenses incurred by the owner of the trackage for shoring his railroad tracks due to trenching crossing or paralleling the railroad right-of-way shall be borne by the Developer or the Contractor whether billed to him directly or to the Township.

B. State Highway Pipe Foundation Underdrain: Replace underdrain which is damaged or removed during construction.

1. Use same type and quality of pipe, and coarse and fine aggregate backfill material as existing.
2. Salvage and reuse of the piping will be permitted to reconstruct the pipe foundation underdrain; however, the Engineer will inspect this pipe after its removal and all such pipe determined unsuitable for reuse shall be replaced by the Contractor with new pipe.
3. Use new coarse and fine aggregate backfill material.
4. Work must be performed to the requirements and satisfaction of the Pennsylvania Department of Transportation.

C. Environmental Requirements:

1. Do not perform trenching, backfilling or compacting when weather conditions or the condition of materials are such, in the opinion of the Engineer, that work cannot be performed satisfactorily.
2. Do not use frozen materials as backfill nor wet materials containing moisture in excess of the amount necessary for satisfactory compaction.
3. Prior to use, moisten dry backfill material not having sufficient moisture to obtain satisfactory placement or compaction.
4. Plan work so as to provide adequate protection during storms with provisions available at all time for preventing flood damage. Protect installed piping and other work at all times against damage from uplift due to high ground water levels.

5. Accommodation of Drainage: Keep gutters, sewers, drains and ditches open at all times for surface drainage. No damming or ponding or water in gutters or other waterways will be permitted, except where stream crossings are necessary and then only to an extent which the Engineer shall consider necessary. Do not direct water flows across or over pavements except through approved pipes or properly constructed troughs. When so required, provide pipes or troughs of such sizes and lengths as may be required, and place the same as required. Perform grading in the vicinity of trenches so that the ground surface is properly pitched to prevent water running into the trenches.
  6. Pumping: Keep excavations free from water at all times during the performance of the work. Build dams and other devices necessary for this purpose, and provide and operate pumps of sufficient capacity for dewatering the excavations. Provide for the disposal of the water removed from excavations in such manner as not to cause injury to the public health, to public or private property, to the work of others, to any portion of the work completed or in progress or produce an impediment to the use of streets, roads and highways.
  7. Do not dispose of water in trenches by draining through completed portions of sewer piping.
  8. When it is necessary to haul soft or wet soil material over roadways, use suitably tight vehicles to prevent spillage. Clear away spillage of materials on roadways caused by hauling.
  9. Provide effective dust control by sprinkling water, use of calcium chloride or any other method approved by Engineer. Employ dust control when, where and in a manner required by Engineer.
- D. Protection: Assume all risks attending the presence or proximity of overhead or underground public utility and private lines, pipes, conduits and support work for same, existing structures and property of whatever nature. Damages and expenses for direct or indirect injury to such structures, or to any person or property by reason of them or by reason of injury to them, whether such structures are or are not shown on the Drawings, rests solely with the Contractor.
1. Outside Rights-Of-Way: Take necessary precautions to protect trees, shrubs, lawns and such other landscaping from damage. Restitution work for damages rests solely with the Contractor.
  2. Pipe Supports: Adequately support underground pipes or conduits exposed as a result of excavations. Provide adequate support along their entire exposed length by timber or planking. Install such supports in such manner that backfilling may be performed without dislodging such pipes or conduits. Place and carefully compact Clean Earth Backfill or Aggregate Backfill, as required, around the supports, and leave such supports in place as a guard against breakage due to backfill settlement.

3. Temporary Protective Construction:
  - a. Temporary Fence Barricade: Erect and maintain substantial temporary fences surrounding excavation to prevent unauthorized persons entering such areas.
  - b. Temporary Fence: Where necessary, to keep one side of streets or roadway free from obstruction or to keep material piled along side of the trench from falling on private property outside the right-of-way, erect and maintain a safe and substantial fence.
  - c. Barricades: Furnish and erect substantial barricades at crossings of trenches, or along trenches, to protect the traveling public.
  - d. Excavation Covers: Cover open excavation when work therein is suspended or left unattended, such as at the end of a work day. For such covers, use materials of sufficient strength and weight to support vehicle traffic and to prevent their removal by unauthorized persons.
  - e. Remove temporary protective construction at the completion of work on the Project.
  
- E. Structure Supports: Where trenches pass buildings or structures which by their construction or position might exert detrimental pressure on the trenches, the Engineer reserves the right to require that such buildings or structures be underpinned or supported and protected, or special sheeting be driven, or that short lengths of trench be opened at one time.
  
- F. Accommodation of Traffic: Do not obstruct streets, roads and highways. Unless the Municipality or Governing Agency authorizes in writing the complete closing of the street, road or highway, employ such measures as may be necessary to keep the street, road or highway open and safe for traffic. Maintain a straight and continuous passageway on sidewalks and over crosswalks, at least three feet wide and free from obstructions. DO NOT OBSTRUCT FIRE HYDRANTS.
  1. At the shutdown of work at the end of the day all streets shall be left in such condition whereby they can be readily opened and safely traveled in cases of emergency such as fire or for ambulance service.
  
- G. Explosives and Blasting: Use and store explosives in accordance with requirements of Federal, State and local laws, rules, regulations, precautions, orders and decrees. Additionally comply with the following:
  1. Do not use methods of blasting which will result in breakage beyond trenching areas or which is dangerous to the public or destructive to property.
  2. The Contractor is solely responsible for injury to persons or property as a result of his use of explosives.
  3. Properly mat and securely cover blasts.
  4. Schedule blasting in the proximity of proposed new concrete work prior to placement of concrete.
  5. Notify utility owners having structures of other installations (if any) above or below ground in proximity to the trenching work prior

to use of explosives. Such notice must be given sufficiently in advance to enable the utility owners to take such steps as they may deem necessary to protect their property from injury. Such notice shall not relieve the Contractor of responsibility of damage resulting from his use of explosives. The Engineer reserves the right to direct that rock within five feet of pipe, conduit or other structures encountered in the trench be removed by methods other than blasting.

6. Provide competent blasting expert to supervise blasting.
  7. Predrilling and blasting not permitted without written permission of Engineer.
  8. Stop blasting operations when street paving adjacent to trench is damaged. Repair damaged street paving. Submit to Engineer methods to be used in subsequent blasting. Do not proceed with blasting without written approval of Engineer on methods to be used in subsequent blasting.
- H. Removal of Rock by Means Other Than Blasting: Where removal of rock by means other than blasting is required, perform the work using methods specifically developed for rock removal and in accordance with the requirements of State and local laws, rules and regulations, and utility owner requirements.
- I. Excavation Condition: Condition and results of excavation are solely the responsibility of the Contractor. Remove slides and cave-ins at whatever time and under whatever circumstance they occur.
- J. Excess Materials: No right of property in materials is granted the Contractor of excavated materials prior to backfilling. This provision does not relieve the Contractor of his responsibility to remove and dispose of surplus excavated materials.
- K. Borrow Material: When the required quantity of backfill material exceeds the quantity of suitable on site material, provide borrow material. If borrow material is needed, notify the Engineer sufficiently in advance to permit the Engineer to verify such need and to view the proposed borrow pit to determine the material suitability. Borrow excavation will be subject to the Engineer's approval whose written consent shall be obtained prior to its use.

## PART 2 - PRODUCTS

### 2.01 MATERIAL

- A. Backfill: On site excavated soil or soil-rock mixed materials free of topsoil, vegetation, lumber, metal, refuse; and free of rock or similar hard objects larger than six inches in any dimension. Rock to soil ratio shall not exceed one part rock to three parts soil.
- B. Clean Earth Backfill: On site excavated material free of vegetation, lumber, metal, refuse; and free of rocks or similar hard objects larger than one inch in any dimension. Rock to soil ratio shall not exceed one part rock to three parts soil.

- C. Aggregate Backfill: Select Granular Material (2RC) conforming to PDT Section 703.3.
- D. Pipe Bedding:
  - 1. First Class Bedding: Coarse Aggregate conforming to PDT Section 703.2.
    - a. For piping having a diameter of 21" and less use AASHTO No. 8 Coarse Aggregate.
    - b. For piping having a diameter of 24" and larger use AASHTO No. 57 Coarse Aggregate.
  - 2. Initial Backfill: Coarse Aggregate conforming to PDT Section 703.2.
    - a. For piping having a diameter of 21" and less use AASHTO No. 8 Coarse Aggregate.
    - b. For piping having a diameter of 24" and larger use AASHTO No. 57 Coarse Aggregate.
- E. Fine Aggregate: Conforming to PDT Section 703.1, for Type A sand.
- F. Concrete Cradle and Encasement: Per requirements of Cast-In-Place Concrete: Section 03300 and of the following Class:
  - 1. Class B: 3000 psi.
- G. Underground Warning Tape:
  - 1. Printed polyethylene tape, 3 inches minimum width, color coded, 1 inch minimum lettering, printed with name of utility buried below, and suitable for installation in all soil types.
  - 2. Magnetic.
  - 3. Provide for:
    - a. Wastewater sewers, green.
    - b. Storm sewers, green.
    - c. Sewage force main, green.
    - d. Water line, blue
    - e. Gas line, yellow.
    - f. Electrical conduit, red.
    - g. Telephone conduit, orange.
    - h. CATV conduit, orange.
    - i. Petroleum line, yellow.
- H. Foundation Backfill: AASHTO No. 3 Coarse Aggregate conforming to PDT Section 703.2.

2.02 OPTION IN MATERIALS

- A. Backfill Under Proposed Streets Other Than State Highways: It is a Township requirement that trenches be allowed to settle for a minimum of 90 days prior to replacement of permanent paving.
  - 1. If permanent pavement is to be installed on or after the 90 day limit, use On-Site Backfill material for trench refilling.
  - 2. If permanent pavement is to be installed prior to the 90 day limit, use either one of the Aggregate Backfill materials for refilling the trench.

**PART 3 - EXECUTION**

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**3.01 PREPARATION**

- A. Wastewater Sewer Pipe Lines and Grades: Layout and maintain lines and grades as follows.
1. Sewer grades shall conform to the requirements of the Pennsylvania Department of Environmental Resources. The minimum grade of all terminal sewer runs shall be 0.60 percent. Where practical, however, a grade of at least 1.00 percent is preferred for terminal sewer runs.
  2. By Contractor: Prior to excavation for a run of piping, set control point for line and grade as given on the Drawings.
    - a. Control points sufficiently offset from trench centerline to prevent loss of points during excavation and pipe laying operations.
    - b. Offset on the trench side opposite the excavated material stockpile.
    - c. Control points set 25 feet apart maximum.
    - d. In unpaved areas control points placed on the top of stakes; in paved areas, control points to be spikes driven into paving or crosses cut into paving, both encircled with paint.
    - e. Compute the depth of cut to sewer invert from top of stakes or other control points.
    - f. Use computed depths of cut as guides for rough excavation, allowing for excavating to accommodate the first class bedding, and for concrete cradles or concrete encasements where indicated or required by the Engineer. Mark station and depth of cut on stakes or paint on paved surface.
    - g. Batter Boards and Grade Stakes: As rough excavation is completed set grade stakes or batter boards of No. 2-Grade or equal lumber across the trench opposite the control point. Securely set up and support each board to prevent accidental displacement and to insure each board being leveled equidistant above the pipeline invert. Run a taut string line between boards directly over the proposed pipeline centerline. Use the string line as a control for maintaining pipeline grade and horizontal alignment. Use a grade stake or pole, with a true right-angled offset designed to rest on the pipe invert, to check the vertical distance from string line to invert. Use a plumb line from the string line to the center of pipe to maintain horizontal alignment.
    - h. Methods used to lay out and maintain lines and grades of pipelines, other than those specified previously, will be permitted; however, such methods will be subject to the approval of the Engineer. If use of laser beam is approved by Engineer, check beam position every fifty feet of line by survey or other approved method.

**B. Preparation of Surfaces:**

1. Do not remove trees in rights-of-way except by authorization of the Engineer.
2. Perform authorized tree removal, including stumps and debris, by methods meeting Engineer's approval.
3. Perform authorized shrubbery removal, store shrubs in protected manner and replant or replace such shrubbery.
4. Trim merchantable timber of limbs and tops, and unless otherwise ordered by the Engineer, saw timber into 8 foot lengths. Stock-pile timber at locations designated on the site by the Engineer. Merchantable timber is timber larger than 6 inches in smallest diameter from which saw logs, pulpwood, posts, poles, ties or cordwood can be produced.
5. Dispose of tree removal debris in a lawful manner.
6. Where embankment is to be placed, clear and grub the area to a depth not less than 6 inches below existing ground.

**3.02 PERFORMANCE**

A. Perform shoring in accordance with requirements of Shoring: Section 02151.

B. Perform soil erosion control work in accordance with requirements of Section 02270.

C. Embankments: Construct embankments in accordance with the following paragraphs.

1. Use backfill placed in nine inch layers and each compacted separately using equipment meeting with Engineer's approval. Carry the whole embankment up evenly the required elevation without breaks or irregularities in material distribution or in the formation of layers. Trim embankment slopes and leave in a neat and acceptable condition.
2. Add water to Backfill which does not contain a sufficient amount of moisture to obtain the required compaction. Backfill containing moisture in excess of the amount required to obtain the necessary compaction density may not, without written approval, be incorporated in the embankment until allowed to dry to a moisture content not greater than two percentage points above optimum for that particular material.
3. Fill existing natural depressions or such other depressions resulting from the site work to the level of adjacent ground elevation in the same manner specified for formation of embankment prior to starting initial embankment layer.
4. Remove existing embankment foundation material when determined unsatisfactory by the Engineer. Refill such areas to original elevation in the same manner specified for formation of embankment.
5. Scarify embankment foundation surface where embankment three feet or more in height is to be placed. Scarify or otherwise loosen embankment foundation surface to a depth of six inches where embankment less than three feet in height is to be placed.
6. Existing embankment foundations having a slope steeper than four to one shall be plowed to provide embankment binding when required by

- the Engineer. On steeper slopes the Engineer may require the foundation to be cut into steps or berms.
7. Compact embankment material to a minimum final density of not less than 90 percent of the maximum dry weight density at its optimum moisture content.
  8. Borrow excavation materials required for embankment shall meet the requirements of backfill. During the excavation operation, keep the borrow area graded to insure free water drainage. Following completion of work in the borrow area, grade the area to present a uniformly trim appearance merging into the surrounding terrain and to prevent serious erosion.
  9. When pipe is to be laid in fill, bring embankment height to at least four feet above the top of the pipe before the trench is excavated.
- D. Excavating: Perform excavation and backfilling using machinery except that hand excavation and backfilling may be required where necessary to protect existing structures, utilities or private or public properties; and except that backfilling shall be done by hand to the extent hereinafter specified.
1. Begin excavation in trenches at the control point having the lower invert and proceed upgrade.
  2. Remove surface materials of whatever nature over the line of trenches and other excavations and properly separate and store removed materials as suitable for use in backfilling or other purposes.
    - a. Cut paving with a mechanical saw and to neat lines equidistant from the centerline of the trench.
  3. Remove subsurface materials of whatever nature down to subgrade elevation. Properly separate and store removed subsurface materials as suitable for use in backfilling.
  4. Pre-drilling or pre-drilling and blasting within State Highway rights-of-way not permitted unless authorized by the state highway agency. Prior to removal of rock within State Highway rights-of-way strip earth to rock.
  5. Remove rock to subgrade at least 25 feet in advance of pipe laying.
  6. Remove rock below subgrade if shattered due to rock removal operations and in the opinion of the Engineer it is unfit for foundations. Backfill to subgrade with Class B Concrete per requirements of Cast-In-Place Concrete, Section 03300, or other material acceptable to the Engineer.
  7. Where rock is encountered in excavations for manholes in which blank connections are to be left for future extensions of sewers, remove rock for a distance of not less than ten feet from the center of the manhole in the direction of future extension. Excavate trench to specified width, depth and length.
  8. Remove and waste or otherwise dispose of such excavated materials not required for backfill.

- E. Excavated Material Storage:
  - 1. In streets, roads and highways or in any other locations where working space is limited, remove the excavated materials from the first 100-feet of any opening, when required by the Engineer, as soon as such is excavated; store and return same for backfilling when required. In no case will the Contractor be allowed to cast excavated material beyond the curb or right-of-way lines or on sidewalks or lawns.
  - 2. Where more material is excavated from trenches than can be backfilled or stored on the street or within rights-of-way limits, leaving space for traffic and drainage, remove and store such excess material; return same for backfilling when required.
  
- F. Subgrade Preparation for Wastewater and Storm Sewers: In trenches, both earth and rock (if any), provide first class bedding as pipe foundations. In lieu of first class bedding provide concrete encasement or concrete cradle or other type of bedding as shown on the Sewer Detail Drawings or required by the Engineer. If maximum trench widths specified in Table A (following) are exceeded, provide concrete cradle or concrete encasement in such locations.
  
- G. Trench Width and Depth for Wastewater and Storm Sewers: From subgrade elevation to an elevation at least twelve inches above the top of the outside barrel of the pipe, excavate trench banks to vertical lines and not less than the minimum nor more than the maximum widths specified in Table A. If sheeting is required, the following Table A dimensions apply to the inside face of sheeting.

TABLE A

<u>Diameter of Pipe</u>	Minimum Trench Width (Outside Diameter of Pipe at <u>the Barrel Plus</u> )	Maximum Trench Width (Outside Diameter of Pipe at the Barrel Plus
4 through 24 inches	12 inches	16 inches
27 through 36 inches	20 inches	24 inches
42 through 72 inches	26 inches	30 inches

- 1. From a point twelve inches above the top of the outside barrel of the pipe, keep trench banks as nearly vertical as possible for trenches made in paved or unpaved roadways and in no case shall trench width at the top exceed the outside diameter of the pipe at the barrel plus the dimensions in Table B. When the excavation limits of Table B cannot be held, install temporary sheeting at no expense to the Owner.

TABLE B

<u>Diameter of Pipe</u>	<u>Maximum Trench Width at Top of Trench (Outside Diameter of Pipe at the Barrel Plus)</u>
4 through 24 inches	40 inches
27 through 36 inches	48 inches
42 through 72 inches	54 inches

2. Where pipe lines are constructed in rights-of-way or easements in open country, the maximum top of trench width as specified previously may be exceeded only if the construction is kept entirely within the limits of rights-of-way or easements and can be carried on without damage to adjoining property. The angle of slope shall be the angle at which the trench bank will stand, but in no case shall the angle of slope be steeper than one-half horizontal to one vertical.
  3. In locations other than rights-of-way or easements and where warranted by working conditions, the Engineer may waive Table B requirements provided there is no conflict with the Department of Labor and Industry regulations of the State in which the project is located.
  4. Excavate rock for manhole installation 1 foot outside the exterior lines of the manhole walls and to a depth of the outside bottom.
- H. Additional Excavation: Do not excavate below depths indicated or specified except where unstable or unsuitable material is encountered at subgrade. Excavate such material to the increased depth as may be required by the Engineer and refill to the proposed subgrade with thoroughly compacted Foundation Backfill material or construct timber foundation as required by the Engineer.
- I. Length of Open Trench: The Engineer shall have the right to limit the amount of trench opened in advance of utility pipeline installation and the amount of pipe laid in advance of backfilling, but in no case shall these amounts exceed 300 feet and 100 feet respectively. Complete trench excavation at least twenty-five feet in advance of utility pipeline installation and keep trenches free from obstructions, except that at the end of a work day or at the discontinuance of work, the utility pipeline installation may be completed to within five feet of the end of the open trench. Additional open trench limitations as follows:
1. The Engineer is empowered to require trench refilling over completed utility pipeline at any time if in his judgment such action is necessary.
  2. If Work is stopped on any trench for any reason, except as required by the Engineer, and the excavation is left open for an unreasonable period in advance of construction in the opinion of the Engineer, the Engineer may order trench refilling and not allow trench reopening until ready for actual use.

- J. Tunneling, Jacking and Boring:
1. As Specified in Section 02300 with the following additional requirements:
  2. Make tunnels for laying utility pipelines of sufficient size to allow at all points the proper joining of the pipelines and the proper compacting of refill around them. Methods of tunneling, jacking or boring used as may affect the workmanship or quality of completed work or product shall be changed as work progresses if, in the judgment of the Engineer, conditions so require. Methods of tunneling, jacking and boring with respect to responsibility and liability for safety to persons and property rests solely with the Contractor.
    - a. Where rock is encountered in tunnel work, take rock out fully to the lines prescribed by the Engineer.
    - b. Timber tunnels to such extent as may be necessary. Where ordinary timber lining is used, completely fill the space between such timber and the outer surface of the pipeline with clean earth backfill or other approved material, rammed solidly between the pipeline and the timber lining, or fill same space with concrete encasement material if ordered by the Engineer.
- K. Backfilling: Perform trench backfilling and backfilling excavations for other in line structures by methods which will result in thorough compaction of backfill material without displacement of the grade and alignment of the utility pipeline and its appurtenances and minimum settlement of backfilled material. Displacement of the utility pipeline and settlement of backfill shall be considered evidence of improper workmanship or inclusion of unsuitable backfill materials, or both, and will require regrading and realigning the utility pipeline and removing and recompacting settled material.
1. For Storm and Wastewater Sewers: Following pipe bedding and piping and inline structure installation, backfill trenches to a height at least one foot above the top of the outside barrel of the pipe with Initial Backfill placed in four inch layers. This backfill shall be carefully placed in trenches in such manner as not to damage or disturb the pipe.
  2. For All Utilities: Refill remainder of the trench using backfill materials specified below. Exercise care to carry backfill up evenly on opposite sides of piping.
    - a. Within the Right-of-Way Limits of Existing State Highways: Conform to the requirements of the Pennsylvania Department of Transportation Highway Occupancy Permit.
    - b. Streets Other Than State Highways: Aggregate Backfill compacted in eight inch layers or, for Proposed Streets, or if approved by the Township, On-Site Backfill Material compacted in four inch layers to the bottom of permanent paving.
    - c. Unpaved Shoulders of Proposed State Highways: Backfill compacted in six inch layers to a point 18 inches below the adjacent existing surface. Backfill the remaining 18 inches with Aggregate Backfill compacted in six inch layers.
    - d. Unpaved Shoulders of Proposed and Existing Streets Other Than State Highways: Backfill compacted in six inch layers to a point 6 inches below the adjacent existing surface. Backfill the remaining 6 inches with compacted Aggregate Backfill.

- e. Unimproved Streets: Aggregate Backfill compacted in eight inch layers to existing grade.
  - f. Unpaved Areas: Backfill compacted in six inch layers to bottom of Topsoil. Replace Topsoil to approximate depth of existing topsoil as final backfilling operation and crown to such height as required by the Engineer.
3. Additional Requirements for PVC Pipe Bedding and Backfill:
- a. Install First Class Bedding in accordance with the requirements of ASTM D 2321, Underground Installation of Flexible Thermoplastic Sewer Pipe, using Class 1 material.
  - b. Assure that sufficient First Class Bedding material is worked under the haunching of the pipe to provide adequate side support.
  - c. Prevent movement of pipe during placing of material under the pipe haunch. Walking or standing on pipe will not be permitted.
  - d. Excessive tamping of Initial Backfill over the top of the pipe will not be permitted.
  - e. Do not use rolling equipment or heavy tampers to consolidate backfill until at least 2 feet of backfill is placed over the top of the pipe.
- M. Backfill Restrictions:
- 1. Do not use in backfilling work materials such as house ashes, putrescible refuse and such other materials considered unsatisfactory by the Engineer. Do not permit excavations to be used as dumping areas for refuse.
  - 2. Do not use frozen backfill materials or place backfill materials on frozen subgrade or trench surfaces.
  - 3. Should there be a deficiency of backfill material, provide acceptable borrow material.
  - 4. No bulkheads or retaining walls for backfilling will be allowed in the trenches over utility pipeline, except for temporary use.
- N. Earth Dams: In First Class Bedding installation, construct Earth Dams composed of Clean Earth Backfill material.
- 1. Location - At a point not less than three feet upstream from inline structures; in trenches for service connections at a point not less than three feet from the main wastewater trench; in main wastewater sewer trenches at 100 foot intervals; and trenches at such other locations required by the Engineer.
  - 2. Place Clean Earth Backfill material from subgrade to one foot depth over top of pipe. Length as detailed in Earth Dam Drawing Detail.
  - 3. Place Earth Dam material by hand and compact with proper tools designed for such purpose.
- O. Stream Crossings: Excavate trenches in stream crossings to the depth shown on the Drawings or otherwise required by the Engineer.
- 1. Material excavated may be used as backfill unless specifically prohibited by any state agency having jurisdiction.
  - 2. Make all necessary provisions for cofferdaming, dewatering and removal of excess excavated material.

3. Maintain the flow in the stream at all times.
  4. Where rock is encountered in the stream crossings, do not use forms to construct the Concrete Encasement; place concrete on firm rock below the utility pipeline and against firm rock on both sides of the utility pipeline to provide a firm bond between the encasement and the rock. Should the Contractor excavate beyond the dimensions specified herein before for the Concrete Encasement he will be required to furnish and place all additional concrete required beyond the dimensions shown on the Detail Drawing.
  5. Install Concrete Encasement to a minimum of five feet back from the top edges of the stream banks.
  6. Construct stream crossing in accordance with any additional requirements specified by the Cumberland County Conservation District.
- P. Underground Warning Tape: For the purposes of early warning and identification of buried utility pipelines during future trenching or other excavation, provide continuous identification tapes in trenches. Install in accordance with printed recommendations of the tape manufacturer, and as modified herein. Bury tape at a depth of 12 inches below grade; in pavements measure 12 inches from subgrade.
1. Provide in trenches for utilities indicated in Part 2.
- Q. Wastewater Sewer Service Connections:
1. Excavation: Depth of cut to invert predetermined prior to excavation. Where required, excavate entire length of service connection trench before laying pipe.
  2. Rock: If rock is encountered within ten feet of buildings, remove by drilling and wedging or some other method other than blasting. Remove rock to one foot beyond end of service connection.
  3. Curb and Sidewalk Restoration: Restore curbs and sidewalks disturbed during service connection work.
  4. Markers: Do not backfill upper free end of service connection until elevation and location points are inspected and approved by Engineer. Install a 2 x 4-inch lumber marker set plumb and flush with invert of upper free end of service connection. Cut top of marker flush with existing grade.
- R. Compacting: During the course of backfilling and compacting work, the Engineer may, at any location or depth of trench, make tests to determine whether the Contractor's compaction operations are sufficient to meet specified requirements. Compact trench backfill as follows:
1. All trench excavation and backfill within State Highways right-of-way will be subject to inspection by representatives of the Commonwealth of Pennsylvania, Department of Transportation, and the work must be performed in accordance with the requirements of that department even though such requirements may entail more labor or services than the methods herein described.
  2. Solidly tamp each layer of Initial Backfill around the utility pipeline with proper tamping tools made specially for this purpose.
  3. Thoroughly compact Aggregate Backfill with a vibratory compactor of a type and size satisfactory to the Engineer, and the Pennsylvania Department of Transportation when in State Highways. Compacting of this Aggregate Backfill by puddling or jetting will not be permitted.

4. Use mechanical tampers to compact backfill materials in trench refill operations to produce a density of backfill at the bottom of each layer of not less than 90 percent of maximum density obtained at plus or minus two percentage points of the optimum moisture content as determined by the ASTM D 698 method. Perform field determinations of density, when requested by the Engineer, in accordance with ASTM D 1556 or ASTM D 2922.
  5. The use of puddling or jetting for compacting backfill in trenches is prohibited.
- S. Field Moisture-Density Tests: Conduct a minimum of two field moisture-density determinations for each 1000 feet length of embankment, for each one and one-half foot rise in embankment height, and at locations designated by the Engineer. Conduct the determinations according to ASTM D 1556 or D 2922.
1. The moisture content at which the maximum density of the Backfill is obtained with a given compactive effort shall be considered the optimum moisture content and determined according to ASTM D 698.
  2. If a field test is run and indicates that compaction has not been achieved, then that test does not count toward the testing requirement.
- T. Cleanup:
1. Remove surplus excavated material, rubbish and other construction debris and keep such removed to a point not more than two hundred feet from the head of the open trench, unless otherwise authorized by the Engineer.
  2. After trenches and other excavations are refilled and the work completed, remove surplus excavated materials, rubbish or such other materials from the work in such manner as the Contractor may elect or provide, but subject to the Engineer's approval. Dispose of such materials off the site in a lawful manner at no additional expense to the Owner.
  3. Evenly spread and leave in neat, smooth condition excavated material disposed of lawfully on public property.
  4. Furnish and place topsoil, fertilize and seed grassed areas, both within and outside rights-of-way affected by construction. Reseed and refertilize areas that fail to show a uniform stand of grass. Water, mow, rake, weed and otherwise maintain grass until final acceptance of Contract.
  5. Restore the area covered by both temporary and permanent rights-of-way over private property to as near the original conditions as is practical. Bring area up to original grade, place topsoil, seed, replant or replace shrubbery, repair or replace walks, curbs, driveways, fences and other improvements, damaged or removed.
  6. When the repaving over trenches and other excavations has been completed, sweep paved surfaces having been affected by the work using hand or power sweepers, and if required by the Engineer, flush with water to remove dust and small particles.
- U. Maintenance: Assume responsibility for injury or damage resulting from lack of trench maintenance during the guarantee period.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02230 - ROADWAY EXCAVATION, BACKFILL AND COMPACTION

PART 1 - GENERAL

1.01 RELATED WORK

- A. Erosion and Sediment Pollution Control: Section 02270.
- B. Paving and Surfacing: Section 02500.

1.02 SYSTEM DESCRIPTION

- A. Definitions:
  - 1. Roadway Subgrade: The prepared earth surfaces on or over which additional roadway materials will be placed or work is to be performed.

1.03 REFERENCES

- A. American Society for Testing and Materials:
  - 1. ASTM D 698; Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb (2.49-kg) Rammer and 12-in. (304.8 mm) Drop.
  - 2. ASTM D 1556; Test Method for Density of Soil in Place by the Sand-Cone Method.
  - 3. ASTM D 2922; Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- B. Commonwealth of Pennsylvania Department of Transportation (PDT), Specifications Publication 408/83, as supplemented, PDT Section 703.2 Coarse Aggregate.

1.04 SITE CONDITIONS

- A. Environmental Requirements: Do not perform roadway excavation, backfill and compaction when soil or weather conditions are unsuitable. Unsuitable conditions include moisture saturated or frozen in place soil and precipitation present on the soil or occurring during the Work.
- B. Dust Control: Exercise the necessary means and methods to control dust on the site during the roadway excavation, backfill and compaction work.
- C. Excess Materials: No right of property in materials is granted the Contractor of excess on site materials prior to completion of Site Work. This provision does not relieve the Contractor of his responsibility to remove and dispose of surplus excavated materials. Materials unsuitable for roadway subgrade and not suitable for other

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uses on-site shall become the property of the Contractor and shall be disposed of in a lawful manner off-site.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

- A. Backfill: On-site excavated soil or soil-rock mixed materials free of topsoil, vegetation, lumber, metal, and refuse and rock or similar hard objects larger than six inches in greatest dimension. Rock to soil ratio not to exceed one part rock to three parts soil.
- B. Coarse Aggregate Material: AASHTO No. 57 conforming to PDT Section 703.2.

### PART 3 - EXECUTION

#### 3.01 PERFORMANCE

- A. Perform soil erosion control work in accordance with requirements of Section 02270.
- B. Roadway Excavation: Excavate or otherwise remove and satisfactorily dispose of materials located within the limits indicated on the Drawings for roadways.
  - 1. Excavate to roadway subgrade depths required, and cut drainage channels and waterways as required.
  - 2. Remove rock encountered in roadway excavation to a depth six inches below finished subgrade elevations.
  - 3. Excavate subgrade material determined unsatisfactory in the opinion of the Engineer. Refill such areas to required elevation with Backfill.
- C. Roadway Grading: Shape subgrade of roadways, intersections, approaches, entrances and adjoining pedestrian walkways to no more than 0.10 foot above or below the elevations indicated.
- D. Roadway Embankments without Rock: Construct embankments in accordance with the following paragraphs.
  - 1. Use Backfill placed in nine inch layers and each compacted separately using equipment meeting with Engineer's approval. Carry the whole embankment up evenly the required elevation without breaks or irregularities in material distribution or in the formation of layers. Trim embankment slopes to the lines required and leave in a neat and acceptable condition.
  - 2. Add water to Backfill which does not contain a sufficient amount of moisture to obtain the required compaction. Backfill containing moisture in excess of the amount required to obtain the necessary compaction density may not, without written approval, be incorporated in the embankment until allowed to dry to a moisture content not greater than two percentage points above optimum for that particular material.

3. Fill existing natural depressions or such other depressions resulting from the site work to the level of adjacent ground elevation in the same manner specified for formation of embankment prior to starting initial embankment layer.
  4. Remove existing embankment foundation material when determined unsatisfactory by the Engineer. Refill such areas to original elevation in the same manner specified for formation of embankment.
  5. Scarify embankment foundation surface where embankment three feet or more in height is to be placed. Scarify or otherwise loosen embankment foundation surface to a depth of six inches where embankment less than three feet in height is to be placed.
  6. Existing embankment foundations having a slope steeper than four to one shall be plowed to provide embankment binding when required by the Engineer. On steeper slopes the Engineer may require the foundation to be cut into steps or berms. No additional payment will be made for steps or berms and plowing.
  7. Compact embankment material to a minimum final density of not less than 90 percent of the maximum dry weight density at its optimum moisture content as determined by the ASTM D 698 method.
  8. Borrow Excavation materials required for embankment shall meet the requirements of Backfill. During the excavation operation, keep the borrow area graded to insure free water draining. Following completion of work in the borrow area, grade the area to present a uniformly trim appearance merging into the surrounding terrain and to prevent serious erosion.
- E. Roadway Embankments with Rock: Construct embankments for roadways as specified previously with the exception that materials other than Backfill may be used. Materials such as shale or other rock formations that can be readily incorporated in a 36 inch layer may be used. Construction requirements for roadway embankment containing rock shall be as follows:
1. Break-up shale and other rock-like materials formed by natural consolidation of mud, clay, silt and fine sand into a maximum size that can be readily placed and compacted in loose eight inch layers.
  2. Place rock to form the base of roadway embankments. Place in uniform loose layers not exceeding in depth the approximate average size of the larger rock, but not exceeding 36 inches deep.
  3. Do not dump rock in final position. Position rock by blading or dozing in a manner that will minimize voids, pockets and bridging.
  4. Smooth and level each layer adding Coarse Aggregate Material in sufficient quantity to supplement the smaller rock pieces in filling the voids and pockets.
  5. Form the top 18 inches of roadway embankments with Backfill and construct in the same manner specified for formation of embankments other than those containing rock.
- F. Roadway grading: Shape subgrade of roadways, intersections, approaches, entrances and adjoining pedestrian walkways to no more than 0.10 foot above or below the elevations indicated on the Drawings.

- G. **Compaction:** Compact subgrade material to a minimum final density of not less than 95 percent of the maximum dry weight density at its optimum moisture content. Perform finish rolling on roadway subgrade just prior to installation of aggregate base course.
- H. **Roadway Base Course Construction:** Final subgrade preparation and roadway base course construction as specified in Section 02500.

**3.02 FIELD QUALITY CONTROL**

- A. **Surface Tolerance:** Check finished subgrade surface for smoothness and elevation in accordance with the following:
  - 1. Use an approved template shaped to conform to the design requirement for checking crown and contour of roadways.
  - 2. Use an approved ten foot straightedge to check for longitudinal irregularities in the subgrade.
  - 3. Use string lines for controlling the finished elevation of roadway subgrade. Maintain such lines until surface irregularities have been satisfactorily corrected.
- B. **Corrections:** Correct surface irregularities exceeding previously specified limits to the Engineer's satisfaction either by removing or adding material as required, followed by rolling until satisfactorily compacted.
- C. **Field Moisture-Density Tests:** Conduct a minimum of two field moisture-density determinations for each 1000 feet length of roadway subgrade and at locations designated by the Engineer, and according to ASTM D 1556 or D 2922.
  - 1. The moisture content at which the maximum density of the in place material or the Backfill is obtained with a given compactive effort shall be considered the optimum moisture content and determined according to ASTM D 698.
  - 2. If a field test is run and indicates that compaction has not been achieved, then that test does not count toward the testing requirement.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02270 - EROSION AND SEDIMENT POLLUTION CONTROL

PART 1 - GENERAL

1.01 REQUIREMENTS OF REGULATORY AGENCIES

- A. Erosion and Sediment and Pollution Control Plan:
  - 1. Implement soil erosion and sediment pollution control plan in accordance with rules, regulations and requirements adopted by the Pennsylvania Department of Environmental Resources (DER).
  - 2. Detail requirements for the control plan are described in an Erosion and Sediment Pollution Control Program Manual that may be obtained from the Bureau of Soil and Water Conservation, Division of Soil Resources and Erosion Control, Harrisburg, Pennsylvania.
- B. Fines and related costs resulting from failure to provide adequate protection against soil erosion and sediment pollution control are the obligation of the Contractor.
- C. Erosion and sediment pollution control measures employed will be subject to approval and inspection by the Pennsylvania Department of Environmental Resources as well as the Cumberland County Conservation District.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

NOT APPLICABLE TO THIS SECTION

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02300 - TUNNELING, BORING AND JACKING

PART 1 - GENERAL

1.01 RELATED WORK

- A. Shoring: Section 02151
- B. Trenching, Backfilling and Compacting: Section 02221
- C. Piped Wastewater Sewers: Section 02722
- D. Force Mains: Section 02724
- E. Division 3 - Concrete

1.02 QUALITY ASSURANCE

- A. Workmen Qualifications:
  - 1. Employ in the work only personnel thoroughly trained and experienced in the skills required.
  - 2. Have welds made only by welders, tackers and welding operators who have been previously qualified by tests as prescribed in the Structural Welding Code AWS D1.1 of the American Welding Society to perform the type of work required.
- B. Design Criteria:
  - 1. Provide encasing conduit under highways of sufficient strength to support all superimposed loads, including an American Association of State Highway and Transportation Officials H-20 Loading with 50 percent added for impact.
  - 2. Provide encasing conduit under railroad tracks of sufficient strength to support all superimposed loads, including a Cooper E 80 Loading with 50 percent added for impact.
- C. Requirements of Regulatory Agencies:
  - 1. Work of this Section within State Highway right-of-way will be subject to inspection by representatives of the Commonwealth of Pennsylvania Department of Transportation, and the work must be performed in accordance with the requirements of the latest edition of the Commonwealth of Pennsylvania, Pennsylvania Code, Title 67, Transportation, Department of Transportation, Chapter 459, Occupancy of Highways by Utilities.
  - 2. Inspection, insurance or other charges demeneded by the Commonwealth of Pennsylvania Department of Transportation, or other authority having jurisdiction shall be paid for by the Developer.

3. Materials and methods of construction used on railroad company property shall be subject to the approval of the railroad company and the Contractor shall at all times conduct his work and operations fully within the railroad company's rules, regulations and requirements. Ascertain from the railroad company, its rules, regulations and requirements, and what, if any, delays may be encountered. If required by the railroad company, submit for approval an outline of the methods and means proposed for prosecuting the work.
4. If required by the railroad company, materials for track supporting structures shall be furnished by the Contractor for installation and removal by personnel of the railroad company.
5. The railroad company has the right to provide inspection and signalling and to support, reballast, or realign their tracks or perform other work by their own forces. The cost of such items are the responsibility of the Contractor.
6. Record and have on file details pertaining to railroad company inspections. Include as a minimum the dates of inspections, number of railroad company personnel and number of hours spent on inspection by railroad company personnel.
7. If the thickness of the encasing conduit must be increased to meet the railroad company requirement, furnish and install such.
8. Furnish and erect crossing signs on both sides of the tracks. The actual location where each sign is to be erected will be established by the railroad company.

D. Source Quality Control:

1. Shop Tests: In accordance with Article 1.06 of the General Instructions, factory test pipe materials listed in the following. Each pipe manufacturer must have facilities to perform listed tests. The Engineer reserves the right to require the manufacturer to perform such additional number of tests as the Engineer may deem necessary to establish the quality of the material offered for use.

<u>MATERIAL</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
a. Steel Pipe	ASTM A 139 or ASTM A 53	As specified in ASTM A 139 or ASTM A 53 as applicable

2. Laboratory Tests: The Engineer reserves the right to require that laboratory tests also be conducted on materials that are shop tested. Furnish labor, materials, and equipment necessary for collecting, packaging, and identifying representative samples of materials to be tested and the shipping of such samples to the Testing Laboratory.

1.03 REFERENCES

- A. American Association of State Highway and Transportation Officials (H-20): (AASHTO) Loading for Conduits Installed Under Streets, Road, or Highways.

- B. American Railway Engineering Association (A.R.E.A.) (Cooper E-80).
- C. American Society for Testing and Materials:
  - 1. ASTM A 53, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  - 2. ASTM A 120, Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated. (Galvanized) Welded and Seamless for Ordinary Uses.
  - 3. ASTM A 123, Specification for Zinc (Hot-Galvanized) Coatings on Iron and Steel Products.
  - 4. ASTM A 139, Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 in. and over).
  - 5. ASTM A 307, Specification for Carbon Steel Externally Threaded Standard Fasteners.
  - 6. ASTM A 569, Specification for Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip, Commercial Quality.
  - 7. ASTM A 615, Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
  - 8. ASTM C 32, Specification for Sewer and Manhole Brick (Made from Clay or Shale).
  - 9. ASTM C 33, Specification for Concrete Aggregates.
  - 10. ASTM C 150, Specification for Portland Cement.
  - 11. ASTM C 270, Specification for Mortar for Unit Masonry.
  - 12. ASTM F 467, Specification for Nonferrous Nuts for General Use.
  - 13. ASTM F 468, Specification for Nonferrous Bolts, Hex Cap Screws and Studs for General Use.
- D. American Welding Society: AWS D1.1 Structural Welding Code.
- E. Commonwealth of Pennsylvania Department of Transportation (PDT), Specifications Publication 408, as supplemented.
  - 1. PDT Section 703.2 Coarse Aggregate.

1.04 SUBMITTALS

- A. Shop Drawings and Product Data: Furnish completely dimensioned shop drawings, cuts or other data as required to provide a complete description of Products to be installed.
- B. Certificates: Certified records or reports of results of shop tests, such records or reports to contain a sworn statement that shop tests have been made as specified.
- C. Furnish PennDOT and the railroad company for approval, detail drawings, accompanied by design calculations, for the tunneling shield, tunneling pits, including sheeting and bracing therefor, tunnel liner plate and tunneling procedure and grouting method and all such drawings and computations shall bear the seal of a Registered Professional Engineer.
- D. Furnish PennDOT and the railroad company for approval, detail drawings, accompanied by design calculations, for boring or jacking pits including sheeting and bracing therefor, steel pipe and boring or jacking procedure and grouting method and all such drawings and computations shall bear the seal of a Registered Professional Engineer.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Transport, handle and store materials and Products specified herein in a manner recommended by the respective manufacturers of such to prevent damage and defects.

1.06 SITE CONDITIONS

A. Scheduling:

- 1. Perform operations continuously on a 24-hour basis if required by PennDOT.
- 2. The railroad company will designate the acceptable time for constructing the railroad crossing. It is a requirement of the railroad company that operations must be conducted continuously on a 24-hour basis.

B. Environmental Requirements:

- 1. As specified in Sections 02221 and 02722.

C. Protection: As specified in Section 02221 and such added requirements included herein.

- 1. Adequately support and protect utilities and facilities that are encountered in, or may be affected by, the work.
- 2. Temporary track supports to be provided shall be as shown on Penn Central Transportation Company's Drawing Number 43380-R1 entitled "Temporary Track Support for Support of Tracks When Tunneling or Driving Pipe" which is included hereinafter at the end of this Section of the Specifications.
- 3. Structure Supports: As specified in Section 02221.
- 4. Accommodation of Traffic: As specified in Section 02221.
- 5. Explosives and Blasting: Not permitted in performance of work of this Section.
- 6. Excavation Conditions: As specified in Section 02221.
- 7. Excess Materials: As specified in Section 02221.
- 8. Borrow Material: As specified in Section 02221.

PART 2 - PRODUCTS

2.01 ENCASING CONDUIT

A. Steel Tunnel Liner Plate: Cold formed, steel, four flanged liner plates.

- 1. Minimum Inside Neutral Axis Diameter: As shown on the Drawings or as indicated by the Engineer.
- 2. Minimum Thickness: U.S. Standard Gauge 8, marked on each liner plate by manufacturer.
- 3. Steel: Structural quality hot rolled carbon steel; ASTM A 569.
- 4. Provide tapped grout holes and plugs (minimum 1 1/2 inch diameter) in every third plate.
- 5. Hot Dipped Galvanized: ASTM A 123.
- 6. Nuts and Bolts: Minimum 1/2 inch diameter, coarse thread, conforming to ASTM A 307, Grade A.

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7. Coating: Factory coat inside and outside with asphaltic material to a minimum thickness of 0.05 inch.
  8. Acceptable Manufacturers:
    - a. Armco Drainage and Metal Products, Inc.
    - b. Republic Steel Corp.
    - c. Commercial Shearing and Stamping Company.
    - d. Or Equal.
- B. Steel Pipe: ASTM A 139, Grade B or ASTM A 53, Grade B.
1. Minimum Diameter: As required by authority having jurisdiction.
  2. Minimum Wall Thickness: As required by design criteria.
- C. Reinforced Concrete Pipe (RCP): As specified in Section 02722 and Section 02724.
- D. Prestressed Concrete Cylinder Pipe (PCCP): As specified in Section 02722.
- 2.02 WASTEWATER SEWER PIPE AND FITTINGS
- A. Ductile Iron Pipe (DIP): As specified in Section 02722 and Section 02724.
1. Use mechanical joint pipe.
- B. Reinforced Concrete Pipe (RCP): As specified in Section 02722.
- C. Prestressed Concrete Cylinder Pipe (PCCP): As specified in Section 02722.
- 2.03 MISCELLANEOUS MATERIAL
- A. Concrete: As specified in Section 03330.
1. Class B: 3000 psi.
- B. Lean Concrete: 2000 psi compressive strength at 28 days with minimum cement content per cubic yard in accordance with current ready-mix plant standard practice.
1. Reduced Aggregate: Aggregate with particle size not less than 1/8-inch or more than 1/2-inch in any dimension and a maximum of 5 percent of particles passing a #8 sieve.
- C. Aggregate Backfill:
1. AASHTO No. 8 Coarse Aggregate conforming to PDT Section 703.2.
- D. Brick: Commercially manufactured brick made from clay or shale and burned, meeting requirements of ASTM C 32, Grade MS.
- E. Mortar: Material composition meeting requirements of ASTM C 270. Type M with waterproofing admixture included.
1. Medusa Cement Company; Medusa Waterproofing Paste or Powder.
  2. Grace Construction Materials; Hydratite.
  3. Chem-Master Corporation; Hydrolox.
  4. Or Equal.

- F. Grout (Sand/Cement):
  - 1. Portland Cement: ASTM C 150 Type II.
  - 2. Sand: ASTM C 33, fine aggregate.
  - 3. Water: Potable.
  - 4. Grout Quality: Mixture of one part Portland Cement, three parts fine aggregate and water.
  
- G. Sand: ASTM C 33, fine aggregate.
  
- H. Hold Down Rod: Reinforcement bar, ASTM A 615, Grade 60, deformed.
  - 1. Field coat with Bitumastic No. 300-M as manufactured by Koppers Company, Inc., or equal.
  
- I. Treated Wood Blocking (Pipe Support in Conduit): Wood species of the allowable types under the WHPA or SPIB grading rules and stamped to indicate product compliance with U.S. Dept. of Commerce Product Standard PS-20-70.
  - 1. Preservative treatment shall conform to American Wood Preserves Association Standard P-5 (0.60 pounds per cu. ft. of wood) for soil contact service; Wolman CCA Type C, or equal.
  - 2. Steel Bands: Use one inch wide (min.) stainless steel strapping to make the treated wood blocking attachment bands. Secure the bands in place with stainless steel compression style band clamps. Provide a minimum of two bands on each set of treated wood blocking.
  
- J. Railroad Crossing Sign:
  - 1. Dimensions and lettering as shown on the Drawings.
  - 2. Sign Plate: Mill finish aluminum alloy 6061-T6, minimum 0.080 inch thick.
  - 3. Steel Pipe Post: Shall conform to ASTM A 120 with schedule 40 wall thickness and galvanized finish.
  - 4. Aluminum U-Bolts, Nuts and Washers: ASTM F 467 and ASTM F 468.
  - 5. Painting:
    - a. Thoroughly clean all sign plate surfaces with mineral spirits to remove grease, dirt and moisture.
    - b. Apply one coat of Sherwin-Williams Zinc Chromate Primer #B50Y1, which when thoroughly dry shall be followed by 2 coats of Sherwin-Williams Metalastic Enamel (White).
    - c. When the second coat of enamel has thoroughly dried, all required lettering shall be neatly done to the satisfaction of the Engineer by a professional sign painter using an approved grade of exterior black paint or enamel.

**PART 3 - EXECUTION**

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**3.01 INSPECTION**

- A. Inspect Materials and Products before installing in conformance with the inspection requirements of the appropriate referenced standard.
  
- B. Remove rejected Materials and Products from the Project.

3.02 PREPARATION

- A. As specified in Sections 02221 and 02722.

3.03 PERFORMANCE

- A. Excavation: As specified in Section 02221 and such added requirements included herein:

1. Should the Contractor in constructing any tunneling, boring or jacking pit excavate below the subgrade for the pipe sewer, he will be required to backfill the area excavated below the subgrade with Aggregate Backfill or with concrete as required by the Engineer.

- B. Tunneling:

1. Tunneling shall conform to the applicable requirements of Section 02221 and all applicable requirements of PennDOT and the railroad company.
  - a. Install the tunnel liner plate to the limits indicated on the Drawings or required by the Engineer, PennDOT or the railroad company.
  - b. Tunneling pits shall be as shown on the Sewer Detail Drawing entitled "Tunnel Work Pit and Tunnel Liner Plate".
  - c. Exercise care in trimming the surface of the excavated section in order that the steel liner plates fit snugly against undisturbed material.
  - d. Do not advance excavation ahead of the previous installed liner plates any more than is necessary for the installation of the succeeding liner plate.
  - e. Support vertical face of the excavation as necessary to prevent sloughing. Completely bulkhead the heading at any interruption of the tunneling operation.
  - f. Paint field bolt heads and nuts.
2. Grouting:
  - a. Place a uniform mixture of grout under pressure behind the liner plate and the undisturbed material.
  - b. Provide grout holes tapped for no smaller than 1 1/2 inch pipe, spaced at approximately 3 feet around the circumference of the tunnel liner plates in every third ring.
  - c. Start grouting at the lowest hole in each grout panel and proceed upwards simultaneously on both sides of the tunnel.
  - d. Install threaded plug in each grout hole as the grouting is completed at that hole.
  - e. Proceed with grouting as required by the Engineer, but in no event shall more than six linear feet of tunnel be progressed beyond the grouting.

- C. Boring:

1. Boring shall conform to the applicable requirements of the regulatory agency and additional requirements specified herein.
  - a. Install the encasing conduit by the boring method to the limits required by the Engineer or regulatory agency.
  - b. Excavate and sheet boring pit.

- c. Provide devices at the front of the pipe to prevent auger and cutting heads from leading the encasing conduit. Unsupported excavation ahead of pipe is prohibited.
- d. Over-cut by cutting head not to exceed the outside diameter of the encasing conduit by more than one-half inch.
- e. The use of water or other liquids to facilitate casing placement and spoil removal is prohibited.
- f. If voids develop or if bored hole diameter is more than 1 inch greater than the outside diameter of the encasing conduit, place Grout to fill voids.
- g. Check conduit alignment in a manner and at times required by Engineer. Check alignment and grade at least once per shift as the work progresses.
- h. Completely bulkhead heading at interruptions in boring operation.
- i. Completely weld joints around the circumference between sections of steel pipe encasing.

**D. Jacking:**

- 1. Jacking shall conform to all applicable requirements of the regulatory agencies and additional requirements specified herein. This operation shall be conducted without handmining ahead of the pipe and without the use of any type of boring, augering, or drilling equipment.
  - a. Install the encasing conduit by the jacking method to the limits required by the Engineer or the regulatory agencies.
  - b. Preliminary work shall consist of excavating and sheeting an acceptable shaft on the downstream side of the crossing and the installation of a backstop and guide timbers.
  - c. Design: Bracing and backstops shall be so designed and jacks of sufficient rating used so that the jacking can be progressed without stoppage except for adding lengths of pipe.
  - d. Accurately place guide timbers on line and grade.
  - e. Support: The vertical face of the excavation shall be supported as necessary to prevent sloughing.
  - f. Use poling boards and bulkheads as required if subgrade conditions in the heading are unstable.
  - g. Jacking and excavation within the pipe shall proceed simultaneously with the ground being cut no more than 2 inch outside the pipe at the top and sides and not less than 2 inch above subgrade at the bottom.
  - h. The use of water or other liquids to facilitate casing placement and spoil removal is prohibited.
  - i. If voids develop or if jacked hole diameter is more than 1 inch greater than the outside diameter of the encasing conduit place grout to fill voids in manner approved by the regulatory agencies.
  - j. Check conduit alignment in a manner and at times required by Engineer. Check alignment and grade at least once per shift as the work progresses.
  - k. Completely bulkhead heading at interruptions in jacking operation.
  - l. Completely weld joints around the circumference between sections of steel pipe encasing.

- E. Laying and Testing Wastewater Sewer Pipe: Lay and test pipe in encasing conduit as specified in Sections 02722 and 02724 and such added requirements included herein.
  - 1. Support and maintain the alignment and grade of sewer piping until the concrete cradle is installed and concrete has cured.
  - 2. Provide concrete cradle as indicated on Detail Drawings. Concrete construction as specified in Section 03300.
  - 3. Paint exposed portion of hold down rod if used.
  
- F. Installing and Testing Other Utilities: Install and test utility pipelines in encasing conduit as required by PennDOT and in conformance with the applicable rules and regulations pertaining to the utility being installed.
  
- G. Encasing Conduit Filling and Closing: After the utility pipeline has been installed in the encasing conduit and has been tested, fill the encasing conduit with sand or lean concrete, whichever is required by the regulatory agency.
  - 1. Close one end of encasing conduit with brick and mortar before filling encasing conduit. Close other end of encasing conduit with brick and mortar after filling encasing conduit or as operation dictates.
  
- H. Railroad Crossing Sign: Erect crossing signs on both sides of the tracks at railroad crossings, at locations established by the railroad company.
  
- I. Cleanup: As specified in Section 02221.

3.04 FIELD QUALITY CONTROL

- A. Testing: After installing the appropriate utility pipeline in encasing conduit, and before filling conduit, conduct line acceptance testing as specified previously.

END OF SECTION



DIVISION 2 - SITE WORK

SECTION 02500 - PAVING AND SURFACING

PART 1 - GENERAL

1.01 RELATED WORK

- A. Trenching, Backfilling and Compaction: Section 02221.
- B. Roadway Excavation, Backfill and Compaction: Section 02230.
- C. Division 3 - Concrete.

1.02 QUALITY ASSURANCE

A. Definitions:

- 1. Specified maximum trench width: The applicable maximum trench width specified in Table B in Section 02221.
- 2. Street: Unless otherwise specifically qualified herein, the term Street as used in this Section is understood to mean a street, highway, avenue, boulevard, road, alley, lane, driveway, parking lot, or any other area used as a way for vehicles.

B. Source Quality Control:

- 1. Maintain the quality of work by using the products of a qualified bituminous concrete producer and qualified plant operating workmen.
- 2. Use products of a bituminous concrete bulk producer regularly engaged in production of hot-mix, hot-laid bituminous concrete conforming to the standards referenced herein.
- 3. Use materials conforming to the requirements of the Commonwealth of Pennsylvania Department of Transportation Specifications Publication 408, as supplemented.

C. Workmen Qualifications:

- 1. Provide at least one person thoroughly trained and experienced in the skills required and who readily understands the design and is completely familiar with the application of bituminous concrete paving work. During progress of bituminous concrete paving work the trained person shall be present to direct the performance of work.
- 2. For actual finishing of bituminous concrete surfaces and operation of the equipment, use only personnel thoroughly trained and experienced in the skills required.

D. Requirements of Regulatory Agencies:

- 1. Removal, protection and replacement of paving on State Highways will be subject to inspection by representatives of the Commonwealth of Pennsylvania Department of Transportation, and the work shall be performed in accordance with the requirements of the Commonwealth of Pennsylvania, Pennsylvania Code, Title 67,

Transportation, Department of Transportation, Chapter 459, Occupancy of Highways By Utilities, July, 1989.

2. Inspection, insurance or other charges demanded by the Commonwealth of Pennsylvania Department of Transportation, or other authority having jurisdiction will be paid for by the Contractor.
3. Removal, protection and replacement of paving on streets other than state highways shall be performed in accordance with the requirements of this Section.

1.03 REFERENCES

- A. The PDT Sections noted herein refer to sections contained in the Commonwealth of Pennsylvania Department of Transportation Specifications Publication 408, as supplemented. The payment provisions do not apply to work to be performed under this Specifications Section.

1. PDT Section 305 Bituminous Concrete Base Course.
2. PDT Section 350 Subbase.
3. PDT Section 401 Plant Mixed Bituminous Concrete Courses.
4. PDT Section 403 Recycled Plant-Mixed Bituminous Concrete Courses.
5. PDT Section 420 Bituminous Wearing Course ID-2 and Bituminous Wearing Course ID-2, RPS.
6. PDT Section 620 Guide Rail.
7. PDT Section 630 Plain Cement Concrete Curb.
8. PDT Section 636 Bituminous Concrete Curb.
9. PDT Section 676 Cement Concrete Sidewalks.
10. PDT Section 703 Aggregates.
11. PDT Section 721 Calcium Chloride.
12. PDT Section 962, Painting Traffic Lines and Markings.

- B. Commonwealth of Pennsylvania Department of Transportation Bulletin 25.

- C. Commonwealth of Pennsylvania Department of Transportation Bulletin 27.

1.04 PROJECT CONDITIONS

- A. Environmental Requirements:

1. Do not install aggregate courses when ambient temperature is below or is expected to fall below freezing.
2. Do not use aggregate containing frost nor place aggregate courses on frozen subgrade.
3. Terminate placement of bituminous concrete surface courses of permanent pavement between October fifteen to thirty first, and do not resume placement prior to April first to fifteenth; interim days between date limits may be used for placement as determined by the Engineer depending upon weather conditions.
4. Do not place bituminous concrete surface courses of permanent pavement when the ambient temperature is 40 degrees F. or lower; nor when the temperature of the pavement, base or binder on which it is to be placed is 40 degrees F. or lower.
5. Adhere to manufacturer's data on air and surface temperature limits and relative humidity during application and curing of paint coatings.

6. Do not spray apply paint when wind velocity is above 15 mph.
7. Schedule painting work to avoid dust and airborne contaminants.
8. Apply paint during daylight hours only.

B. Time Requirements: The permanent replacement of street roadway and shoulder pavement shall be placed as soon as the trenches have been acceptable backfilled in accordance with Section 02221. However, in the event the permanent pavement cannot be placed due to the weather limitations specified previously, provide a temporary pavement.

C. Protection:

1. Protect and maintain cut pavement edges until permanent replacement paving is placed.
2. Protect paved surfaces outside of the pavement removal limits. Repair pavement outside removal limits, as may be damaged by construction operations.
3. Use such means as necessary to protect and maintain pavement materials before, during, and after installation to protect the installed work and materials of other trades.
4. In the event of failure of the work of this Section within the Guarantee Period, immediately make repairs and replacements. Upon failure to perform maintenance or repairs within three days after receiving written notice from the Township or Engineer, the Township may perform such maintenance or repairs and deduct the cost thereof from any moneys due or to become due the Contractor under the Contract.
5. Assume responsibility for any injury or damage resulting from lack of required maintenance or repairs during Guarantee Period. Indemnify and save harmless the Owner and Engineer from loss by reason of suit or action at law, based upon occurrence or omission occurring during this period.

D. Completion Certificate will not be issued until work of this Section is completed.

#### 1.05 DELIVERY, STORAGE AND HANDLING

A. Paint Materials: Take necessary precautions to ensure safe storage and use of paint materials and the prompt and safe disposal of waste. Store paint products protected from weather when these products may be affected by freezing.

### PART 2 - PRODUCTS

#### 2.01 BASE COURSE MATERIALS

A. Subbase:

1. Coarse Aggregate: Type C, or better, stone conforming to PDT Section 703.2, No. 2A aggregate.

B. Bituminous Concrete Base Course: Conforming to PDT Section 305 and Section 403 for RAP requirements.

2.02 SURFACE COURSE MATERIALS

- A. Bituminous Materials:
  - 1. Asphalt Cement: AC-20 conforming to PDT Bulletin 25.
  - 2. Bituminous Tack Coat: Class E-1, E-6 or E-8 emulsified asphalt conforming to PDT Bulletin 25.
- B. Bituminous Pavement Materials:
  - 1. Wearing Course: Hot mixed, hot laid, Bituminous Wearing Course ID-2: Conforming to PDT Section 420.

2.03 MISCELLANEOUS MATERIALS

- A. Temporary Paving: Type 2-P Bituminous Stockpile Patching Material conforming to Section 484 of Bulletin 27.
- B. Guide Rail: Type 2-S without rubbing rail, conforming to PDT Section 620.
- C. Calcium Chloride: Conforming to PDT Section 721.
- D. Cement Concrete Curb, Sidewalks and Driveways: Materials and construction as specified under Division 3 - Concrete.
- E. Traffic Zone Paint: Provide products meeting requirements of PDT Section 962 for the following:
  - 1. Yellow Traffic Zone Paint: Low-heat, rapid-dry formulation for center lines; reflective.
  - 2. White Traffic Zone Paint: Low-heat, rapid-dry formulation for edgelines and stop bars; reflective.
  - 3. Paint Quality: Paint material composition shall conform to AASHTO Type F paint formulation and AASHTO M-247, Type (standard gradation) for reflective media (glass beads).

2.04 PAVEMENT MIXES

- A. Composition of Mixtures: Binder and wearing course mixture composition shall conform to the requirements of PDT Section 401.
  - 1. Establish a job-mix formula prior to beginning work which shall not be changed during the progress of work without the Engineer's approval. Job-mixing tolerances shall not be presumed to permit acceptance of materials whose gradations fall outside the master ranges set in the specified PDT Sections.
  - 2. The approved job-mix formula shall lie within the specification limits and be suitable for the layer thickness and other conditions prevailing. It shall not be changed after work has started without the approval of the Engineer.

**PART 3 - EXECUTION**

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**3.01 PREPARATION**

- A. Subgrade Preparation: Just prior to (subbase) installation, as specified in Section 02230, perform roadway grading and finish rolling.
  - 1. Perform subgrade preparation only after site grading, trenching, etc., have been completed and accepted by the Engineer.
  - 2. The moisture content of the subgrade material at the time of compaction shall not exceed two percentage points above the optimum moisture content.
  - 3. Subgrade Over Trenches: Backfill and compact trenches as specified in Section 02221.
  
- B. General Requirements for Pavement Removal:
  - 1. Cut existing pavement to neat lines equidistant from the centerline of the trench. Cut pavement with a mechanical saw.
  - 2. Remove pavement to a width equal to the specified maximum trench width plus two feet cut back; not less than one foot on each side of the trench width as excavated.
  - 3. Where the pavement consists of a concrete base course and a bituminous surface course, remove the bituminous surface course for a width equal to the specified maximum trench width plus three feet and not less than 18 inches on each side of the trench width as excavated.
  - 4. If pavement is removed or disturbed for a greater width without written authorization of the Engineer, the required pavement replacement shall be at the Contractor's expense.
  - 5. At joints between existing pavements and new paving work, cut and neatly trim the edges of existing pavements in a manner subject to the Engineer's approval. Provide an application of Class AC-20 petroleum asphalt at the locations where new bituminous paving joins existing bituminous paving.
  - 6. Remove temporary pavement and backfill to required depth for installation of permanent replacement pavement. No additional payment will be made for removing temporary pavement and backfill.
  
- C. State Highway Pavement Removal:
  - 1. Remove State Highway pavement in accordance with PennDOT requirements.
  
- D. Subbase Construction: Install coarse aggregate Subbase in accordance with PDT Section 350. Install Subbase to after compaction thickness indicated on the Drawings.
  
- E. Dust Control: Provide effective dust control by sprinkling water, by the use of calcium chloride or by other methods approved by the Engineer. Use dust control measures, where and when, in a manner required by the Engineer.

3.02 TEMPORARY PAVEMENT INSTALLATION

A. General Requirements:

1. State Highways: Install temporary pavement in accordance with PennDOT requirements.
2. After backfilling of any trench in a paved right-of-way is completed, temporary paving shall be provided over the trench. Install temporary paving to a thickness of two inches after compaction, with the top surface flush with the surface of the adjacent pavement.
3. When permanent pavement cannot be placed because of previously specified weather limitations on placing bituminous concrete pavement courses, provide temporary pavement over areas where existing pavement has been removed. Install temporary pavement to two inches thickness after compaction, with top surface flush with surface of adjacent pavement.

3.03 PERMANENT REPLACEMENT PAVING INSTALLATION:

A. General Requirements: Methods of preparing mixture, placing mixture, compaction, and protection of in-place bituminous concrete for pavement shall comply with PDT Sections 305.3 and 401.3. The specified thicknesses are the compacted thicknesses.

B. Location of types and thicknesses of replacement pavements are shown on the table and Drawings following this Specifications Section:

1. Install surface course of replacement pavement with top surface flush with surface of adjacent pavement.

C. Base Course Installation:

1. Where roadways receive trench restoration only, install the Bituminous Concrete Base Course with the top surface below the surface of the adjacent pavement a distance equal to the thickness of the replacement surface course pavement.
2. Bituminous Concrete Base Course: Construct new roadway base course and restored area base course, in accordance with the requirements of PDT Section 305.

D. Wearing Course Installation:

1. Bituminous Concrete Wearing Course: ID-2, construct in accordance with the requirements of PDT Section 420.
2. Use Bituminous Tack Coat material to seal joints in wearing courses as specified in PDT Section 401.3 (j) 3.

E. Shoulder Restoration:

1. Shoulder resotration shall be in accordance with PennDOT requirements for the type of shoulder being resored.

3.04 MISCELLANEOUS MATERIALS INSTALLATION

A. Unimproved Roads: Backfill as specified in Section 02221 with the exception that the top six inches of backfill shall be Select Granular Material. Grade, shape and roll the full width of the road.

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- B. Cement Concrete Curbs: Replace curbs to same shape, thickness, workmanship and finish as the original curb unless otherwise required by the Engineer. Construction methods as specified in PDT Section 630.
- C. Bituminous Concrete Curb: Construct in accordance with the requirements of PDT Section 636.
- D. Cement Concrete Driveway: Backfill as specified in Section 02221. Replace cement concrete to same workmanship, thickness and finish as the original driveway unless otherwise required by the Engineer.
- E. Cement Concrete Sidewalk: Replace cement concrete sidewalk removed or disturbed with a four inch thick crush stone bed and a four inch thick concrete surface; width to match existing. Construct bed and concrete surface as specified in PDT Section 676.
- F. Bituminous Concrete Driveway: Provide a two inch thick wearing course of ID-2 bituminous concrete with the top surface flush with the top surface of the adjacent existing paving.
- G. Stone Driveway: Restore to a condition equal to its original undisturbed condition using the same type and quality of materials as that of the particular driveway restored.
- H. Guide Rail: Replace guide rail which is damaged or removed during construction.
  - 1. Use same type and quality of guide rail material as existing.
  - 2. Salvage and reuse of the guide rail will be permitted for reconstruction; however, the Engineer will inspect this guide rail after its removal and all such guide rail determined unsuitable for reuse shall be replaced by the Contractor with new guide rail.
  - 3. Work on guide rail within PennDOT right-of-way shall be performed to the requirements and satisfaction of the Pennsylvania Department of Transportation.

### 3.05 NEW PAVEMENT INSTALLATION

- A. Install underground utilities and concrete curbs prior to the placement of the subbase.
- B. Install subbase and base course in accordance with Pennsylvania Department of Transportation requirements.
- C. Place hot-mixed, hot-laid surface course materials by mechanical spreading and finishing equipment meeting requirements of PennDOT specifications. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing impracticable, the mixture shall be placed and screeded by hand tools to give the required compacted depth. Methods of spreading and finishing bituminous concrete shall also meet requirements of PennDOT specifications.

- D. Immediately after spreading bituminous concrete, and after surface irregularities are adjusted, thoroughly and uniformly compact by rolling. Roll the surface when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking, or shoving.
- E. The number, weight, and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in a workable condition. The sequence of rolling operations, the selection of roller types, and the number of passes shall produce a density equal to 95 percent of the corresponding daily plant Marshall density. Continue finish rolling until roller marks are eliminated. Equipment and specific rolling procedures shall be in accordance with PennDOT specifications.
- F. The finished surface shall be smooth and, when checked with a ten foot straight-edge, no part of the surface shall deviate more than 1/4-inch.
- G. Areas adjacent to straight surbs, inlets, utility covers, and connections to existing paving shall be sealed with AC-20.

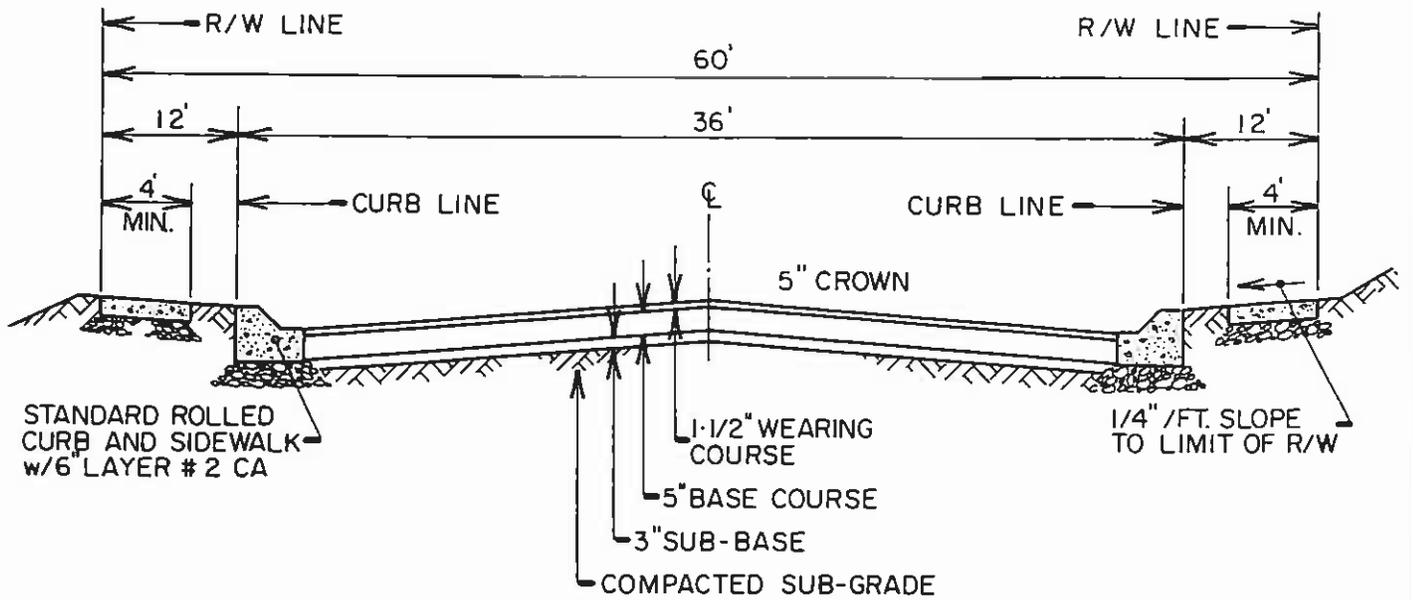
3.06 PAVEMENT MARKING

- A. Paint Application:
  - 1. Prior to pavement marking, clean pavement surface free of contaminants that will prohibit paint adhesion.
  - 2. Strictly follow paint manufacturer's label instructions for mixing, thinning, proper spreading rate and drying time. In no case shall film thickness be less than manufacturer's recommendations nor shall area coverage per gallon exceed manufacturer's recommendations.
  - 3. If material has thickened or must be diluted for application, the coating shall be built up to the same film thickness achieved with undiluted material. Do not use thinner to extend coverage of the paint.
  - 4. Regardless of the surface condition, apply paint to achieve a suitable finish either by decreasing the coverage rate or by applying additional coats of paint.
- B. Roadway Traffic Lines and Markings: Apply in accordance with PDT Section 962.
  - 1. Apply wet paint lines as indicated with an allowable width tolerance of plus or minus 1/8-inch.
  - 2. Spot the location of the final pavement markings by applying pavement spots at 25 foot intervals. Have the Engineer approve the final location of the spots before applying the traffic lines.
  - 3. Paint lines accurately with sharp, clearly defined edges. Paint solid colored areas free of skips and holidays. Make linework straight and uniformly spaced.
  - 4. Provide temporary satisfactory barriers for at least 30 minutes, or until the paint is dry and track free from vehicular traffic. Repaint marked or damaged areas.

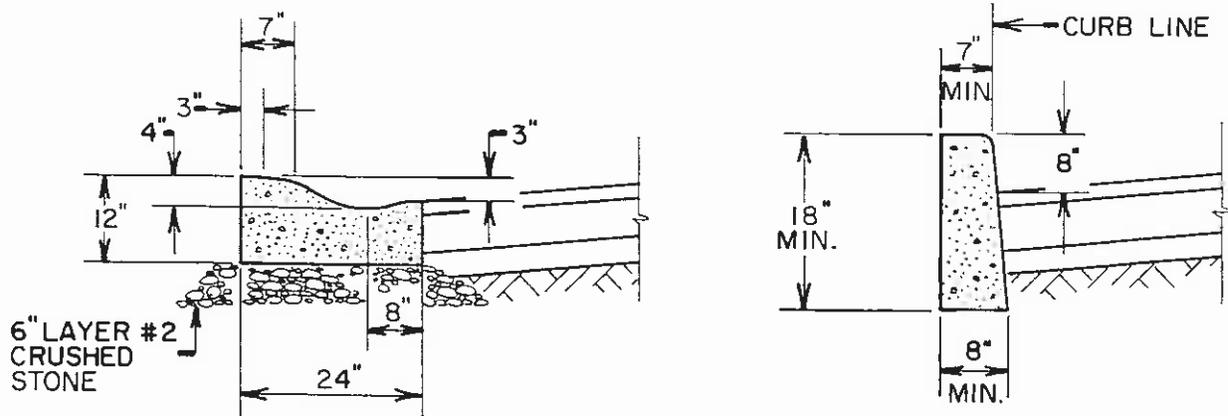
3.07 MAINTENANCE

- A. Continuously maintain temporary pavement until it is replaced with permanent pavement.
- B. Maintain the work done under this Section for a period of twelve months after the date of the Township's approval and acceptance of the Work. Maintenance shall include the repair or removal and replacement of such work which has failed, or wherever surface depressions have developed. Materials and methods used to repair or replace such work to conform to the applicable requirements of this Section.
- C. Should the Contractor fail to perform required maintenance or repairs within three days after receiving written notice from the Township or Engineer, the Township may perform such maintenance or repairs at the expense of the Contractor.

END OF SECTION



## CROSS SECTION



## STANDARD ROLLED AND STRAIGHT CURB

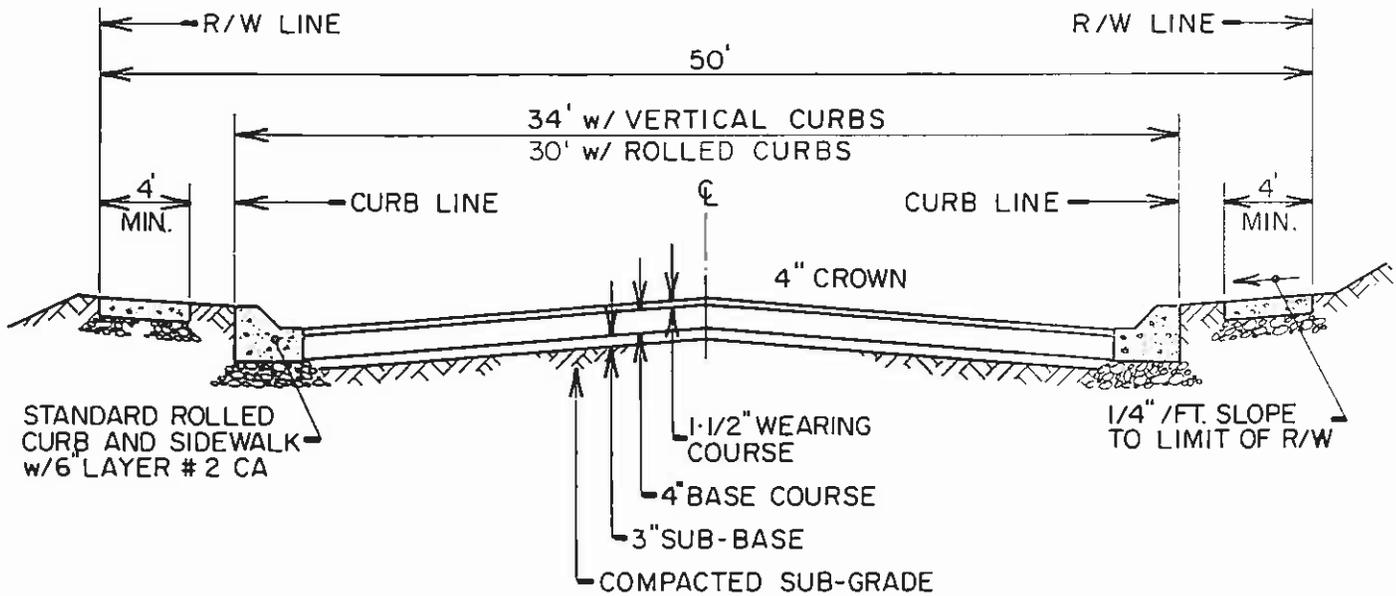
### NOTES :

1. PLACE ON 6" #2 CA STONE BED.
2. CURB STRUCTURE, MINIMUM 4000 P.S.I. COMPR. STRENGTH.
3. CONCRETE SIDEWALK AS REQUIRED, 4000 P.S.I. COMPR. STRENGTH MIN ..

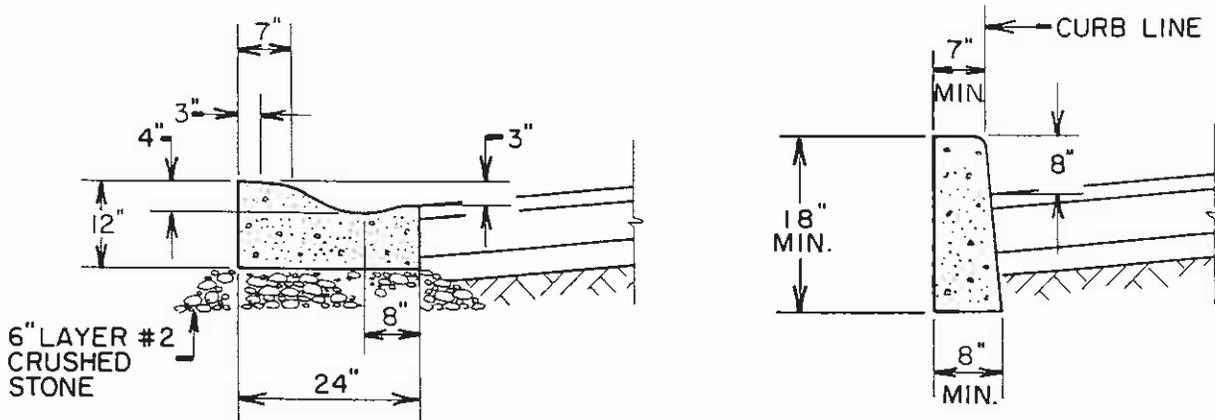
EAST PENNSBORO TOWNSHIP  
CUMBERLAND COUNTY, PENNSYLVANIA

## TYPICAL COLLECTOR STREET CROSS SECTION

NO SCALE



**CROSS SECTION**



**STANDARD ROLLED AND STRAIGHT CURB**

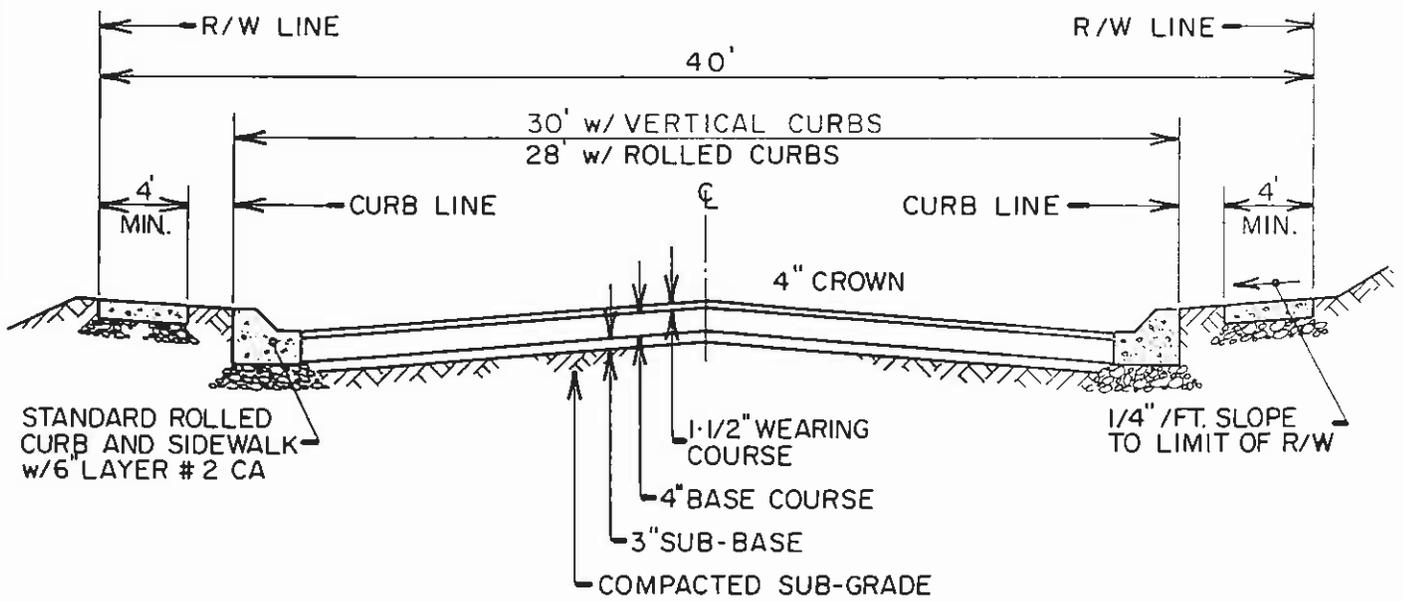
NOTES :

1. PLACE ON 6" #2 CA STONE BED.
2. CURB STRUCTURE, MINIMUM 4000 P.S.I. COMPR. STRENGTH.
3. CONCRETE SIDEWALK AS REQUIRED, 4000 P.S.I. COMPR. STRENGTH MIN ..

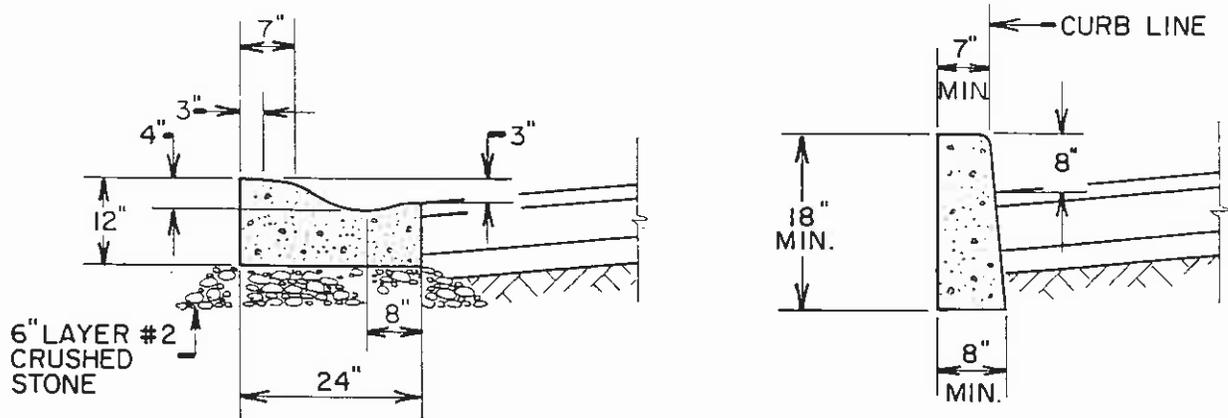
EAST PENNSBORO TOWNSHIP  
CUMBERLAND COUNTY, PENNSYLVANIA

**TYPICAL MINOR AND CUL-DE-SAC STREET CROSS SECTION**

NO SCALE



## CROSS SECTION



## STANDARD ROLLED AND STRAIGHT CURB

### NOTES :

1. PLACE ON 6" #2 CA STONE BED.
2. CURB STRUCTURE, MINIMUM 4000 P.S.I. COMPR. STRENGTH.
3. CONCRETE SIDEWALK AS REQUIRED, 4000 P.S.I. COMPR. STRENGTH MIN ..

EAST PENNSBORO TOWNSHIP  
CUMBERLAND COUNTY, PENNSYLVANIA

## TYPICAL MARGINAL ACCESS STREET CROSS SECTION

NO SCALE

DIVISION 2 - SITE WORK

SECTION 02601 - MANHOLES

PART 1 - GENERAL

1.01 RELATED WORK

- A. Trenching, Backfilling and Compacting: Section 02221
- B. Division 3 - Concrete.

1.02 QUALITY ASSURANCE

- A. Initial Manhole: To serve as the minimum acceptable conditions of construction throughout the Project, construct the first manhole in the Project to demonstrate the following:
  - 1. Demonstrate manhole base construction methods.
  - 2. Demonstrate manhole component sealing in the case of precast reinforced concrete manholes.
  - 3. Demonstrate manhole step alignment.
  - 4. Demonstrate pipe opening sealing.
  - 5. Demonstrate method of adjustment of manhole frame and cover to grade and manhole frame and cover attachment.
  - 6. Demonstrate successful manhole acceptance test.
- B. Source Quality Control:
  - 1. Maintain uniform quality of products and component compatibility by using the products of one manufacturer in the case of precast reinforced concrete manholes.
  - 2. Obtain certificate of construction compliance with ASTM C 478 from the precast reinforced concrete manhole manufacturer. Submit same certificate as part of required submittals.
  - 3. Obtain certificate of material compliance with ASTM A 48, Class 30 tensile strength from the manhole frame and cover manufacturer. Furnish certification that tensile test bars were from same pour as castings. Submit same certificates as part of required submittals.
    - 4. Shop and Laboratory Tests: In accordance with Article 1.06 of the General Instructions, materials stated herein require periodic testing according to methods referenced, or as required by the Engineer.
  - a. Laboratory Tests:
    - 1) Submit three manhole frame and cover tensile test bars for each 50 manhole frames and covers, or less (if total required is less than 50). Engineer will verify certifications, release one bar for the "Machined Bar Tensile Test", and retain two remaining bars.
    - 2) Testing Laboratory shall furnish both Engineer and Contractor two (2) copies of test result reports. Same reports will be considered as sufficient evidence of acceptance or rejection of materials represented.

- b. Shop Tests:
  - 1) Manhole component manufacturers shall have the capability to perform the number of tests the Engineer may require to establish the quality of the proposed manhole components.
  - 2) Manufacturers shall furnish to the Engineer certified test records or reports with sworn statement of tests made as specified.
  - 3) Precast Reinforced Concrete Manholes: Conduct tests as specified in ASTM C 478.
  - 4) Manhole Frames and Covers:
    - a) Test for AASHTO H-20 highway loading.
    - b) Test one manhole cover of each design submitted for approval.
- c. The Engineer reserves the right to accept certified test records or reports of previously conducted tests.

1.03 REFERENCES

- A. American Society for Testing and Materials.
  - 1. ASTM A 48, Specification for Gray Iron Castings.
  - 2. ASTM A 276, Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
  - 3. ASTM A 307, Specification for Carbon Steel Externally Threaded Standard Fasteners.
  - 4. ASTM A 615, Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
  - 5. ASTM C 270, Specification for Mortar for Unit Masonry.
  - 6. ASTM C 361, Specification for Reinforced Concrete Low-Head Pressure Pipe.
  - 7. ASTM C 443, Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
  - 8. ASTM C 478, Specification for Precast Reinforced Concrete Manhole Sections.
  - 9. ASTM C 923, Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.
  - 10. ASTM D 695, Test Method for Compressive Properties of Rigid Plastics.
  - 11. ASTM D 2146, Specification for Propylene Plastic Molding and Extrusion Materials.
- B. American Association of State Highway and Transportation Officials (AASHTO) Standards as referenced throughout these Specifications.
- C. American Water Works Association:
  - 1. AWWA C 302, AWWA Standard for Reinforced Concrete Water Pipe-Noncylinder Type, Not Prestressed.
- D. Federal Specifications:
  - 1. Fed. Spec. SS-S-210A, Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints (Type 1 Rope Form).

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### 1.04 SUBMITTALS

#### A. Shop Drawings and Product Data:

1. Manufacturer's published detail drawings, modified to suit design conditions if required, and Contractor prepared drawings as applicable.
2. Manufacturer's descriptive literature and specifications covering the product specified. Include installation information.

#### B. Certificates:

1. Certified records or reports of results of shop tests; such records or reports to contain a sworn statement that shop tests have been made as specified.
2. Manufacturer's sworn certification that components and products will be manufactured in accordance with specified reference standards for components and products.
3. Manufacturer's sworn certification that manhole frame and cover tensile test bars were poured from the same iron as castings they represent.

### 1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Transport and handle precast reinforced concrete manhole components and other Products specified herein in a manner recommended by the respective manufacturers of such to prevent damage and defects.

B. Store precast reinforced concrete manhole components in accordance with manufacturer's recommendations to prevent joint damage and contamination. Exercise such care in storage of other specified Products as recommended by the respective manufacturers.

### 1.06 SITE CONDITIONS

#### A. Environmental Requirements:

1. In no instance set or construct manhole bases on subgrade containing frost.
2. To improve workability of "Preformed Plastic Sealing Compound" during cold weather, store such at temperature above 70°F or artificially warm compound in a manner satisfactory to the Engineer.
3. During warm weather stiffen "Preformed Plastic Sealing Compound" by placing under cold water or by other means as recommended by the compound manufacturer.

## PART 2 - PRODUCTS

### 2.01 BASIC MATERIALS

A. Cast-In-Place Concrete Products: Formwork and Cast-In-Place Concrete per requirements of Division 3 - Concrete.

B. Waterproofed Mortar: Material composition meeting requirements of ASTM C 270, Type M with waterproofing admixture included.

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1. Acceptable Manufacturers:
  - a. Medusa Cement Company; Medusa Waterproofing Paste or Powder.
  - b. Grace Construction Materials; Hydratite
  - c. Chem-Master Corporation; Hydrolox.
  - d. Or Equal.
  
- C. Epoxy Bonding Compound: Provide a high-modulus, low-viscosity, moisture insensitive epoxy adhesive having the following characteristics.
  1. Mix Ratio: 100 percent solids, two-component; mixed one part by volume component B to two parts by volume component A.
  2. Ultimate Compressive Strength: 13,000 psi after cure at 73 degrees F. and 50 percent relative humidity determined in accordance with ASTM D 695.
  3. Acceptable Manufacturers:
    - a. Sika Corporation; Sikadur Hi-Mod.
    - b. Euclid Chemical Company; No. 452 Epoxy System.
    - c. A. C. Horn, Inc.; Epoxite Binder.
    - d. Or Equal.
  
- D. Manhole Steps: Design as indicated on Detail Drawings.
  1. Aluminum Step: Aluminum Alloy AA Designation 6061-T6. Coat that portion of aluminum step being embedded in concrete with heavy bodied bituminous paint.
  2. Cast Iron Step: Gray iron casting meeting requirements of ASTM A 48, Class No. 30.
  3. Reinforced Plastic Step: Composed of a 3/8 inch Grade 60, ASTM A 615 deformed steel reinforcing bar completely encapsulated in Grade 49108, ASTM D 2146 polypropylene copolymer compound, Type II; M. A. Industries, Inc., Type PS4, or equal.
  
- E. Standard Manhole Frame and Cover(Used for Storm Sewer Manholes): Gray iron castings conforming to ASTM A 48, Class No. 30, designed for AASHTO Highway Loading Class HS-20. Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion or other defects. Frame and cover design and dimensions as indicated on Detail Drawings.
  1. Finish: Bearing surfaces machined to prevent rocking and rattling under traffic. Casting surfaces shotblast cleaned and coated with asphalt paint, non-tacky drying.
  2. Identification: Cast the word "SEWER" integrally on cover in 2-inch size raised letters.
  3. Frame Hold-down Bolts: ASTM A 307.
  4. Cover Gasket: One piece O-ring gasket factory installed in a machined rectangular or dovetail groove in the cover bearing surface.
    - a. Gasket material of neoprene composition having good abrasion resistance, low compression set, 40 durometer hardness and suited for use in sanitary sewer manholes.
    - b. Gluing of gasket is not permitted.
  5. Tensile Test Bar: Size B, cast separately, but poured from same iron as castings they represent.

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- F. Watertight Manhole Frame and Cover (Used for Wastewater Sewer Manholes): Gray iron castings conforming to previously specified requirements for Standard Manhole Frame and Cover with the addition of cover hold-down bolts.
1. Cover Hold-down Bolts: Type 316 stainless steel, ASTM A 276, bolts and washers; or manufacturer's standard bronze bolts and washers.
- G. Preformed Plastic Sealing Compound: Fed. Spec. SS-S-210A, Type 1, Rope Form, of either bitumastic base compound or butyl rubber base compound, and shipped protected in a removable two-piece wrapper. Size cross-section of rope form to provide squeeze-out of material around entire interior and exterior circumference when joint is completed.
1. K. T. Snyder Company, Inc.; RAM-NEK.
  2. K. T. Snyder Company, Inc.; RUB'R-NEK.
  3. Hamilton Kent Manufacturing Company; KENT-SEAL NO. 2.
  4. Or Equal.
- H. PVC Waterstop: Gasket type waterstop composed of virgin polyvinyl chloride (PVC) such as manufactured by Fernco Joint Sealer Co.; CMA Concrete Manhole Adapter. (CMA Waterstop distributed by The General Engineering Company, Frederick, Maryland)

### 2.02 PRECAST REINFORCED CONCRETE MANHOLE COMPONENTS

- A. Materials and Construction: Conforming to requirements specified in ASTM C 478 except as follows:
1. Concrete: Composition and compressive strength conforming to ASTM C 478 except use Type II or Type III cement in manhole components and increase compressive strength to 4500 psi (at 28 days) in precast bases.
  2. Casting and Curing: Wet cast and steam curing process in accordance with Section 3.6.11 and 3.7.2 of AWWA C 302.
  3. Lifting Holes and Lugs: Thru-wall holes not permitted in manhole component construction.
  4. Manhole Steps: Factory installed in manhole components, prealigned vertically, spaced on equal centers, and located the minimum distance from ends of risers and top sections as indicated on the Sewer Detail Drawings.
  5. Manhole Component Seals: Manhole component joints factory formed for self-centering concrete to concrete bearing employing either a rubber compression gasket or preformed plastic sealing compound.
    - a. Rubber Compression Gasket: Composition conforming to ASTM C 361 or ASTM C 443.
    - b. Preformed Plastic Sealing Compound: As specified previously.
  6. Manhole Component Design: Base, riser section and top section dimensions and diameters, not consistent with ASTM C 478, are as indicated on Detail Drawings.
- B. Precast Bases and Riser Sections: Design, materials and construction as specified previously.
- C. Pipe Opening Seals: Custom preformed during manufacturing in each base and riser section requiring such, to accommodate type of pipe and pipe opening seal provided.

1. Pipe Opening Seals: Resilient gasket type conforming to requirements specified in ASTM C 923.
  
- D. Precast Top Sections: Designs as required by Detail Drawings, of materials and construction as specified previously except additional and differing requirements as follows:
  1. Flat Slab Tops: Thickness versus diameter as indicated on Sewer Detail Drawings. Tops factory formed to properly accept and support required manhole frame and cover and formed to join riser section in a matching joint.
  2. Eccentric Cone Tops: Manufacture to same minimum wall thickness and with same area of circumferential steel reinforcement as riser sections.
  3. Hold Down Bolt Inserts: Factory cast in top section no less than two 3/4-inch threaded inserts to accommodate manhole frame hold down bolts. Threaded inserts of 3-inches depth and designed for an ultimate load in tension of 12,500 pounds. Inserts factory plugged for shipping. Coordinate insert location with manhole component manufacturer to assure proper location in top sections.
  
- E. Precast Grade Rings: Leveling and adjusting units of 3-inches or 4-inches thickness of materials and constructions as specified previously. Factory cast grade rings with hold down bolt holes matching location of same in manhole frame. Design must provide for full bearing of manhole frame.
  
- F. Waterproof Coating: Provide asphalt compound coating of either the solvent type or the emulsion type. However, mixtures of the two types in the Project is not permitted.
  1. Solvent Type: Brush or spray-on asphalt compound; cold-applied and conforming to Federal Specification SS-A-701 B.
  2. Emulsion-Type: Brush or spray-on asphalt-base, clay emulsion with fibers; cold-applied and conforming to Federal Specification SS-R-1781.
  3. Acceptable Manufacturers:
    - a. W.R. Meadows, Inc.; SEALMASTIC
    - b. Cooper Creek
    - c. Or Equal.
  4. Application: The coating may be either shop or field applied. Apply coating to the exterior of manhole components.
    - a. Apply coating in two coats at the rate of 75 to 100 square feet per gallon per coat. Allow 24 hours drying between coats.

## 2.03 OPTIONS IN PRODUCTS

- A. Manhole Construction Options: Unless indicated otherwise on the Drawings, construct only one type of manhole throughout this Project. Select the manhole construction type from the options listed as follows:
  1. All-precast reinforced concrete manhole components.
  2. All-precast reinforced concrete manhole components except manhole base. Base of cast-in-place concrete.

- B. Manhole Steps Option: Provide one type of manhole step throughout the Project selected from the types specified previously.
- C. Manhole Component Seals Option: Provide one type of manhole component seal throughout the Project selected from the seal types specified previously.
- D. Manhole Pipe Opening Seals Option: Provide one type pipe opening seal throughout the Project.

**PART 3 - EXECUTION**

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**3.01 INSPECTION**

- A. Inspect precast reinforced concrete manhole components in accordance with requirements of ASTM C 478 regarding repairable defects and defects subject to rejection by the Engineer.

**3.02 PREPARATION**

- A. Keep pipe and manhole interiors cleared of debris as construction progresses.
- B. Earthwork: Perform earthwork for manhole installation as specified in Section 02221 and according to the following:
  - 1. Make excavations for manholes to a nearly vertical plane beginning at bottom of excavation one-foot beyond manhole base outside diameter (6-inches each side) to two-feet beyond manhole base outside diameter dimension for top of excavation limit (one-foot each side).
  - 2. If surface pavement of any type is encountered (vehicle or pedestrian ways), cut such pavement to a rectangular shape as opposed to circular shape of manhole. Make limits of cut not to exceed one-foot beyond "top of excavation limit" as specified previously.
  - 3. Should "bottom of excavation limit" be exceeded, provide concrete cradle or encasement for pipes entering or leaving manhole.
- C. Coating Touch-Up: Touch-up chipped, cracked, or abraded surfaces and finished joints with a heavy coating the particular factory coating material on the manhole.

**3.03 MANHOLE CONSTRUCTION METHODS**

- A. Cast-In-Place Concrete Manhole Base: Construct in accordance with design and dimensions indicated on Detail Drawings. When necessary to construct wider or deeper manhole bases than indicated or specified, build such bases as required by the Engineer.
  - 1. Form and pour concrete in accordance with requirements of Division 3 - Concrete. Additional requirements as follows:
    - a. Vibrate poured concrete using mechanical vibrator of a type and design approved by Engineer. Use vibrators of type capable of

- transmitting vibration to concrete in frequencies of not less than five thousand impulses per minute.
- b. Form and pour joint monolithically in manhole base top to match joint of adjoining precast riser section. Use template as obtained from precast concrete manhole component manufacturer of manhole components used in the Project.
2. Install sewer piping in cast-in-place manhole bases prior to pouring the concrete.
    - a. Apply Epoxy Bonding Compound in accordance with manufacturers instructions to pipe at base connection prior to pouring the concrete.
    - b. Install PVC Waterstop on pipes entering and leaving manhole base prior to pouring concrete. Install PVC Waterstop in accordance with manufacturer's written instructions.
  3. Use Class A (4000 psi) concrete unless indicated otherwise on Drawings.
- B. Precast Concrete Bases: Install bases on a 6-inch deep compacted layer of aggregate meeting requirements of First Class Bedding as specified in Section 02221.
1. When using prefabricated pipe opening seals for connecting pipes into manholes, and such seals create an annular space on interior and exterior of manhole wall pipe openings after pipe connection is made, fill such annular spaces with preformed plastic sealing compound.
    - a. Tightly caulk sealing compound into annular spaces in a manner to completely fill the spaces and render the installation watertight.
    - b. Following sealing compound installation, trowel compound surface smooth and flush with interior face of manhole.
- C. Length of Pipe Connections into Manholes:
1. Use pipes no longer than 5-feet in length when connecting into manholes through resilient gasket type pipe opening seals.
  2. For all other pipe connections into manholes, use pipes of such length that a pipe joint is provided at the outside edge of manhole base or wall as applicable. Also use pipes no longer than 6 feet in length for first pipe joined thereto.
- D. Concrete Channel Fill: Field pour concrete channel fill for each manhole base.
1. Form inverts directly in concrete channel fill.
  2. Accurately shape invert to a semi-circular bottom conforming to inside of connecting pipes, and steel trowel finish to a smooth dense surface.
  3. Make changes in size and grade gradually.
  4. Make changes in direction of entering sewer and branches to a true curve of as large a radius as manhole size will permit.
  5. Make slopes gradual outside the invert channels.
  6. Use Class B (3000 psi) concrete.

- E. Manhole Wall Erection: Provide precast reinforced concrete straight riser, tapered riser and top sections necessary to construct complete manholes. Fit the different manhole components together to permit watertight jointing and true vertical alignment of manhole steps.
1. If rubber compression gaskets are used between sections, install gaskets and join sections in accordance with written instructions of manhole component manufacturer.
  2. If preformed plastic sealing compound is used between sections, install sealing compound in accordance with manufacturer's recommendations, and join sections also in accordance with written instructions of manhole component manufacturer.
    - a. Prime joint surfaces if required by preformed sealing compound manufacturer.
    - b. If sealing compound is installed in advance of section joining leave exposed half of two piece protective wrapper in place until just prior to section joining.
    - c. Use preformed sealing compound as the sole element utilized in sealing section joints from internal and external hydrostatic pressure.
    - d. Arrange for the preformed sealing compound manufacturer's representative to be present for first installation of manhole sections to instruct workmen on proper installation methods of sealing compound and to be present while manhole sections are being installed.
    - e. Following manhole section installation, trowel sealing compound surface smooth and flush with interior face of manhole.
    - f. Make pipe connections into manhole walls as specified previously for pipes connecting into manhole bases.
- F. Lifting Recess Sealing: Seal with properly designed tapered rubber plugs. Drive plugs into recesses in such manner to render holes completely water and air tight. Sealing of lifting recesses with grout not permitted.
- G. Frame and Cover Installation: Where required, make final adjustment of frame to elevation using materials selected in Contractor Options.
1. Set precast grade rings in Waterproof Mortar. Mortar thickness not to exceed 3/4-inch maximum and 3/8-inch minimum. Wet, but do not saturate precast grade rings immediately before laying.
  2. Pre-set grade rings to proper plane and elevation using wedge or blocks of cementitious material not exceeding one square inch wide on all sides. No more than four wedges or blocks per grade ring permitted. Incorporate wedges or blocks in fresh mortar in a manner to completely encase each. Crown fresh mortar to produce squeeze-out between grade rings. Tool exposed joints with appropriately shaped tool and compact mortar edge into joints. Clean off excess mortar prior to initial mortar set.
  3. Bolt manhole frames in place on manhole top section, or on leveling units if required, after installing 1/2-inch thick preformed plastic sealing compound on bearing surface of manhole frame. Remove excess sealing compound squeeze-out after manhole frame is bolted in place.
  4. Use bolts of sufficient length to properly pass through leveling units, if any, engage full depth of manhole top section inserts and

allowing enough threaded end to pass through manhole frame to properly tighten nut and washer. Tighten manhole frame bolts after mortar has cured.

- H. **Plugging Pipe Openings:** Plug pipe openings in manholes where such openings are required for future pipe connections.
  - 1. Use masonry units and waterproofed mortar laid up to prevent deterioration.
  - 2. Install such materials to meet exfiltration limits and to allow future removal without damage to manhole.
- I. **Drop Manholes:** Construct in accordance with Type indicated on Detail Drawings. Use same type pipe and fittings in drop connection as used in sewer line from which drop connection is made.

### 3.04 INTERFACING EXISTING CONSTRUCTION

- A. **Connections To Existing Sewers:** Where new manholes are constructed on existing sewers the Contractor shall have the option to use cast-in-place manhole bases or precast bases, both as specified previously.
  - 1. Replace with new, broken or damaged pipe resulting from this work. New pipe material shall match existing. Use compatible joint materials or flexible pipe coupling.
  - 2. Connect new pipe to new manhole bases or new in-line structures as specified previously.
  - 3. If precast manhole bases are used replace existing sewer pipe with new to first joint outside the manhole base.
  - 4. Maintain flow of existing sewer both during construction operations and until concrete is cured both in the case of cast-in-place work and formed inverts.
  - 5. Cut with a saw piping to be removed. Chipping or breaking pipe with a hammer not permitted.

### 3.05 FIELD QUALITY CONTROL

- A. **General Requirements:** Test each manhole constructed in wastewater pipelines by one of the methods specified herein. If the manhole is constructed on an existing wastewater sewer where sewage flow must be maintained, the test will be waived.
  - 1. Conduct tests in presence of and to complete satisfaction of the Engineer.
  - 2. Should a manhole not satisfactorily pass testing, discontinue manhole construction in the Project until such manhole does test satisfactorily.
  - 3. Provide tools, materials (including water), equipment and instruments necessary to conduct manhole testing specified herein.
    - a. **Vacuum Testing Equipment:**
      - 1) Use vacuum apparatus equipped with necessary piping, control valves and gauges to control air removal rate from manhole and to monitor vacuum.
      - 2) Provide an extra vacuum gauge of known accuracy to frequently check test equipment and apparatus.
      - 3) Vacuum testing equipment and associated testing apparatus subject to Engineer's approval.

- 4) Provide seal plate with vacuum piping connections for inserting in manhole frame.
  4. Prior to testing manholes, thoroughly clean and seal openings, both to complete satisfaction of the Engineer. Seal openings using properly sized plugs.
  5. Perform testing with frames installed. The joint between the manhole and the manhole frame shall be included in the test.
  6. The Contractor may elect to make a test prior to backfilling for his own purposes; however, the tests of the manholes for acceptance, shall be conducted after the backfilling has been completed.
- B. Exfiltration Test Procedure:
1. Completely fill manhole with water.
  2. Allow water filled manhole to stand four hours prior to testing to allow absorbing in materials.
  3. At commencement of test, fill manhole to top of manhole frame.
  4. During a four consecutive hour period keep an accurate record of the amount of water to be added because of exfiltration. Acceptable limits of exfiltration as follows:
  5. Consider manhole acceptable when exfiltration rate does not exceed a rate of 0.038 gallons a day per inch of manhole diameter per vertical foot of manhole.
- C. Vacuum Test Procedure:
1. Perform vacuum testing in accordance with the testing equipment manufacturer's written instructions.
  2. Draw a vacuum of 10 inches of mercury and close the valves.
  3. Consider manhole acceptable when vacuum does not drop below 9 inches of mercury for the following manhole sizes and times:
    - a. 4 foot diameter - 60 seconds.
    - b. 5 foot diameter - 75 seconds.
    - c. 6 foot diameter - 90 seconds.
- D. Repair and Retest: Determine source or sources of leaks in manholes failing acceptable limits of exfiltration.
1. Repair or replace defective materials and workmanship, as is the case, and conduct such additional manhole acceptance tests and such subsequent repairs and retesting as required until manholes meet test requirements.
  2. Materials and methods used to make manhole repairs must meet with Engineer's approval prior to use.

END OF SECTION

DIVISION 2 - SITE WORK  
SECTION 02721 - STORM SEWERS

PART 1 - GENERAL

1.01 RELATED WORK

- A. Trenching, Backfilling, and Compacting: Section 02221.
- B. Manholes: Section 02601.
- C. Division 3 - Concrete.

1.02 REFERENCES

- A. American National Standards Institute:
  - 1. ANSI A21.10, Gray Iron and Ductile Iron Fittings, 2 through 48 Inch, for Water and Other Liquids.
  - 2. ANSI A21.11, Rubber Gasket Joints for Cast Iron and Ductile Pressure Pipe and Fittings.
  - 3. ANSI A21.50, Thickness Design of Ductile Iron Pipe.
  - 4. ANSI A 21.51, Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Water or Other Liquids.
- B. American Association of State Highway and Transportation Officials:
  - 1. AASHTO M-36, Corrugated Steel Pipe, Metallic Coated.
  - 2. AASHTO M-176, Porous Concrete Pipe.
  - 3. AASHTO M-190, Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches.
- C. American Society for Testing and Materials:
  - 1. ASTM A 82, Specification for Steel Wire, Plain, for Concrete Reinforcement.
  - 2. ASTM A 185, Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
  - 3. ASTM C 32, Specification for Sewer and Manhole Brick (Made from Clay or Shale).
  - 4. ASTM C 33, Specification for Concrete Aggregates.
  - 5. ASTM C 76, Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
  - 6. ASTM C 150, Specification for Portland Cement.
  - 7. ASTM C 270, Specification for Mortar for Unit Masonry.
  - 8. ASTM C 443, Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
  - 9. ASTM C 478, Specification for Precast Reinforced Concrete Manhole Sections.
  - 10. ASTM C 507, Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.

11. ASTM D 1248, Specification for Polyethylene Plastic Molding and Extrusion Materials.

- B. Commonwealth of Pennsylvania Department of Transportation (PDT), Specifications Publication 408, as supplemented.
  - 1. PDT Section 610.2 Pipe For Pipe Underdrain and Pavement Base Drain.
  - 2. PDT Section 703.2, Coarse Aggregate
- C. Commonwealth of Pennsylvania Department of Transportation, Bureau of Highway Design, Standards For Roadway Construction, PDT Pub. 72.
- D. Federal Specifications:
  - 1. Fed. Spec. SS-S-210A, Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints (Type 1 Rope Form).

1.03 SUBMITTALS

- A. Shop Drawings and Product Data
  - 1. Submit shop drawings with information necessary for fabrication and installation of Storm Sewer products.
  - 2. Submit manufacturer's descriptive literature covering the piping and those products used in its installation.

1.04 SITE CONDITIONS

- A. Environmental Requirements:
  - 1. Keep trenches dewatered until pipe joints have been made and concrete cradle and encasement (as required) have cured.
  - 2. Do not lay pipe in water or on bedding containing frost.
  - 3. Do not lay pipe when weather conditions are unsuitable, as determined by the Engineer, for pipe laying work.
  - 4. To improve workability of Preformed Plastic Sealing Compound during cold weather, store such at temperature above 70 degrees F or artificially warm compound in a manner satisfactory to the Engineer.
  - 5. During warm weather stiffen Preformed Plastic Sealing Compound by placing under cold water or by other means as recommended by the compound manufacturer.

**PART 2 - PRODUCTS**

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2.01 MATERIALS

- A. Concrete Work Products: Formwork, Reinforcement, and Cast-In-Place Concrete as specified in Division 3 - Concrete.
- B. Waterproofed Mortar: Mortar material composition shall meet the requirements of ASTM C 270 for Type M mortar with waterproofing admixture added.
  - 1. Type M, 2500 psi (Parts by volume include: 1 part cement, 1/4 part lime, and sand at not less than 2-1/4 nor more than 3 times the sum of the volumes of cement and lime used.)

2. Waterproofing Agent: Medusa Waterproofing Powder by Medusa Portland Cement Co.; Hydratite by Grace Construction Materials; or Hydrolox by Chem-Master Corp. Add the Medusa product in the ratio of two pounds per bag of cement; add the other products per manufacturer's recommendations.
- C. Drainage Structure Brick: Masonry units made from clay or shale conforming to physical and dimensional requirements of ASTM C32, Grade MS.
- D. Riprap: Field stone or rough unhewn quarry stone of approximately rectangular shapes. Provide stones of such quality that will not disintegrate on exposure to water or weathering.
1. Minimum thickness: 9 inches measured perpendicular to face of stone.
  2. Minimum face dimensions: Not less than stone thickness.
  3. Weight: Not less than 70 percent of the individual pieces weighing 150 lbs. maximum and 10 percent weighing less 100 lbs. minimum.
- E. Bituminous Coated Corrugated Metal Pipe (BCCMP): 16 gauge minimum (heavier gauges required for larger diameter and to suit the required load conditions) conforming to AASHTO M 36. Circular-Type I with asphalt coating conforming to AASHTO M 190 Type A. Connect pipe sections together with dimpled band connections.
1. Flared End Section: Factory fabricated and designed for attachment to corrugated metal pipe using a joint band. End sections formed with integral flange or toe plate on bottom outer edge for anchorage and to prevent undercutting.
- F. Reinforced Concrete Pipe: Class III, of Wall B minimum, conforming to requirements of ASTM C76. Pipe manufactured free of honeycomb with hard, dense surface inside and outside to roughness coefficient (Kutters'n') not exceeding 0.013.
1. Pipe Joints: Tongue and groove or bell and spigot type.
  2. Joint Gaskets: Compression type conforming to requirements of ASTM C 443.
  3. Cement Concrete: ASTM C 150.
  4. Aggregate: ASTM C 33.
  5. Steel Reinforcement: ASTM A 82 Wire and ASTM A 185 Wire Fabric.
- G. Reinforced Concrete Elliptical Pipe and Fittings: Horizontal (HE) Class HE-III), unless indicated otherwise on the Drawings, conforming to requirements of ASTM C 507. Pipe manufactured free of honeycomb with hard, dense surface inside and outside to roughness coefficient (Kutters'n') not exceeding 0.013.
1. Pipe Joints: Tongue and groove or bell and spigot type.
  2. Joint Gaskets: Preformed plastic sealing compound.
  3. Cement Concrete: ASTM C 150.
  4. Aggregate: ASTM C 33.
  5. Steel Reinforcement: ASTM A 82 Wire and ASTM A 185 Wire Fabric.
  6. Preformed Plastic Sealing Compound: Fed. Spec. SS-S-210A, Type 1, Rope Form, of either bitumastic base compound or butyl rubber base compound, and shipped protected in a removable two-piece wrapper. Size cross-section of rope form to provide squeeze-out of material

around entire interior and exterior circumference when joint is completed.

- a. K. T. Snyder Company, Inc., RAM-NEK
- b. K. T. Snyder Company, Inc., RUB'R-NEK
- c. Hamilton Kent Manufacturing Company; KENT-SEAL NO. 2
- d. General Sealants Corporation; GS #79.
- e. Or Equal.

- H. High Density Polyethylene Corrugated Pipe: Provide pipe and fittings manufactured from polyethylene compounds which meet or exceed the requirements of Type III, Category 4 or 5, Graded P33 or P34, Class C according to ASTM D-1248. Clean reworked material may be incorporated into the compounds.
1. Pipe and fittings showing visible defects and foreign inclusions in the material are not acceptable.
  2. Pipe lengths shall have cleanly and squarely cut ends so as not to adversely affect pipe joining.
  3. Provide corrugated fittings (corrugations shall match the pipe) of either molded or fabricated type. Fittings by other than the pipe manufacturer are not acceptable.
  4. Joints: Split coupling type and of a corrugated design to engage the pipe corrugations for a minimum of four corrugations, two on each side of the pipe joint.
  5. Gaskets: Provide neoprene sponge gaskets on each pipe joint where pipe is installed under roadway embankments. Insert the gasket under the coupling on each side of the pipe joint.
  6. Acceptable Manufacturers:
    - a. Advanced Draining Systems, Inc.
    - b. Or Equal.
- I. Ductile Iron (DIP): Class 50, conforming to requirements of ANSI A21.50 and ANSI A21.51.
1. Fittings: Gray iron or ductile iron castings, ANSI A21.10.
  2. Rubber gasket joint: ANSI A21.11.
  3. Wall Pipe: Gray iron casting, joint types as indicated on the Drawings; F-1400 Series, as manufactured by Clow Corporation or equal.
- J. Contractor Option: The Contractor shall have the option to use either of the following pipe underdrain materials. However a mixture of materials shall not be permitted.
1. Porous Cement Concrete Pipe: Machine made of cement concrete conforming to AASHTO Designation M 176, also to the requirements of PDT Section 610.2.
  2. Perforated Plastic Semi-circular Pipe: Extruded or moulded using a high density, flexible plastic with minimal material thickness of 0.125 inches; and conforming to the requirements of PDT Section 610.2.

## 2.02 DRAINING STRUCTURES

- A. Concrete Endwall: Conforming to Pennsylvania Department of Transportation Type DW. Forming, reinforcement and concrete requirements as specified in Division 3 - Concrete.

- B. Concrete Inlet: Field cast reinforced concrete type conforming to Pennsylvania Department of Transportation Type M or Type C.
  - 1. Forming, reinforcement and concrete material requirements as specified in Division 3 - Concrete.
  - 2. Frame and grating fabricated of structural steel bars and a structural steel angle frame with integral concrete anchoring lugs. Design to sustain H-20 loading per current AASHTO Specifications.
  
- C. Precast Concrete Inlets: Conforming to Pennsylvania Department of Transportation Type M or Type C. Concrete of Class A type conforming to Section 03300. Reinforce openings in inlet with reinforcement bars conforming to ASTM A 615. Reinforce walls and bottom with welded wire fabric conforming to ASTM A 185. Cast steel angle in top of inlet to hold grate.
  
- D. Inlet Frame and Grate: Provide gratings of design indicated and fabricated of structural steel bar and angle with angle frame. Design to sustain H-20 loading per current ASSHTO Specifications.
  
- E. Manhole Frames and Covers: As specified in Section 02601 with the following exceptions.
  - 1. Identification: Cast the word STORM integrally on cover in 2-inch size raised letters.
  - 2. No Cover Gasket required.
  
- F. Precast Concrete Manholes: Components and material requirements as specified in Section 02601.
  
- G. Waterproof Coating (For Precast Concrete Structures): Provide asphalt compound coating of either the solvent type or the emulsion type. However, mixtures of the two types in the Project is not permitted.
  - 1. Solvent Type: Brush or spray-on asphalt compound; cold-applied and conforming to Federal Specification SS-A-701 B.
  - 2. Emulsion-Type: Brush or spray-on asphalt-base, clay emulsion with fibers; cold-applied and conforming to Federal Specification SS-R-1781.
  - 3. Acceptable Manufacturers:
    - a. W.R. Meadows, Inc.; SEALMASTIC
    - b. Cooper Creek
  - 4. Application: The coating may be either shop or field applied. Apply coating to the exterior of inlet components.
    - a. Apply coating in two coats at the rate of 75 to 100 square feet per gallon per coat. Allow 24 hours drying between coats.

**PART 3 - EXECUTION**

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**3.01 PREPARATION**

- A. Inspection: Prior to start of storm drainage construction inspect each section of pipe for defects before actual use. Pipe already laid and

later found defective will not be accepted and shall be replaced with new materials and relayed at the Contractor's expense.

1. Inspect precast manhole components in accordance with requirements of ASTM Designation C-478 regarding repairable defects and defects subject to rejection by the Engineer.
2. In no instance lay pipe or set or construct inlets, endwalls or manhole bases in excavations containing water or on subgrade containing frost. In all instances keep excavations water-free until concrete pours of whatever nature have cured. Keep pipe and manhole interiors cleared of debris as construction progresses.

3.02 CONSTRUCTION

- A. Earthwork: Perform earthwork for buried storm sewer piping and associated concrete structures as specified in Section 02221.
- B. Concrete Work: Perform concrete work incidental to the storm sewer construction as specified in Division 3 - Concrete.
- C. Riprap Placement: Place and spread riprap in such a manner as to produce a reasonable well-graded mass of rock with a minimum of voids. Distribute the fines in order to chink voids between larger pieces.
- D. Storm Sewer Piping Installation:
  1. Following trench preparation, install First Class Bedding, and lay pipe proceeding up-grade true to lines and grades given.
  2. Rest each pipe section on bedding for the full length of its barrel. Make recesses to facilitate joint band installation. Backfill recesses with First Class Bedding material immediately following pipe joining operations.
- E. Pipe Joining:
  1. Coupling Band (BCCMP): Lay pipe with the outside laps of circumferential joints pointing upstream. Use the pipe manufacturer's coupling bands installed in strict accordance with instructions furnished with the pipe. Prior to backfilling, touch-up the damaged area (if any) in the factory applied bituminous coating using a compatible bituminous material such as recommended by the pipe manufacturer.
  2. Push-On Joints: To make push-on joints, properly seat sealing gasket, evenly and sufficiently lubricate the spigot end of pipe, and fully enter joint until joint line is visible. Make deflection, if required, only after the joint has been assembled properly.
  3. Reinforced Concrete Elliptical Pipe - Preformed plastic sealing compound joints shall be carefully made in accordance with the written instructions of the manufacturer of the preformed plastic sealing compound. The spacing between pipe joints (inside) shall not exceed one-half inch. Excess sealing compound extruding from the joint on the inside of the pipe shall be trowelled smooth.

- F. Manhole Construction: Construct manholes as specified in Section 02601.
1. Cast bases to accommodate pipe entering such.
  2. Terminate pipe in manhole bases flush with interior surface of base.
- G. Drainage Structure Installation: In general, install the drainage structures in accordance with PDT Pub. 72. Do not complete drainage structures until after grading has been finished and the necessary arrangements have been made to insure suitable connections and tie-ins at proper grade and alignment.
1. Set precast drainage structures on a bed of aggregate, over undisturbed or well compacted earth.
  2. Set inlet and outlet pipe in drainage structures cut flush with inside face of walls and extend a sufficient distance beyond the outside face of drainage structure walls to provide for pipe section connections.
  3. Fill annular space between pipe and openings in drainage structure with Type M mortar.
  4. Install inlet frame and grate with frame anchored into the drainage structure top.
- H. Connections To Existing Precast Concrete Structures:
1. Cut required opening or openings by such methods so as to prevent cracking and spalling of existing concrete.
  2. Make openings of sufficient size to accommodate the pipe and one inch of annular mortar space. Fill such annular space with Waterproofed Mortar thoroughly compacted in place.
  3. Set pipes entering such existing concrete structures flush with inside face of such structures.
  4. If required, fill bottom of structures with Class B concrete to invert of new pipe and slope surface 1 1/4-inch to outlet pipe.
- I. Connections To Existing Sewers: Connect new inlets to existing sewers as follows:
1. Replace with new, broken or damaged pipe resulting from this work. New pipe material shall match existing. Use compatible joint materials or flexible pipe coupling.
  2. Connect new pipe to new inlet as specified previously.
  3. Replace existing sewer pipe with new to first joint outside the manhole base.
  4. Cut with a saw piping to be removed. Chipping or breaking pipe with a hammer not permitted.
- J. Underdrain Installation: Install underdrain using materials specified in Section 02221. Perform trench preparation, backfilling, and compaction in accordance with Section 02221.

END OF SECTION

DIVISION 2 - SITEWORK

SECTION 02722 - PIPED WASTEWATER SEWER

PART 1 - GENERAL

1.01 RELATED WORK

- A. Trenching Backfilling and Compacting: Section 02221.
- B. Manholes: Section 02601.

1.02 QUALITY ASSURANCE

- A. Design Criteria: In addition to the design requirements of the Pennsylvania Department of Environmental Resources, comply with the following:
  - 1. Use only one type and class of pipe in any continuous line of sewer between structures.
  - 2. Use pipe and fittings designed to withstand imposed trench loadings and prevailing site conditions at the various locations.
  - 3. Provide a minimum depth of cover of 5 feet for pipe sewers.
- B. Source Quality Control:
  - 1. Shop Tests: In accordance with Article 1.06 of the General Instructions, factory test pipe materials listed in the following. Each pipe manufacturer must have facilities to perform listed tests. The Engineer reserves the right to require the manufacturer to perform such additional number of tests as the Engineer may deem necessary to establish the quality of the material offered for use.

<u>MATERIAL</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
a. Ductile Iron Pipe	ANSI A 21.51	As specified in ANSI A 21.51.
b. Polyvinyl Chloride Pipe	ASTM D 3034, ASTM F 789, ASTM F 679 or ASTM F 794 as applicable.	As specified in ASTM D 3034, ASTM F 789, ASTM F 679 or ASTM F 794 as applicable.
c. Reinforced Concrete Pipe	ASTM C 76	As specified in ASTM C 76.
d. Prestressed Concrete Cylinder Pipe	AWWA C 301	As specified in AWWA C 301.

- 2. Laboratory Tests: The Engineer reserves the right to require that laboratory tests also be conducted on materials that are shop tested. Furnish labor, materials, and equipment necessary for collecting, packaging, and identifying representative samples of materials to be tested and the shipping of such samples to the Testing Laboratory.

3. The Engineer reserves the right to accept certified test records or reports of previously conducted tests.

1.03 REFERENCES

A. American National Standards Institute:

1. ANSI A 21.10, Gray-Iron and Ductile-Iron Fittings, 2 through 48 inches, for Water and Other Liquids.
2. ANSI A 21.11, Rubber Gasket Joints for Cast Iron and Ductile Pressure Pipe and Fittings.
3. ANSI A 21.50, Thickness Design of Ductile-Iron Pipe.
4. ANSI A 21.51, Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Water or Other Liquids.

B. American Society for Testing and Materials.

1. ASTM A 48, Specification for Gray Iron Castings.
2. ASTM C 76, Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
3. ASTM C 144, Specification for Aggregate for Masonry Mortar.
4. ASTM C 150, Specification for Portland Cement.
5. ASTM C 361, Specification for Reinforced Concrete Low-Head Pressure Pipe.
6. ASTM C 924, Standard Practice For Testing Concrete Pipe Sewer Lines By Low-Pressure Air Test Method.
7. ASTM D 2321, Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
8. ASTM D 2564, Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
9. ASTM D 3034, Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
10. ASTM D 3212, Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
11. ASTM F 477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
12. ASTM F 679, Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
13. ASTM F 789, Specification for Type PS-46 Poly (Vinyl Chloride) (PVC) Plastic Gravity Flow Sewer Pipe and Fittings.
14. ASTM F 794, Specification for Poly (Vinyl Chloride) (PVC) Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

C. American Water Works Association:

1. AWWA C 100, Cast-Iron Pressure Fittings.
2. AWWA C 104, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
3. AWWA C 151, Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
4. AWWA C 301, Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids.
5. AWWA C 302, Reinforced-Concrete Water Pipe-Noncylinder Type, Not Prestressed.
6. AWWA C 600, Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances.

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- D. Federal Specifications:
    - 1. Fed. Spec. SS-S-168 (2), Sealing Compound, Sewer, Bituminous, Two Component, Mineral-Filled, Cold-Applied.
    - 2. Fed. Spec. SS-S-210A, Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints (Type 1 Rope Form).
  - E. Uni-Bell Plastic Pipe Association:
    - 1. UNI-B-6, Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe.
    - 2. UNI-B-9, Recommended Performance Specification for Polyvinyl Chloride (PVC) Profile Wall Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
- 1.04 SUBMITTALS
- A. Shop Drawings and Product Data: Furnish completely dimensioned shop drawings, catalog cut or other data as required to provide a complete description of piping and piping specialties.
  - B. Certificates:
    - 1. Certified records or reports of results of shop tests, such records or reports to contain a sworn statement that shop tests have been made as specified.
    - 2. Manufacturer's sworn certification that pipe will be manufactured in accordance with specified reference standards for each pipe type.
- 1.05 PRODUCT DELIVERY, STORAGE AND HANDLING
- A. Transport, handle and store pipe materials and other Products specified herein in a manner recommended by the respective manufacturers to prevent damage and defects.
- 1.06 SITE CONDITIONS
- A. Environmental Requirements:
    - 1. Keep trenches dewatered until pipe joints have been made and concrete cradle and encasement, if any, have cured.
    - 2. Under no circumstances lay pipe in water or on bedding containing frost.
    - 3. Do not lay pipe when weather conditions are unsuitable, as determined by the Engineer, for pipe laying work.
    - 4. To improve workability of "Preformed Plastic Sealing Compound" during cold weather, store such at temperature above 70 degrees F or artificially warm compound in a manner satisfactory to the Engineer.
    - 5. During warm weather stiffen "Preformed Plastic Sealing Compound" by placing under cold water or by other means as recommended by the compound manufacturer.

**PART 2 - PRODUCTS**

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**2.01 SEWER PIPE AND FITTINGS**

- A. For pipe joints, use rubber gaskets suitable for conveying domestic sewage.
  
- B. Ductile Iron (DIP):
  - 1. Pipe: ANSI A21.50 and ANSI A 21.51.
  - 2. Wall Thickness Class (Buried): As indicated on Drawings or as determined by the Engineer.
  - 3. Fittings: Gray iron or ductile iron ANSI A21.10. Fittings larger than 48 in. AWWA C100 Class B.
  - 4. Joints:
    - a. Rubber-Gasket Joints (Buried): ANSI A 21.11.
      - 1) For buried pipe installation, provide either push-on or mechanical joints except where other types of joints are indicated on the Drawings or required by the Specifications or regulatory agency.
  - 5. Lining and Coating:
    - a. Pipe and Fitting Lining: Manufacturer's standard cement-mortar lining in accordance with AWWA C104, single thickness. Lining shall include an asphaltic seal coat to prevent moisture loss in cement-mortar curing sequence.
    - b. Pipe and Fitting Coating: Manufacturer's standard asphaltic coating, approximately one mil thick in accordance with AWWA C151, applied to the outside of pipe and fittings.
  
- C. Polyvinyl Chloride Pipe (PVC):
  - 1. Pipe, Solid Wall, 6 through 15 Inch Diameters: Type PSM SDR-35, ASTM D 3034, or Type PS-46, ASTM F 789 (to 18 inch diameter).
  - 2. Pipe, Solid Wall, 18 through 27 Inch Diameters: Type PS-46, ASTM F 679.
  - 3. Pipe, Closed Profile or Ribbed Wall, 18 through 48 Inch Diameters: Type PS-46, ASTM F 794.
  - 4. Fittings: Conforming to same applicable ASTM Specification requirements for pipe.
  - 5. Joints: Push-on with elastomeric gasket, ASTM D 3212; and ASTM F 477 for gasket specifications.
    - a. Pipe bell design shall incorporate a gasket locked in a groove so as to prevent displacement when pipes are joined.
  
- D. Reinforced Concrete Pipe (RCP):
  - 1. Pipe: ASTM C 76, Class III, of Wall B minimum, except where indicated otherwise on Drawings or determined by the Engineer, and having an interior surface roughness coefficient measured in Kutters 'n' not exceeding 0.013. Pipe acceptance based on Paragraph 5.1.1 of ASTM C 76 ("Acceptance on the Basis of Plant Load-Bearing Tests, Materials Tests, and Inspection of Manufactured Pipe for Visual Defects and Imperfections") and written certification of conformity to the following. Submit such certification two weeks prior to pipe delivery.
    - a. Pipe manufactured with Type II Portland Cement, ASTM C 150.

- b. Pipe cured to meet specified strength.
  - c. Pipe manufactured with circular reinforcement with both bell and spigot ends reinforced. Bell and spigot reinforcement to be attached to barrel reinforcement.
  - 2. Fittings and Specials: Manufactured in accordance with requirements of Section 4, AWWA Standard C302 with wall thickness equal to adjoining pipe. Manufactured with circular reinforcement.
  - 3. Rubber and Steel Joints: Formed of steel joint rings on tongue and groove ends or on bell and spigot ends, both with round rubber gasket contained in an external groove in the tongue or spigot end ring. The joint and rubber gasket shall conform to requirements specified in Section 3.3 and 3.4 respectively of AWWA Standard C 302; additional requirements as follows:
    - a. The exposed portion of the steel joint rings shall have a factory applied coal tar epoxy, or epoxy-polyamide, protective coating applied to 8 mils dry film thickness. The pipe manufacturer shall prepare the steel surfaces and apply the coating in strict conformance with the manufacturer's instructions. Field applied coatings not acceptable.
    - b. The bell end of the pipe shall have a factory applied grout retaining diaper anchored in place with straps. The diaper is inverted for final placement in the field finishing of the joint.
    - c. Provide joint grout for finishing the joint which shall consist of one part portland cement conforming to ASTM C 150, and three parts sand conforming to ASTM C 144, and water in sufficient quantity to mix the grout to a consistency of thick cream free of lumps.
  - 4. Rubber and Concrete Joints: Formed of concrete and sealed with round rubber gasket contained in an external groove in the concrete of the tongue or spigot end. Joint and rubber gasket shall conform to requirements specified in ASTM C 361.
- E. Prestressed Concrete Cylinder Pipe (PCCP):
- 1. Manufactured according to AWWA Standard C 301 and the following additional requirements, using Type II Portland Cement, ASTM C 150 and calcereous aggregate (limestone).
    - a. Pipe manufactured either by horizontal centrifugation, or vertical wet casting with inside and outside forms, or dry-pack casting, AWWA C 301 3.6.9, 3.6.10, or 3.6.11 respectively.
    - b. Minimum wire shall be No. 6 with maximum class of Class III.
    - c. Minimum cylinder thickness shall be 16 ga. Exterior coating shall have maximum sand-cement ratio of 2 1/2 to 1.
  - 2. Fittings: Manufactured in conformity with AWWA C 301, Section 4.
  - 3. Joints: Bell and spigot design, steel joint ring and round rubber gasket, each conforming to AWWA C 301 and the following:
    - a. The exposed portion of the steel joint rings shall have a factory applied coal tar epoxy, or epoxy-polyamide, protective coating applied to 8 mils dry film thickness. The pipe manufacturer shall prepare the steel surfaces and apply the coating in strict conformance with the manufacturer's instructions. Field applied coatings not acceptable.

- b. The bell end of the pipe shall have a factory applied grout retaining diaper anchored in place with straps. The diaper is inverted for final placement in the field finishing of the joint.
  - c. Provide joint grout for finishing the joint which shall consist of one part portland cement conforming to ASTM C 150, and three parts sand conforming to ASTM C 144, and water in sufficient quantity to mix the grout to a consistency of thick cream free of lumps.
- F. PVC Waterstop: Gasket type waterstop composed of virgin polyvinyl chloride (PVC) such as manufactured by Fernco Joint Sealer Co.; CMA Concrete Manhole Adapter. (CMA Waterstop distributed by The General Engineering Company, Frederick, Maryland).
- G. Flexible Pipe Coupling: Clamped design with virgin PVC coupling and two type #305 stainless steel bands, such as manufactured by Fernco Joint Sealer Co. (Flexible Couplings distributed by The General Engineering Company, Frederick, Maryland).
- 2.02 SERVICE CONNECTION PIPE AND FITTINGS
- A. Polyvinyl Chloride (PVC) Pipe, 6-Inch Diameter: Service connection piping may be the same as specified for Sewer Pipe and Fitting or Schedule 40 pipe conforming to ASTM D 1785 and made from Class 12454-B Rigid PVC Compounds with a hydrostatic design stress of 2,000 psi and designated as PVC 1120.
- 1. Joint and Fittings: Socket-Type for solvent welding; fittings shall conform to ASTM D 2467 and made from Class 12454-B Rigid PVC Compound.
  - 2. Joint Solvent: Conforming to ASTM D 2564.
- B. Cast Iron Saddles (For Other Than Plastic Pipe): Correctly contoured for outside diameter of pipe and incorporating a gasket and band assembly.
- 1. Saddle Body: Cast iron, ASTM A 48, Class 35, coated inside and out with heavy coat of black asphaltum type paint.
  - 2. Gasket: Compound rubber (neoprene) tubular O-ring design, ASTM C-361.
  - 3. Band: Type C 304 stainless steel band assembled with two 3/8-inch Type C-304 stainless steel T-bolts, washers and hex nuts.
  - 4. Provide spigot or bell inlet and proper adaptor or coupling suitable for connection of the type and size of service connection pipe.
  - 5. Acceptable Manufacturer: The General Engineering Company; Sealtite, or equal.
- C. PVC Saddles (Polyvinyl Chloride): Correctly contoured for outside diameter of pipe and incorporating ring gasket bell outlet.
- 1. Wye or tee saddle of same material as specified previously for Sewer Pipe.
  - 2. Solvent Cement: ASTM D 2564.

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- D. Pipe Outlets (RCP or PCCP): Factory fabricated integrally cast concrete pipe outlets incorporating saddle plates for additional support at the outlet with outlet neck adequately reinforced in manner similar to the sewer pipe.
  - 1. Outlet neck of mechanical joint bell end and incorporating special shaped steel joint rings and round rubber gasket.
- E. Pipe Plugs: Designed for permanent installation and removable. Obtain plugs for various types of pipe used from the respective pipe manufacturer.

### 2.03 OPTIONS IN PRODUCTS

- A. Sewer Pipe and Fittings Options: Unless indicated otherwise on the Drawings, the sewer mains in this Project shall incorporate only one of the listed types of pipe for a given range of pipe sizes. However, use only pipes of the material options listed. The options are as follows:
  - 1. Six through 15 inch diameter size range:
    - a. Polyvinyl Chloride Pipe (PVC) type PSM SDR-35 or PS-46.
  - 2. 18 inch and larger diameters:
    - a. Polyvinyl Chloride Pipe (PVC): Solid Wall, PS-46, Closed Profile, PS-46 or Ribbed Wall PS-46.
    - b. Reinforced Concrete Pipe (RCP) with either Rubber-and-Steel joint or Rubber and Concrete joint.
    - c. Prestressed Concrete Cylinder Pipe (PCCP). Where 20 inch diameter PCCP will be permitted.
  - 3. Pipe Material Option Exception: Ductile Iron Pipe (DIP), with either push-on or mechanical joints, may be used for pipe sizes 8 through 21 inches.
  - 4. Required Pipe Material Exception: Use only DIP where required by the Engineer because of prevailing site conditions, where required by utility companies and/or local governmental bodies, or where the sewer main is laid in fill material.
- B. Service Connection Options: For service connections on RCP and PCCP use either Cast Iron Saddles or Pipe Outlets. A mixture of types not acceptable.

## PART 3 - EXECUTION

### 3.01 INSPECTION

- A. Inspect each section of pipe and each pipe fitting before laying in conformance with the inspection requirements of the appropriate referenced standard.
- B. Remove rejected pipe from the Project.

3.02 PREPARATION

- A. General:
  - 1. Clean piping interior prior to laying pipe and following pipe laying.
  - 2. Keep open ends of piping and pipe attachment openings capped or plugged until actual connection or actual pipe testing.
  - 3. Excavate trenches in rock at least 25-feet in advance of pipe laying. Protect pipe ends from blasting.
  
- B. Earthwork: Perform earthwork for sewer installation as specified in Section 02221.

3.03 SEWER CONSTRUCTION METHODS

- A. General Requirements: Use proper and suitable tools and appliances for the proper and safe handling, lowering into trench and laying of pipes.
  - 1. Lay pipe proceeding upgrade true to line and grades given. Lay bell and spigot pipe with bell end upgrade. Lay tongue and groove pipe with groove end upgrade.
  - 2. Exercise care to ensure that each length abuts against the next in such manner that no shoulder or unevenness of any kind occurs along inside bottom half of pipe line.
  - 3. No wedging or blocking permitted in laying pipe unless by written order of Engineer.
  - 4. Before joints are made, bed each section of pipe full length of barrel with recesses excavated so pipe invert forms continuous grade with invert of pipe previously laid. Do not bring succeeding pipe into position until the preceding length is embedded and securely in place.
  - 5. Dig bell holes sufficiently large to permit proper joint making and to insure pipe is firmly bedded full length of its barrel.
  - 6. Walking or working on completed pipe line, except as necessary in tamping and backfilling, not permitted until trench is backfilled one-foot deep over top of pipes.
  - 7. Take up and relay pipe that is out of alignment or grade, or pipe having disturbed joints after laying.
  - 8. Take up and replace with new, such in-place pipe sections found to be defective.
  - 9. Bedding materials and concrete work for pipe bedding as specified in Section 02221.
  
- B. Joints: Make joints in joining of pipe materials specified previously under PART 2 and not specifically covered for installation under PART 3 of this Specification, in strict accordance with manufacturer's installation instructions and such included reference standards.
  - 1. Arrange and pay for pipe manufacturer's representative to be present for first installation of pipe to instruct workmen on proper installation methods.
  - 2. Make joints absolutely watertight and immediately repair detected leaks and defects. Methods of repair subject to Engineer's approval.

- C. Laying Ductile Iron Pipe: Installation and joint assembly according to AWWA C 600, and as follows:
  - 1. Where necessary to field cut pipe use approved pipe cutter, milling cutter or abrasive wheel saw.
  - 2. Make joints as specified previously under "Joints."
  
- D. Laying Specified Types of Plastic Pipe: Installation and joint assembly according to ASTM D 2321 for Class I bedding material.
  
- E. Laying Reinforced Concrete Pipe: In addition to previously specified reference standard specification requirements, Rejection requirements of ASTM C 76 govern acceptance of RCP prior to and following installation. Make-up Rubber and Steel joints as follows:
  - 1. Joint Make-up: During joint make-up check the gasket position using the pipe manufacturer provided feeler gauge, or similar procedure as recommended by the pipe manufacturer. If the gasket is not in place, open the joint and re-make the joint using a new gasket.
  - 2. Finishing the Joint: Position the inverted factory installed grouting diaper properly over the entire joint in accordance with the manufacturer's instructions. Pour the flowable grout mixture into the opening at the top of the diaper so that it completely fills the external joint recess. Rod or puddle the grout to ensure complete filling of the joint recess. Apply a stiff grout mix over the diaper opening to form a grout seal.
  
- F. Laying Prestressed Concrete Cylinder Pipe: In addition to previously specified reference standard specification requirements, Rejection requirements of AWWA C 301 govern acceptance of PCCP prior to and following installation.
  - 1. Joint Make-up: During joint make-up check the gasket position using the pipe manufacturer provided feeler gauge, or similar procedure as recommended by the pipe manufacturer. If the gasket is not in place, open the joint and re-make the joint using a new gasket.
  - 2. Finishing the Joint: Position the inverted factory installed grouting diaper properly over the entire joint in accordance with the manufacturer's instructions. Pour the flowable grout mixture into the opening at the top of the diaper so that it completely fills the external joint recess. Rod or puddle the grout to ensure complete filling of the joint recess. Apply a stiff grout mix over the diaper opening to form a grout seal.
  
- G. Service Connection Fittings:
  - 1. Wyes or Tees: Make connections to sewer using wye or tee fittings of same material and joint configuration as the sewer at planned point of branch connection.
    - a. Use commercially manufactured wye or tee fittings and one-eighth bends.
    - b. Set wye or tee branches at proper vertical angles as required to bring service connections to the proper depth.
    - c. Fittings locations determined by the Engineer with respect to service connections to existing house or building location.

2. Saddles: Make connections to sewers, which incorporate a saddle connection, by machine cutting a hole in the sewer of proper size to accommodate the saddle. Use a machine specifically designed for the purpose; no other means of making the hole permitted.
    - a. Install saddle in accordance with manufacturer's installation instructions.
  3. Pipe Outlet: Connect service connection piping to outlet in manner specified for joining pipe.
  4. Plugs: Close free ends of branches and service connections with a carefully fitted plug. Type of plug used and method of installation to Engineer's approval. Installed plugs shall successfully pass Line Acceptance Tests.
- H. Drop Connections: Make drop connections where drop in invert is two feet or more or as required by the Engineer. Use same pipe material used to construct the main from which the drop connection is made. Construct drop connection in accordance with design shown on Detail Drawing. Precase collars are acceptable for encasing the riser pipe.
- I. Connections to Existing Manholes or Structures: Cut required opening or openings by such methods so as to prevent cracking and spalling concrete. Make openings of sufficient size to accommodate pipe with PVC Waterstop installed and one inch of annular grout space. Grout annular space using Non-Shrink and Non-Metallic Grout as specified in Section 03600. Make connection watertight. Form a new invert channel in the existing manhole base to properly connect the flow through the existing manhole. Do not permit ground water, surface water or debris to enter the existing facilities through the new connection. Provide drop connection if connection invert is 2 feet or more above the manhole invert.
- J. Reconnection of Existing Service Connections: Use wye or tee fittings or saddles for connection to the sewer main. Use pipe if required as specified previously. Make connection to existing piping with flexible pipe couplings.
- 3.04 SERVICE CONNECTION CONSTRUCTION
- A. General Requirements: Build service connections (house or other service lines) to such points indicated on Sewer Detail Drawings. Lay and join service connections in every respect as specified previously for Sewer Construction Methods except as follows:
1. Line and Grade: Lay service connections true to line and grade furnished by Engineer, and unless otherwise required by Engineer, at a 90 degree angle to curb line.
  2. Test Tees: If required, install a 6 x 6 x 6-inch test tee on upper free end of service connections, three feet behind the right-of-way (test tee for Owner's use in testing house or building sewer lines connected to service connection). Provide test tees of same material as service connection. Close two outlets of test tee with Plugs. Type of plug used and method of installation subject to Engineer's approval. Installed plugs shall successfully pass Line Acceptance Test.

3. In general, where depth of sewer invert is 12-feet or more, or elsewhere as designated by the Engineer, install service connections to enter the sewer as shown on Sewer Detail Drawings for "Service Connection-Deep Sewer". Use same material used for service connections.
4. Where DIP, RCP or PCCP is used for pipe sewer mains, use PVC pipe for service connection piping. Provide suitable adaptor.

3.05 FIELD QUALITY CONTROL

- A. General Requirements: Conduct tests specified herein so that each pipe line installed in the Project is tested to the Engineer's satisfaction.
  1. Provide tools, materials (including water), apparatus and instruments necessary for pipe line testing.
  2. Conduct tests of every kind in the presence of and to the satisfaction of the Engineer.
- B. Testing Equipment:
  1. Use air compressing apparatus equipped with a control panel with necessary piping, control valves and gauges to control air flow rate to piping test section; and to monitor air pressure within piping test section and air pressure within test section seal plugs. To prevent accidental overloading of piping test section, provide air compressing apparatus with an approved pressure relief device set to relieve at 10 psi.
  2. Provide an extra pressure gauge of known accuracy to frequently check test equipment and apparatus.
  3. Air testing equipment and associated testing apparatus subject to Engineer's approval.
  4. Provide GO-NO-GO Mandrel and incidental equipment for Deflection Test. Mandrel to conform to following requirements:
    - a. Cylindrical in shape with odd number of arms not less than nine, spaced evenly around the mandrel.
    - b. Minimum contact length of mandrel arms with pipe wall not less than the nominal diameter of the pipe being tested.
    - c. Mandrel diameter 95 percent of inside pipe diameter.
- C. Cleaning Prior to Tests: Before tests are conducted, clean piping including sewers, branches and service connections until free of dirt or silt or construction debris.
- D. Initial Section Test: To demonstrate acceptability of installed pipe materials and workmanship, construct and air test one sewer section from manhole to manhole using the pipe provided in the Contract. Pretesting such section prior to actual "Initial Section Test" not permitted.
  1. Conduct Initial Section Test in same manner as Line Acceptance Test specified in a following paragraph.
  2. Conduct said Initial Section Test for each size and type pipe material used in the Project prior to continued installation of same pipe.

3. Provide pipe manufacturer's representation during laying, back-filling and testing of Initial Sections Tests.
4. The Engineer has the option to order the same "Initial Section Test" for any section of sewer in each 3,000 lineal feet of sewer line of any particular size and material.
5. Conduct same "Initial Section Test" for one manhole to manhole sewer section of each 3,000 lineal feet of sewer.
6. Failure of an "Initial Section Test" will be sufficient cause for the Engineer to reject manufacturer and supplier of pipe regardless of cause of failure.
7. Sewer sections successfully tested as Initial Section Test will be retested under Line Acceptance Test.

E. Line Acceptance Test:

1. Plug free ends of branches (if any) and service connections.
2. After a section of sewer and its service connections is constructed between adjacent manholes, backfilled and successfully cleaned, perform a low pressure air Line Acceptance Test in accordance with the Standards listed hereinafter and the following:
  - a. Seal Sewer piping at upstream and downstream manholes with pneumatic type plugs. Test plug seal before actual use by testing plugs outside the trench in one length of pipe pressurized to maximum anticipated testing pressure. Plugs shall hold without bracing and show no movement.
  - b. Introduce low pressure air slowly into sealed sewer section until internal air pressure is 4 psig greater than the average ground water pressure acting on the pipe.
  - c. Allow two minutes minimum for air temperature to stabilize, adding only required air to maintain pressure.
  - d. After stabilization period (3.5 psig minimum in pipe) disconnect air supply and determine rate of air loss by measuring time interval required for 3.5 psig to decrease to 2.5 psig greater than the average groundwater pressure acting on the pipe.
  - e. To determine the groundwater pressure acting on the pipe being tested, divide the height in feet of the groundwater above the invert of the pipe by 2.3. Add the result to the previously specified test pressures (i.e., If maximum groundwater height is 11.5 feet above the pipe invert, the groundwater pressure is 5 psig. This increases the 3.5 psig and 2.5 psig to 8.5 psig and 7.5 psig, respectively.) Test pressure not to exceed 10 psig regardless of height of groundwater over the pipe.
  - f. Consider sewer line "Acceptable" when a 1.0 psig pressure drop does not occur within the test time specified in the AIR TEST TABLES immediately following this Section.
  - g. Standards:
    - 1) DIP, RCP and PCCP: ASTM C 924.
    - 2) PVC Pipe, Solid: UNI-B-6.
    - 3) PVC Pipe, Closed Profile: UNI-B-9.
3. For sections of sewer containing service connections which service existing buildings, perform "Line Acceptance Test" by testing one joint at a time.

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- a. Equipment: Use joint testing apparatus such as "Cherne Joint Tester", Cherne Industrial, Inc., Edina, Minnesota or equal.
  - b. Use air pressure for testing joint as previously specified.
  - c. Consider joint acceptable when the pressure loss is less than one pound in one minute immediately following air stabilization.
- F. Deflection Test: In addition to air tests and infiltration test, conduct deflection tests on PVC pipe. Test each PVC pipe sewer main installed.
1. Conduct deflection testing not less than 30 days after section of pipe sewer main and service connection between adjacent manholes is backfilled.
    - a. Pull mandrell through pipe section manually; powered pulling devices not permitted.
    - b. Consider sewer line section which mandrel cannot pass through, to have more than maximum allowable deflection of 5 percent.
- G. Infiltration Test: In addition to air tests and deflection test specified previously, conduct infiltration tests at such time and manner required by Engineer.
1. Infiltration rate of groundwater or other water into the sewer line, including manhole bases and walls, exceeding 200 gallons per inch diameter per mile of sewer per day during periods of high groundwater levels will be considered evidence of defective material or improper workmanship.
  2. Make repairs and replacements if necessary, if rate of infiltration exceeds allowable maximum rate.
  3. Regardless of whether the rate of leakage exceeds or is below the allowable maximum rate, repair leaks in pipe sewer lines.
- H. Repair and Retest: When section or sections of sewer fails to meet test requirements specified previously:
1. Determine source or sources of leakage.
  2. Repair or replace defective material, and if a result of improper workmanship, correct such.
  3. Take up and relay pipe sewer line section that has more than the maximum allowable deflection.
  4. Conduct additional tests required to demonstrate that sewer line meets specified tests requirements.
- I. The Township reserves the right to retest at the Contractor's expense, any piping throughout the duration of the Construction Period.
1. Make repairs to piping found defective by such Township conducted tests.

END OF SECTION

AIR TEST TABLES

8" PIPE DIAMETERS

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR  
PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG  
( POUNDS PER SQUARE INCH GAGE )

**	LENGTH OF MAIN LINE IN FEET																			
	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
0	18	36	53	71	89	107	125	142	160	178	196	214	232	249	267	285	303	321	338	356
25	28	46	63	81	99	117	135	152	170	188	206	224	242	259	277	295	313	331	348	366
50	38	56	73	91	109	127	145	162	180	198	216	234	252	269	287	305	323	341	358	376
75	48	66	83	101	119	137	155	173	190	208	226	244	262	279	297	315	333	351	368	386
100	58	76	93	111	129	147	165	183	200	218	236	254	272	289	307	325	343	361	378	396
125	68	86	104	121	139	157	175	193	210	228	246	264	282	299	317	335	353	371	388	406
150	78	96	114	131	149	167	185	203	220	238	256	274	292	309	327	345	363	381	398	416
175	88	106	124	141	159	177	195	213	230	248	266	284	302	319	337	355	373	391	408	426
200	98	116	134	151	169	187	205	223	240	258	276	294	312	329	347	365	383	401	418	436
225	108	126	144	161	179	197	215	233	250	268	286	304	322	339	357	375	393	411	429	446
250	118	136	154	171	189	207	225	243	260	278	296	314	332	349	367	385	403	421	439	456
275	128	146	164	181	199	217	235	253	270	288	306	324	342	359	377	395	413	431	449	466
300	138	156	174	191	209	227	245	263	280	298	316	334	352	370	387	405	423	441	459	476
325	148	166	184	201	219	237	255	273	290	308	326	344	362	380	397	415	433	451	469	486
350	158	176	194	211	229	247	265	283	301	318	336	354	372	390	407	425	443	461	479	496
375	168	186	204	221	239	257	275	293	311	328	346	364	382	400	417	435	453	471	489	506
400	178	196	214	232	249	267	285	303	321	338	356	374	392	410	427	445	463	481	499	516
425	188	206	224	242	259	277	295	313	331	348	366	384	402	420	437	455	473	491	509	526
450	198	216	234	252	269	287	305	323	341	358	376	394	412	430	447	465	483	501	519	536
475	208	226	244	262	279	297	315	333	351	368	386	404	422	440	457	475	493	511	529	546
500	218	236	254	272	289	307	325	343	361	378	396	414	432	450	467	485	503	521	539	557
525	228	246	264	282	299	317	335	353	371	388	406	424	442	460	477	495	513	531	549	567
550	238	256	274	292	309	327	345	363	381	398	416	434	452	470	487	505	523	541	559	577
575	248	266	284	302	319	337	355	373	391	408	426	444	462	480	498	515	533	551	569	587

\*\* - LENGTH OF 6" DIAMETER LATERAL IN FEET

AIR TEST TABLES

10" PIPE DIAMETERS

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR  
PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG  
( POUNDS PER SQUARE INCH GAGE )

LENGTH OF MAIN LINE IN FEET

**	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
0	22	45	67	89	111	134	156	178	200	223	245	267	289	312	334	356	378	401	423	445
25	32	55	77	99	121	144	166	188	210	233	255	277	299	322	344	366	388	411	433	455
50	42	65	87	109	131	154	176	198	220	243	265	287	309	332	354	376	398	421	443	465
75	52	75	97	119	141	164	186	208	230	253	275	297	319	342	364	386	408	431	453	475
100	62	85	107	129	151	174	196	218	240	263	285	307	329	352	374	396	418	441	463	485
125	72	95	117	139	161	184	206	228	250	273	295	317	339	362	384	406	429	451	473	495
150	82	105	127	149	171	194	216	238	260	283	305	327	349	372	394	416	439	461	483	505
175	92	115	137	159	181	204	226	248	270	293	315	337	359	382	404	426	449	471	493	515
200	102	125	147	169	191	214	236	258	280	303	325	347	370	392	414	436	459	481	503	525
225	112	135	157	179	201	224	246	268	290	313	335	357	380	402	424	446	469	491	513	535
250	122	145	167	189	211	234	256	278	301	323	345	367	390	412	434	456	479	501	523	545
275	132	155	177	199	221	244	266	288	311	333	355	377	400	422	444	466	489	511	533	555
300	142	165	187	209	232	254	276	298	321	343	365	387	410	432	454	476	499	521	543	565
325	152	175	197	219	242	264	286	308	331	353	375	397	420	442	464	486	509	531	553	575
350	162	185	207	229	252	274	296	318	341	363	385	407	430	452	474	496	519	541	563	585
375	173	195	217	239	262	284	306	328	351	373	395	417	440	462	484	506	529	551	573	595
400	183	205	227	249	272	294	316	338	361	383	405	427	450	472	494	516	539	561	583	605
425	193	215	237	259	282	304	326	348	371	393	415	437	460	482	504	526	549	571	593	615
450	203	225	247	269	292	314	336	358	381	403	425	447	470	492	514	536	559	581	603	626
475	213	235	257	279	302	324	346	368	391	413	435	457	480	502	524	546	569	591	613	636
500	223	245	267	289	312	334	356	378	401	423	445	467	490	512	534	557	579	601	623	646
525	233	255	277	299	322	344	366	388	411	433	455	477	500	522	544	567	589	611	633	656
550	243	265	287	309	332	354	376	398	421	443	465	487	510	532	554	577	599	621	643	666
575	253	275	297	319	342	364	386	408	431	453	475	498	520	542	564	587	609	631	653	676

\*\* - LENGTH OF 6" DIAMETER LATERAL IN FEET

AIR TEST TABLES

12" PIPE DIAMETERS

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR  
PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG  
( POUNDS PER SQUARE INCH GAGE )

**	LENGTH OF MAIN LINE IN FEET																			
	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
0	27	53	80	107	134	160	187	214	240	267	294	321	347	374	401	427	454	481	508	534
25	37	63	90	117	144	170	197	224	250	277	304	331	357	384	411	437	464	491	518	544
50	47	73	100	127	154	180	207	234	260	287	314	341	367	394	421	447	474	501	528	554
75	57	83	110	137	164	190	217	244	270	297	324	351	377	404	431	457	484	511	538	564
100	67	93	120	147	174	200	227	254	280	307	334	361	387	414	441	467	494	521	548	574
125	77	104	130	157	184	210	237	264	290	317	344	371	397	424	451	477	504	531	558	584
150	87	114	140	167	194	220	247	274	301	327	354	381	407	434	461	487	514	541	568	594
175	97	124	150	177	204	230	257	284	311	337	364	391	417	444	471	498	524	551	578	604
200	107	134	160	187	214	240	267	294	321	347	374	401	427	454	481	508	534	561	588	614
225	117	144	170	197	224	250	277	304	331	357	384	411	437	464	491	518	544	571	598	624
250	127	154	180	207	234	260	287	314	341	367	394	421	447	474	501	528	554	581	608	634
275	137	164	190	217	244	270	297	324	351	377	404	431	457	484	511	538	564	591	618	644
300	147	174	200	227	254	280	307	334	361	387	414	441	467	494	521	548	574	601	628	654
325	157	184	210	237	264	290	317	344	371	397	424	451	477	504	531	558	584	611	638	664
350	167	194	220	247	274	301	327	354	381	407	434	461	487	514	541	568	594	621	648	674
375	177	204	230	257	284	311	337	364	391	417	444	471	498	524	551	578	604	631	658	684
400	187	214	240	267	294	321	347	374	401	427	454	481	508	534	561	588	614	641	668	695
425	197	224	250	277	304	331	357	384	411	437	464	491	518	544	571	598	624	651	678	705
450	207	234	260	287	314	341	367	394	421	447	474	501	528	554	581	608	634	661	688	715
475	217	244	270	297	324	351	377	404	431	457	484	511	538	564	591	618	644	671	698	725
500	227	254	280	307	334	361	387	414	441	467	494	521	548	574	601	628	654	681	708	735
525	237	264	290	317	344	371	397	424	451	477	504	531	558	584	611	638	664	691	718	745
550	247	274	301	327	354	381	407	434	461	487	514	541	568	594	621	648	674	701	728	755
575	257	284	311	337	364	391	417	444	471	498	524	551	578	604	631	658	684	711	738	765

\*\* - LENGTH OF 6" DIAMETER LATERAL IN FEET

AIR TEST TABLES

15" PIPE DIAMETERS

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR  
PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG  
( POUNDS PER SQUARE INCH GAGE )

LENGTH OF MAIN LINE IN FEET

**	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
0	31	63	94	125	157	188	219	250	282	313	344	376	407	438	470	501	532	563	595	626
25	41	73	104	135	167	198	229	260	292	323	354	386	417	448	480	511	542	573	605	636
50	51	83	114	145	177	208	239	270	302	333	364	396	427	458	490	521	552	583	615	646
75	61	93	124	155	187	218	249	280	312	343	374	406	437	468	500	531	562	594	625	656
100	71	103	134	165	197	228	259	290	322	353	384	416	447	478	510	541	572	604	635	666
125	81	113	144	175	207	238	269	301	332	363	394	426	457	488	520	551	582	614	645	676
150	91	123	154	185	217	248	279	311	342	373	404	436	467	498	530	561	592	624	655	686
175	101	133	164	195	227	258	289	321	352	383	414	446	477	508	540	571	602	634	665	696
200	111	143	174	205	237	268	299	331	362	393	424	456	487	518	550	581	612	644	675	706
225	121	153	184	215	247	278	309	341	372	403	434	466	497	528	560	591	622	654	685	716
250	131	163	194	225	257	288	319	351	382	413	445	476	507	538	570	601	632	664	695	726
275	141	173	204	235	267	298	329	361	392	423	455	486	517	548	580	611	642	674	705	736
300	152	183	214	245	277	308	339	371	402	433	465	496	527	558	590	621	652	684	715	746
325	162	193	224	255	287	318	349	381	412	443	475	506	537	568	600	631	662	694	725	756
350	172	203	234	265	297	328	359	391	422	453	485	516	547	578	610	641	672	704	735	766
375	182	213	244	275	307	338	369	401	432	463	495	526	557	588	620	651	682	714	745	776
400	192	223	254	285	317	348	379	411	442	473	505	536	567	599	630	661	692	724	755	786
425	202	233	264	296	327	358	389	421	452	483	515	546	577	609	640	671	702	734	765	796
450	212	243	274	306	337	368	399	431	462	493	525	556	587	619	650	681	712	744	775	806
475	222	253	284	316	347	378	409	441	472	503	535	566	597	629	660	691	722	754	785	816
500	232	263	294	326	357	388	419	451	482	513	545	576	607	639	670	701	732	764	795	826
525	242	273	304	336	367	398	429	461	492	523	555	586	617	649	680	711	743	774	805	836
550	252	283	314	346	377	408	439	471	502	533	565	596	627	659	690	721	753	784	815	846
575	262	293	324	356	387	418	450	481	512	543	575	606	637	669	700	731	763	794	825	856

\*\* - LENGTH OF 6" DIAMETER LATERAL IN FEET

AIR TEST TABLES

16" PIPE DIAMETERS

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR  
PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG  
( POUNDS PER SQUARE INCH GAGE )

**	LENGTH OF MAIN LINE IN FEET																			
	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
0	36	71	107	142	178	214	249	285	321	356	392	427	463	499	534	570	605	641	677	712
25	46	81	117	152	188	224	259	295	331	366	402	437	473	509	544	580	615	651	687	722
50	56	91	127	162	198	234	269	305	341	376	412	447	483	519	554	590	626	661	697	732
75	66	101	137	173	208	244	279	315	351	386	422	457	493	529	564	600	636	671	707	742
100	76	111	147	183	218	254	289	325	361	396	432	467	503	539	574	610	646	681	717	752
125	86	121	157	193	228	264	299	335	371	406	442	477	513	549	584	620	656	691	727	762
150	96	131	167	203	238	274	309	345	381	416	452	487	523	559	594	630	666	701	737	772
175	106	141	177	213	248	284	319	355	391	426	462	498	533	569	604	640	676	711	747	782
200	116	151	187	223	258	294	329	365	401	436	472	508	543	579	614	650	686	721	757	792
225	126	161	197	233	268	304	339	375	411	446	482	518	553	589	624	660	696	731	767	802
250	136	171	207	243	278	314	349	385	421	456	492	528	563	599	634	670	706	741	777	812
275	146	181	217	253	288	324	359	395	431	466	502	538	573	609	644	680	716	751	787	823
300	156	191	227	263	298	334	370	405	441	476	512	548	583	619	654	690	726	761	797	833
325	166	201	237	273	308	344	380	415	451	486	522	558	593	629	664	700	736	771	807	843
350	176	211	247	283	318	354	390	425	461	496	532	568	603	639	674	710	746	781	817	853
375	186	221	257	293	328	364	400	435	471	506	542	578	613	649	684	720	756	791	827	863
400	196	232	267	303	338	374	410	445	481	516	552	588	623	659	695	730	766	801	837	873
425	206	242	277	313	348	384	420	455	491	526	562	598	633	669	705	740	776	811	847	883
450	216	252	287	323	358	394	430	465	501	536	572	608	643	679	715	750	786	821	857	893
475	226	262	297	333	368	404	440	475	511	546	582	618	653	689	725	760	796	831	867	903
500	236	272	307	343	378	414	450	485	521	557	592	628	663	699	735	770	806	841	877	913
525	246	282	317	353	388	424	460	495	531	567	602	638	673	709	745	780	816	851	887	923
550	256	292	327	363	398	434	470	505	541	577	612	648	683	719	755	790	826	861	897	933
575	266	302	337	373	408	444	480	515	551	587	622	658	693	729	765	800	836	871	907	943

\*\* - LENGTH OF 6" DIAMETER LATERAL IN FEET

18" PIPE DIAMETERS

AIR TEST TABLES

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR  
PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG  
( POUNDS PER SQUARE INCH GAGE )

**	LENGTH OF MAIN LINE IN FEET																			
	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
0	36	72	108	144	180	216	252	288	325	361	397	433	469	505	541	577	613	649	685	721
25	46	82	118	154	190	226	262	299	335	371	407	443	479	515	551	587	623	659	695	731
50	56	92	128	164	200	236	272	309	345	381	417	453	489	525	561	597	633	669	705	741
75	66	102	138	174	210	246	282	319	355	391	427	463	499	535	571	607	643	679	715	751
100	76	112	148	184	220	256	292	329	365	401	437	473	509	545	581	617	653	689	725	761
125	86	122	158	194	230	266	303	339	375	411	447	483	519	555	591	627	663	699	735	771
150	96	132	168	204	240	276	313	349	385	421	457	493	529	565	601	637	673	709	745	781
175	106	142	178	214	250	286	323	359	395	431	467	503	539	575	611	647	683	719	755	791
200	116	152	188	224	260	297	333	369	405	441	477	513	549	585	621	657	693	729	765	801
225	126	162	198	234	270	307	343	379	415	451	487	523	559	595	631	667	703	739	775	811
250	136	172	208	244	280	317	353	389	425	461	497	533	569	605	641	677	713	749	785	821
275	146	182	218	254	290	327	363	399	435	471	507	543	579	615	651	687	723	759	795	831
300	156	192	228	264	301	337	373	409	445	481	517	553	589	625	661	697	733	769	805	841
325	166	202	238	274	311	347	383	419	455	491	527	563	599	635	671	707	743	779	815	851
350	176	212	248	284	321	357	393	429	465	501	537	573	609	645	681	717	753	789	825	861
375	186	222	258	295	331	367	403	439	475	511	547	583	619	655	691	727	763	799	835	871
400	196	232	268	305	341	377	413	449	485	521	557	593	629	665	701	737	773	809	845	881
425	206	242	278	315	351	387	423	459	495	531	567	603	639	675	711	747	783	819	855	892
450	216	252	288	325	361	397	433	469	505	541	577	613	649	685	721	757	793	829	865	902
475	226	262	299	335	371	407	443	479	515	551	587	623	659	695	731	767	803	839	875	912
500	236	272	309	345	381	417	453	489	525	561	597	633	669	705	741	777	813	849	886	922
525	246	282	319	355	391	427	463	499	535	571	607	643	679	715	751	787	823	859	896	932
550	256	292	329	365	401	437	473	509	545	581	617	653	689	725	761	797	833	869	906	942
575	266	303	339	375	411	447	483	519	555	591	627	663	699	735	771	807	843	879	916	952

\*\* - LENGTH OF 6" DIAMETER LATERAL IN FEET

AIR TEST TABLES

20" PIPE DIAMETERS

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR  
PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG  
( POUNDS PER SQUARE INCH GAGE )

LENGTH OF MAIN LINE IN FEET

**	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
0	40	81	121	162	202	243	283	324	364	405	445	486	526	567	607	648	688	729	769	809
25	50	91	131	172	212	253	293	334	374	415	455	496	536	577	617	658	698	739	779	819
50	61	101	141	182	222	263	303	344	384	425	465	506	546	587	627	668	708	749	789	829
75	71	111	151	192	232	273	313	354	394	435	475	516	556	597	637	678	718	759	799	840
100	81	121	161	202	242	283	323	364	404	445	485	526	566	607	647	688	728	769	809	850
125	91	131	172	212	252	293	333	374	414	455	495	536	576	617	657	698	738	779	819	860
150	101	141	182	222	262	303	343	384	424	465	505	546	586	627	667	708	748	789	829	870
175	111	151	192	232	272	313	353	394	434	475	515	556	596	637	677	718	758	799	839	880
200	121	161	202	242	283	323	363	404	444	485	525	566	606	647	687	728	768	809	849	890
225	131	171	212	252	293	333	373	414	454	495	535	576	616	657	697	738	778	819	859	900
250	141	181	222	262	303	343	383	424	464	505	545	586	626	667	707	748	788	829	869	910
275	151	191	232	272	313	353	393	434	474	515	555	596	636	677	717	758	798	839	879	920
300	161	201	242	282	323	363	404	444	484	525	565	606	646	687	727	768	808	849	889	930
325	171	211	252	292	333	373	414	454	494	535	575	616	656	697	737	778	818	859	899	940
350	181	221	262	302	343	383	424	464	504	545	585	626	666	707	747	788	828	869	909	950
375	191	231	272	312	353	393	434	474	515	555	595	636	676	717	757	798	838	879	919	960
400	201	241	282	322	363	403	444	484	525	565	605	646	686	727	767	808	848	889	929	970
425	211	251	292	332	373	413	454	494	535	575	615	656	696	737	777	818	858	899	939	980
450	221	261	302	342	383	423	464	504	545	585	626	666	706	747	787	828	868	909	949	990
475	231	271	312	352	393	433	474	514	555	595	636	676	716	757	797	838	878	919	959	1000
500	241	281	322	362	403	443	484	524	565	605	646	686	726	767	807	848	888	929	969	1010
525	251	291	332	372	413	453	494	534	575	615	656	696	737	777	817	858	898	939	979	1020
550	261	301	342	382	423	463	504	544	585	625	666	706	747	787	827	868	908	949	989	1030
575	271	311	352	392	433	473	514	554	595	635	676	716	757	797	837	878	918	959	999	1040

\*\* - LENGTH OF 6" DIAMETER LATERAL IN FEET

21" PIPE DIAMETERS

AIR TEST TABLES

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR  
PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG  
( POUNDS PER SQUARE INCH GAGE )

LENGTH OF MAIN LINE IN FEET

**	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
0	45	89	134	178	223	268	312	357	402	446	491	535	580	625	669	714	759	803	848	892
25	55	99	144	189	233	278	322	367	412	456	501	545	590	635	679	724	769	813	858	902
50	65	109	154	199	243	288	332	377	422	466	511	555	600	645	689	734	779	823	868	912
75	75	119	164	209	253	298	342	387	432	476	521	566	610	655	699	744	789	833	878	922
100	85	129	174	219	263	308	352	397	442	486	531	576	620	665	709	754	799	843	888	932
125	95	139	184	229	273	318	362	407	452	496	541	586	630	675	719	764	809	853	898	943
150	105	149	194	239	283	328	372	417	462	506	551	596	640	685	729	774	819	863	908	953
175	115	159	204	249	293	338	382	427	472	516	561	606	650	695	739	784	829	873	918	963
200	125	169	214	259	303	348	392	437	482	526	571	616	660	705	749	794	839	883	928	973
225	135	179	224	269	313	358	403	447	492	536	581	626	670	715	759	804	849	893	938	983
250	145	189	234	279	323	368	413	457	502	546	591	636	680	725	769	814	859	903	948	993
275	155	199	244	289	333	378	423	467	512	556	601	646	690	735	780	824	869	913	958	1003
300	165	209	254	299	343	388	433	477	522	566	611	656	700	745	790	834	879	923	968	1013
325	175	219	264	309	353	398	443	487	532	576	621	666	710	755	800	844	889	933	978	1023
350	185	229	274	319	363	408	453	497	542	586	631	676	720	765	810	854	899	943	988	1033
375	195	239	284	329	373	418	463	507	552	596	641	686	730	775	820	864	909	953	998	1043
400	205	250	294	339	383	428	473	517	562	606	651	696	740	785	830	874	919	963	1008	1053
425	215	260	304	349	393	438	483	527	572	617	661	706	750	795	840	884	929	973	1018	1063
450	225	270	314	359	403	448	493	537	582	627	671	716	760	805	850	894	939	983	1028	1073
475	235	280	324	369	413	458	503	547	592	637	681	726	770	815	860	904	949	994	1038	1083
500	245	290	334	379	423	468	513	557	602	647	691	736	780	825	870	914	959	1004	1048	1093
525	255	300	344	389	433	478	523	567	612	657	701	746	790	835	880	924	969	1014	1058	1103
550	265	310	354	399	443	488	533	577	622	667	711	756	800	845	890	934	979	1024	1068	1113
575	275	320	364	409	453	498	543	587	632	677	721	766	810	855	900	944	989	1034	1078	1123

\*\* - LENGTH OF 6" DIAMETER LATERAL IN FEET

AIR TEST TABLES

24" PIPE DIAMETERS

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR  
PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG  
( POUNDS PER SQUARE INCH GAGE )

**	LENGTH OF MAIN LINE IN FEET																			
	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
0	53	107	160	214	267	321	374	427	481	534	588	641	695	748	801	855	908	962	1015	1068
25	63	117	170	224	277	331	384	437	491	544	598	651	705	758	811	865	918	972	1025	1078
50	73	127	180	234	287	341	394	447	501	554	608	661	715	768	821	875	928	982	1035	1089
75	83	137	190	244	297	351	404	457	511	564	618	671	725	778	831	885	938	992	1045	1099
100	93	147	200	254	307	361	414	467	521	574	628	681	735	788	841	895	948	1002	1055	1109
125	104	157	210	264	317	371	424	477	531	584	638	691	745	798	851	905	958	1012	1065	1119
150	114	167	220	274	327	381	434	487	541	594	648	701	755	808	861	915	968	1022	1075	1129
175	124	177	230	284	337	391	444	498	551	604	658	711	765	818	871	925	978	1032	1085	1139
200	134	187	240	294	347	401	454	508	561	614	668	721	775	828	881	935	988	1042	1095	1149
225	144	197	250	304	357	411	464	518	571	624	678	731	785	838	892	945	998	1052	1105	1159
250	154	207	260	314	367	421	474	528	581	634	688	741	795	848	902	955	1008	1062	1115	1169
275	164	217	270	324	377	431	484	538	591	644	698	751	805	858	912	965	1018	1072	1125	1179
300	174	227	280	334	387	441	494	548	601	654	708	761	815	868	922	975	1028	1082	1135	1189
325	184	237	290	344	397	451	504	558	611	664	718	771	825	878	932	985	1038	1092	1145	1199
350	194	247	301	354	407	461	514	568	621	674	728	781	835	888	942	995	1048	1102	1155	1209
375	204	257	311	364	417	471	524	578	631	684	738	791	845	898	952	1005	1058	1112	1165	1219
400	214	267	321	374	427	481	534	588	641	695	748	801	855	908	962	1015	1068	1122	1175	1229
425	224	277	331	384	437	491	544	598	651	705	758	811	865	918	972	1025	1078	1132	1185	1239
450	234	287	341	394	447	501	554	608	661	715	768	821	875	928	982	1035	1089	1142	1195	1249
475	244	297	351	404	457	511	564	618	671	725	778	831	885	938	992	1045	1099	1152	1205	1259
500	254	307	361	414	467	521	574	628	681	735	788	841	895	948	1002	1055	1109	1162	1215	1269
525	264	317	371	424	477	531	584	638	691	745	798	851	905	958	1012	1065	1119	1172	1225	1279
550	274	327	381	434	487	541	594	648	701	755	808	861	915	968	1022	1075	1129	1182	1235	1289
575	284	337	391	444	498	551	604	658	711	765	818	871	925	978	1032	1085	1139	1192	1245	1299

\*\* - LENGTH OF 6" DIAMETER LATERAL IN FEET

POLYVINYL CHLORIDE PIPE  
 SPECIFICATION TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP  
 FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015

1 Pipe Diameter (in.)	2 Minimum Time (min: sec)	3 Length for Minimum Time (ft)	4 Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)									
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft		
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:42
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48	19:56	22:47
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38	28:29	31:20
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04	44:52	49:41
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41	64:06	70:31
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31	87:15	96:03
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33	113:57	125:21
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48	144:23	158:53
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15	178:03	195:51
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53	215:25	237:03
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46	256:25	282:03

FROM: Uni-Bell Plastic Pipe Association, UNI-B-6-79

DIVISION 2 - SITEWORK

SECTION 02724 - FORCE MAINS

PART 1 - GENERAL

1.01 RELATED WORK

- A. Trenching, Backfilling and Compacting: Section 02221.
- B. Manholes: Section 02601.
- C. Piped Wastewater Sewer: Section 02722.

1.02 QUALITY ASSURANCE

- A. Design Criteria: In addition to the design requirements of the Pennsylvania Department of Environmental Resources, comply with the following:
  - 1. Use only one type and class of pipe in any continuous force main between structures.
  - 2. Use pipe and fittings designed to withstand imposed trench loadings and prevailing site conditions at the various locations.
  - 3. Provide a minimum depth of cover of 4 feet for force mains.
- B. Source Quality Control:
  - 1. Shop Tests: In accordance with Article 1.06 of the General Instructions, factory test pipe materials listed in the following. Each pipe manufacturer must have facilities to perform listed tests. The Engineer reserves the right to require the manufacturer to perform such additional number of tests as the Engineer may deem necessary to establish the quality of the material offered for use.

<u>MATERIAL</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
a. Ductile Iron Pipe	ANSI A 21.51	As specified in ANSI A 21.51.
b. Polyvinyl Chloride Pipe	ASTM D 2241	As specified in ASTM D 2241.
2. Laboratory Tests: The Engineer reserves the right to require that laboratory tests also be conducted on materials that are shop tested. Furnish labor, materials, and equipment necessary for collecting, packaging, and identifying representative samples of materials to be tested and the shipping of such samples to the Testing Laboratory.		

1.03 REFERENCES

- A. American National Standards Institute:
  - 1. ANSI A 21.4, Cement-Mortar Lining for Cast Iron and Ductile-Iron Pipe and Fittings for Water.

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2. ANSI A 21.10, Gray-Iron and Ductile-Iron Fittings, 2 through 48 inches, for Water and Other Liquids.
  3. ANSI A 21.11, Rubber Gasket Joints for Cast Iron and Ductile Pressure Pipe and Fittings.
  4. ANSI A 21.15, Flanged Cast-Iron and Ductile-Iron pipe with Threaded Flanges.
  5. ANSI A 21.50, Thickness Design of Ductile-Iron Pipe.
  6. ANSI A 21.51, Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Water or Other Liquids.
  7. ANSI B 16.1, Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
  8. ANSI B 16.21, Nonmetallic Gaskets for Pipe Flanges.
  9. ANSI B 18.2.1, Square and Hex Bolts and Screws, Including Askew head Bolts, Hex Cap Screws, and Lag Screws.
  10. ANSI B 18.2.2, Square and Hex Nuts.
- B. American Society for Testing and Materials.
1. ASTM A 48, Specification for Gray Iron Castings.
  2. ASTM A 240, Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
  3. ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.
  4. ASTM B 85, Specification for Aluminum-Alloy Die Castings.
  5. ASTM B 371, Specification for Copper-Zinc-Silicon Alloy Rod.
  6. ASTM B 438, Specification for Sintered Bronze Bearings (Oil-Impregnated).
  7. ASTM B 584, Specification for Copper Alloy Sand Castings for General Applications.
  8. ASTM D 2241, Specification for Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series).
  9. ASTM D 3139, Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
  10. ASTM F 477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- C. American Water Works Association:
1. AWWA C 104, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
  2. AWWA C 151, Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
  3. AWWA C 509, Resilient-Seated Gate Valves, 3 Through 12 NPS, for Water and Sewage Systems.
  4. AWWA C 550, Protective Interior Coatings for Valves and Hydrants.
- 1.04 SUBMITTALS
- A. Shop Drawings and Product Data: Furnish completely dimensioned shop drawings, cuts or other data as required to provide a complete description of piping, piping specialties, and valves.
- B. Certificates:
1. Certified records or reports of results of shop tests, such records or reports to contain a sworn statement that shop tests have been

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made as specified. Certification to be sworn by and bear the seal of a Registered Professional Engineer.

2. Manufacturer's sworn certification that pipe will be manufactured in accordance with specified reference standards for each pipe type.

C. Submit design calculations for air release, and air and vacuum valves.

### 1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Transport, handle, and store pipe materials and precast reinforced concrete manhole components and other products specified herein in a manner recommended by the respective manufacturers to prevent damage and defects.

### 1.06 SITE CONDITIONS

- A. Environmental Requirements:
  1. Keep trenches dewatered until pipe joints have been made and concrete cradle and encasement, if any, have cured.
  2. Under no circumstances lay pipe in water or on bedding containing frost.
  3. Do not lay pipe when weather conditions are unsuitable, as determined by the Engineer, for pipe laying work.

## PART 2 - PRODUCTS

### 2.01 PIPE AND PIPE FITTINGS

- A. Ductile Iron (DIP):
  1. Pipe: ANSI A21.50 and ANSI A21.51.
  2. Wall Thickness Class (Buried): Class 50, minimum.
  3. Wall Thickness Class (Exposed): Class 53, minimum.
  4. Fittings: Gray iron or ductile iron ANSI A21.10, rated for 250 psi working pressure.
  5. Joints:
    - a. Rubber-Gasket Joints (Buried): ANSI A21.11.
      - 1) For buried pipe installation, provide either push-on or mechanical joints except where other types of joints are indicated on the Drawings or required by the Specifications.
      - 2) Provide rubber gaskets suitable for conveying domestic sewage.
    - b. Restrained Joints: Conforming to requirements of ANSI A21.11 and designed for a working pressure equal to connected pipe rating. Provide joints for pipe and fittings similar to the following:
      - 1) American Cast Iron Pipe Company; Lok-Fast or Lok-Set.
      - 2) Clow Corporation; Super-Lock.
      - 3) United States Pipe and Foundry Company; TRFLEX.
      - 4) Or Equal.
    - c. Flanged Joints (Exposed): ANSI A21.15.

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- 1) Gaskets: 1/16 in. thick cloth insertion rubber full face type conforming to ANSI B16.21.
  - 2) Bolts: ANSI B18.2.1.
  - 3) Nuts: ANSI B18.2.2.
6. Lining and Coating:
- a. Pipe and Fitting Lining: Manufacturer's standard cement-mortar lining in accordance with AWWA C 104, double thickness. Lining shall include an asphaltic seal coat to prevent moisture loss in cement-mortar curing sequence.
  - b. Pipe and Fitting Coating: Manufacturer's standard asphaltic coating, approximately one mil thick in accordance with AWWA C 151, applied to the outside of pipe and fittings.
- B. Polyvinyl Chloride Pipe and Fittings (PVC):
1. To and including 4-inch Diameter: ASTM D2241, SDR 17.
    - a. Pressure Class: 250 psi.
    - b. Pipe Joints: Push-on or compression type, joint performance ASTM D3139, rubber gasket suitable for domestic sewage service ASTM F477.
- 2.02 PIPING SPECIALTIES
- A. Wall Sleeves: Cast iron with intermediate anchoring flange in center of sleeve. Provide wall sleeves similar to those by Clow Corporation, American Cast Iron Pipe Co., U.S. Pipe and Foundry Co., or equal.
- 2.03 SEWAGE VALVE
- A. Sewage Air Release Valve: Designed to automatically release air, gas or vapor under pressure during system operation. Valve design shall feature long body and float stem components so that the operating mechanism is kept free from contact with sewage during operation. Valve construction as follows:
1. Valve Body and Cover: Cast iron, ASTM A48, Class 35.
  2. Discharge Orifice Seat, Mechanism and Valve Stem: Stainless Steel.
  3. Orifice Button: Stainless steel and Buna-N, Nitrile Rubber ASTM SB 800.
  4. Mechanism Lever Pins and Float: High strength stainless steel, ASTM A 240.
  5. Backflushing and Cleaning Accessories: Factory assembled to the valve and consisting of a 2-inch shut-off valve at bottom inlet, a 1-inch blow-off valve near the bottom of the valve body, quick disconnect couplings and 1/2-inch shut-off valve at top of valve, and a section of rubber hose with quick disconnect coupling.
  6. Acceptable Manufacturers:
    - a. Val-Matic Valve And Manufacturing Corp.; Model No. 48 Series.
    - b. Or Equal.
- B. Sewage Air and Vacuum Valve: Designed to automatically exhaust large quantities of air during the filling of a system and to allow air to re-enter the system during draining or when a vacuum occurs. Valve design shall feature long body and float stem components so that the operating mechanism is kept free from contact with sewage during operation. Valve construction as follows:

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1. Valve Body and Cover: Cast iron, ASTM A 48, Class 35.
  2. Float Stem and Guide: Bronze, ASTM B584.
  3. Floats: Stainless Steel, ASTM A240.
  4. Orifice Seat: Buna-N, Nitrile Rubber, ASTM SB 800.
  5. Backflushing and Cleaning Accessories: Factory assembled to the valve and consisting of an inlet shut-off valve, a 1-inch blow-off valve near the bottom of the valve body, quick disconnect couplings and a 1/2-inch shut-off valve at the top of valve, and a section of rubber hose with quick disconnect coupling.
  6. Acceptable Manufacturers:
    - a. Val-Matic Valve And Manufacturing Corp.; Model No. 300 Series.
    - b. Or Equal.
- C. Sewage Combination Air Valves: Consisting of an air release valve and an air and vacuum valve factory piped into a compact assembly. The combination assembly shall automatically release air, gas or vapor under system operating pressure and shall also allow air to re-enter the system during draining or when a vacuum occurs. Combination valve designs shall feature long bodies and float stem components so that the operating mechanisms are kept free from contact with sewage during operation. Valve construction as follows:
1. Valve Bodies and Covers: Cast iron, ASTM A 48, Class 35.
  2. Air Release Valve Discharge Orifice Seat, Mechanism and Valve Stem: Stainless steel.
  3. Air Release Valve Orifice Button: Stainless Steel and Buna-N, Nitrile Rubber ASTM SB 800.
  4. Air Release Valve Mechanism Lever Pins and Float: High strength stainless steel, ASTM A 240.
  5. Air and Vacuum Valve Float Stem and Guide: Bronze, ASTM B 584.
  6. Air and Vacuum Valve Floats: Stainless Steel, ASTM A 240.
  7. Air and Vacuum Valve Orifice Seat: Buna-N, Nitrile Rubber, ASTM SB 800.
  8. Backflushing and Cleaning Accessories: Factory assembled to the combination valves and consisting of two inlet shut-off valves, two blow-off valves, two clear water inlet valves, section of rubber hose and quick disconnect couplings.
  9. Acceptable Manufacturers:
    - a. Val-Matic Valve And Manufacturing Corp.; Model No. 48 or 49/300 Series.
    - b. Or Equal.

### 2.04 GATE VALVE

- A. Hose End Gate Valve: Class 125 bronze gate, screw-in bonnet, non-rising stem, tapered solid wedge, and rated 200 psi non-shock cold water, oil or gas. Valve body shall indicate ratings and manufacturer identification. Design of valve stuffing box of such that repacking under pressure is possible. Valve particulars as follows:
  1. Ends: Female standard pipe size to national standard hose.
  2. Handwheel: Aluminum alloy ASTM B 85, with zinc plated steel nut and aluminum identification plate (opening direction indicated).
  3. Valve Stem: Silicon bronze alloy ASTM B 371.

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4. Packing Nut/Packing Gland: Sintered bronze ASTM B 438 Grade I Type II.
  5. Packing: TFE impregnated asbestos.
  6. Stuffing Box, Bonnet, Valve Body, Wedge and Hose Cap: Bronze ASTM B 62.
  7. Hose Cap Gasket: Rubber.
  8. Safety Chain: Brass.
  9. Acceptable Manufacturers:
    - a. NIBCO, Inc.; Cat. No. T-113-HC.
    - b. Crane Company.
    - c. Wm. Powell Company.
- B. Iron Body Gate Valve: Provide valves of a design working water pressure at 200 psi for valves 12-inch in diameter and smaller. Valve particulars as follows:
1. General Requirements:
    - a. Markings factory cast on the bonnet or body of each valve indicating manufacturer's name or mark, year of valve casting, size of valve, directional flow arrow and designation of working water pressure.
    - b. Valves shall open to the left (counterclockwise). Valves operated by nut, handwheel, or otherwise as indicated on the Drawings. Operating nuts or wheels shall have cast thereon an arrow indicating the direction of opening.
    - c. Valve ends shall conform to the following:
      - 1) Flanged: ANSI B16.1.
      - 2) Mechanical: ANSI A21.11.
    - d. Valves of rising stem type except when installed underground.
    - e. Valve stuffing box of such design that valve can be packed under pressure when in fully open position.
    - f. Design working water pressure at 200 psi for valves 12 in. in diameter and smaller, and 150 psi (high pressure) for valves with diameters of 14-inches and larger.
  2. Valves 3-inches through 12-inches in diameter:
    - a. Iron body, outside screw and yoke, bronze mounted with resilient-seated wedge conforming to AWWA C 509.
    - b. Resilient seat of SBR or Urethane Rubber bonded to cast iron wedge.
    - c. Stem seals of O-ring type.
    - d. Exterior to be asphalt varnish or epoxy coated; interior ferrous metal parts to be epoxy coated, AWWA C 550.
  3. Acceptable Manufacturers:
    - a. Clow Corporation.
    - b. American Darling Valve.
    - c. Kennedy Valve.
    - d. Or Equal.
  4. Tapping Valve:
    - a. Oversize seat rings.
    - b. Raised male face on flanged end for bolting to tapping sleeve.
    - c. Mechanical or push-on joint with slotted holes for bolting to tapping machine.
  5. Valve Boxes: Cast iron extension roadway type, three-piece construction, and of screw adjustment design.

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- a. Boxes shall have 4 1/4-inch minimum shaft diameter and cover marked SEWER.
- b. Boxes hot coated inside and out with a tar or asphalt compound.

### 2.05 AIR RELEASE AND CLEANOUT CHAMBERS

- A. Materials for chambers as specified for precast manholes in Section 02601.
  1. Sump Frame and Grate: Cast iron, ASTM A 48.

### 2.06 OPTIONS IN PRODUCTS

- A. Force Main Pipe and Fittings Options: Construct the force mains in this Project with either DIP or PVC pipe and fittings. However, use only one type of pipe and fittings throughout.
  1. Through four inch diameter:
    - a. Ductile Iron Pipe.
    - b. Polyvinyl Chloride Pipe.
  2. Five inch and larger diameters:
    - a. Ductile Iron Pipe.
- B. Provide only ductile iron pipe and ductile iron or cast iron fittings within air release and cleanout chambers. A mixture of types not acceptable.
- C. Provide either concrete thrust blocks or restrained joints at changes of directions in ductile iron pipe runs. A mixture of types not acceptable.

## PART 3 - EXECUTION

### 3.01 INSPECTION

- A. As specified in Section 02722.

### 3.02 PREPARATION

- A. As specified in Section 02722.

### 3.03 FORCE MAIN CONSTRUCTION METHODS

- A. Construct in accordance with applicable requirements of Section 02722 with the following additional requirements.
  1. Unless indicated otherwise, install piping with not less than four feet of cover.
  2. Flanged Joints: For DIP shall be faced true, fitted with gaskets, and drawn up square and tight to insure full gasket flow and satisfactory seal.
  3. Concrete Thrust Blocks: Provide concrete thrust blocks at each fitting, and at locations where horizontal and vertical deflections are made in the joints of the force mains. Use Class B concrete. Design of thrust blocks as indicated on Detail Drawing.

4. Joint Restraints: Install on buried DIP at changes in direction of pipe runs and at terminal ends of pipe runs in accordance with the following table:

DUCTILE IRON PIPE RESTRAINED JOINT DIMENSIONS

(In feet of straight pipe for each leg)

Fitting	8" Dia. Pipe and smaller
Plug	25
Tee	25
Lateral	25
90°	25
45°	15
22 1/2°	15
11 1/4°	15

B. Setting Valves and Boxes:

1. Unless otherwise directed by the Engineer, set valves and boxes truly vertical.
2. Set valve boxes neatly to grade and in such a way that the box does not transfer shock or stress to the valve. Exercise care to center the box over the wrench nut of the valve.

3.04 AIR RELEASE AND CLEANOUT CHAMBER CONSTRUCTION METHODS

- A. As specified in Section 02601.

3.05 FIELD QUALITY CONTROL

A. General Requirements: Conduct tests specified herein so that each force main installed in the Project is tested to the Engineer's satisfaction.

1. Provide tools, materials (including water), apparatus and instruments necessary for force main testing.
2. Conduct tests of every kind in the presence of and to the satisfaction of the Engineer.
3. Provide an extra pressure gauge of known accuracy to frequently check test equipment and apparatus.
4. The hydrostatic testing equipment and associated testing apparatus is subject to Engineer's approval.
5. When the length of the force main exceeds 1000 feet, test the force main in section. The length of each section to be determined by the Engineer.
6. If PVC pipe is used, test for pipe diameter deflection according to requirements of Section 02722.

B. Cleaning Prior to Tests: Before tests are conducted, clean piping.

C. Line Acceptance Test:

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1. After a force main or section thereof is constructed, backfilled, and successfully cleaned, perform a hydrostatic Line Acceptance Test as follows:
  - a. Seal force main at downstream end with a suitable pipe plug.
  - b. Fill force main with clear water.
  - c. Raise hydrostatic pressure to 100 psi or 1 1/2 times working pressure, whichever is greater, measured at the low point of the particular section of main being tested.
  - d. Before measuring the leakage, a preliminary test period for the removal or absorption of air from the lines will be permitted.
  - e. Maintain test pressure for a period of not less than 4 hours.
  - f. Consider the force main acceptable when measured leakage does not exceed 10 gallons per day per mile per inch of pipe diameter.
- D. Repair and Retest: When the force main or sections of force main fail to meet test requirements, specified previously, determine source or sources of leakage and repair or replace defective material; if a result of improper workmanship, correct such. Conduct such additional tests required to demonstrate that the force main meets specified test requirements.
- E. The Contractor may elect to make a leakage test prior to backfilling the trenches, for his own purposes; however, the leakage tests of the force mains or sections thereof for acceptance, shall be conducted after the backfilling of the trenches has been completed.
- F. The Township reserves the right to retest (at its expense) any installed piping throughout the duration of the Construction Period.
  1. Make repairs to piping found defective by such Township conducted tests.

END OF SECTION

DIVISION 2 - SITEWORK

SECTION 02725 - PRESSURE WASTEWATER SEWER

PART 1 - GENERAL

1.01 RELATED WORK

- A. Trenching, Backfilling and Compacting: Section 02221.
- B. Manholes: Section 02601.
- C. Piped Wastewater Sewer: Section 02722.

1.02 QUALITY ASSURANCE

- A. Design Criteria: In addition to the design requirements of the Pennsylvania Department of Environmental Resources, comply with the following:
  - 1. Use only one type and class of pipe in any continuous sewer between structures.
  - 2. Use pipe and fittings designed to withstand imposed trench loadings and prevailing site conditions at the various locations.
- B. Source Quality Control:
  - 1. Shop Tests: In accordance with Article 1.06 of the General Instructions, factory test pipe materials listed in the following. Each pipe manufacturer must have facilities to perform listed tests. The Engineer reserves the right to require the manufacturer to perform such additional number of tests as the Engineer may deem necessary to establish the quality of the material offered for use.

	<u>MATERIAL</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
a.	Ductile Iron Pipe	ANSI A 21.51	As specified in ANSI A 21.51.
b.	Polyvinyl Chloride Pipe	ASTM D 1785	As specified in ASTM D 1785.
c.	Polyvinyl Chloride Pipe	ASTM D 2241	As specified in ASTM D 2241.

- 2. Laboratory Tests: The Engineer reserves the right to require that laboratory tests also be conducted on materials that are shop tested. Furnish labor, materials, and equipment necessary for collecting, packaging, and identifying representative samples of materials to be tested and the shipping of such samples to the Testing Laboratory.

1.02 REFERENCES

- A. American National Standards Institute:
  - 1. ANSI A 21.10, Gray-Iron and Ductile-Iron Fittings, 2 through 48 inches, for Water and Other Liquids.
  - 2. ANSI A 21.11, Rubber Gasket Joints for Cast Iron and Ductile Pressure Pipe and Fittings.
  - 3. ANSI A 21.15, Flanged Cast-Iron and Ductile-Iron Pipe with Threaded Flanges.
  - 4. ANSI A 21.50, Thickness Design of Ductile-Iron Pipe.
  - 5. ANSI A 21.51, Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Water or Other Liquids.
  - 6. ANSI B1.1, Unified Inch Screw Threads.
  - 7. ANSI B 16.1, Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
  - 8. ANSI B 16.21, Nonmetallic Gaskets for Pipe Flanges.
  - 9. ANSI B 18.2.1, Square and Hex Bolts and Screws, Including Askew head Bolts, Hex Cap Screws, and Lag Screws.
  - 10. ANSI B 18.2.2, Square and Hex Nuts.
  
- B. American Society for Testing and Materials.
  - 1. ASTM A 47, Specification for Malleable Iron Castings.
  - 2. ASTM A 48, Specification for Gray Iron Castings.
  - 3. ASTM A 123, Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - 4. ASTM A 126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
  - 5. ASTM A 183, Specification for Carbon Steel Track Bolts and Nuts.
  - 6. ASTM A 240, Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
  - 7. ASTM A 283, Specification for Low and Intermediate Tensile Strength Carbon Steel Plates of Structural Quality.
  - 8. ASTM A 307, Specification for Carbon Steel Externally Threaded Standard Fasteners.
  - 9. ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.
  - 10. ASTM B 140, Specification for Copper Zinc-Lead (Leaded Red Brass or Hardware Bronze) Rod, Bar and Shapes.
  - 11. ASTM B 371, Specification for Copper-Zinc-Silicon Alloy Rod.
  - 12. ASTM B 584, Specification for Copper Alloy Sand Castings for General Applications.
  - 13. ASTM C 534, Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
  - 14. ASTM C 547, Specification for Mineral Fiber Preformed Pipe Insulation.
  - 15. ASTM D 1784, Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
  - 16. ASTM D 1785, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Schedules 40, 80 and 120.
  - 17. ASTM D 2241, Specification for Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series).
  - 18. ASTM D 2321, Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.

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19. ASTM D 2466, Specification for Socket-Type Poly (Vinyl Chloride) PVC Plastic Pipe Fittings, Schedule 40.
20. ASTM D 2564, Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
21. ASTM D 2774, Recommended Practice for Underground Installation of Thermoplastic Pressure Piping.
22. ASTM D 2855, Recommended Practice for Making Solvent-Cemented Joints With Poly (Vinyl Chloride) PVC Pipe and Fittings.
23. ASTM D 3139, Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
24. ASTM E 84, Test Method for Surface Burning Characteristics of Building Materials.
25. ASTM F 477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

### C. American Water Works Association:

1. AWWA C 104, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C 151, Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
3. AWWA C 600, Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances.
4. AWWA C 800, Threads for Underground Service Line Fittings (with Appendix on Collected Standards for Service Line Materials).

## 1.03 SUBMITTALS

### A. Shop Drawings and Product Data: Furnish completely dimensioned shop drawings, catalog cuts and product data as required to provide a complete description of the following:

1. Pipe and Pipe Fittings
2. Piping Specialties
3. Combination Sewage Valve
4. Valves
5. Air Release and Cleanout Chambers

### B. Certificates:

1. Certified records or reports of results of Shop Tests, such records or reports to contain a sworn statement that Shop Tests have been made as specified. Certification to be sworn by and bear the seal of a Registered Professional Engineer.
2. Manufacturer's sworn certification that pipe will be manufactured in accordance with specified reference standards for each pipe type.

### C. Submit design calculations for air release, and air and vacuum valves.

## 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

### A. Transport, handle, and store pipe materials and other products specified herein in a manner recommended by the respective manufacturers to prevent damage and defects.

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### 1.05 SITE CONDITIONS

#### A. Environmental Requirements:

1. Keep trenches dewatered until pipe joints have been made and concrete cradle and encasement, if any, have cured.
2. Under no circumstances lay pipe in water or on bedding containing frost.
3. Do not lay pipe when weather conditions are unsuitable, as determined by the Engineer, for pipe laying work.

### PART 2 - PRODUCTS

#### 2.01 PIPE AND PIPE FITTINGS

##### A. Polyvinyl Chloride Pipe and Fittings (PVC):

1. Pipe: ASTM D 2241, SDR 21 PVC; Pressure Class 200 psi.
  - a. Pipe Joints: Push-on or compression type, joint performance ASTM D 3139, rubber gasket suitable for domestic sewage service ASTM F 477.
  - b. Fitting Joints: Same as pipe or socket-type, ASTM D 2564 unless flanged joints are indicated on the Drawings.
  - c. Socket Type Fittings: ASTM D 2466 manufactured from Class 12454-B Rigid PVC Compound.
  - d. Flanges: PVC Schedule 40 150-lb. flanges manufactured from Rigid PVC Compounds conforming to ASTM D 1784.
    - 1) Gaskets: Soft rubber full face flat type.
    - 2) Bolts: Steel conforming to ASTM A 307.
  - e. Solvent: ASTM D 2564.
2. Pipe: ASTM D 1785 Schedule 40 manufactured from Class 1245-B Rigid PVC Compounds with a hydrostatic design stress of 13.8 MPa (2000 psi) designated as PVC 1120; Pressure Class: 160 psi.
  - a. Socket Type Fittings: ASTM D 2466 manufactured from Class 12454-B Rigid PVC Compound.
    - 1) Joints: Socket-Type, ASTM D 2564 unless flanged joints are indicated on the Drawings.
    - 2) Flanges: PVC Schedule 40 150-lb. flanges manufactured from Rigid PVC Compounds conforming to ASTM D 1784.
      - a) Gaskets: Soft rubber full face flat type.
      - b) Bolts: Steel conforming to ASTM A 307.
  - c. Solvent: ASTM D 2564.

##### B. Ductile Iron Pipe and Fittings (DIP):

1. Pipe: ANSI A21.50 and ANSI A21.51.
2. Wall Thickness Class (Buried): Class 51, minimum.
3. Wall Thickness Class (Exposed): Class 53, minimum.
4. Fittings: Gray iron or ductile iron ANSI A21.10, rated for 250 psi working pressure.
5. Joints: Provide rubber gaskets suitable for domestic sewage service.

- a. Rubber-Gasket Joints (Buried): ANSI A21.11.
    - 1) For buried pipe installation, provide either push-on or mechanical joints except where other types of joints are required by the Specifications or regulatory agency.
  - b. Flanged Joints (Exposed): ANSI A21.15.
    - 1) Gaskets: 1/16 inch thick cloth insertion rubber full face type conforming to ANSI B16.21.
    - 2) Bolts: ANSI B18.2.1.
    - 3) Nuts: ANSI B18.2.2.
6. Lining and Coating:
- a. Pipe and Fitting Lining: Manufacturer's standard cement-mortar lining in accordance with AWWA C 104, double thickness. Lining shall include an asphaltic seal coat to prevent moisture loss in cement-mortar curing sequence.
  - b. Pipe and Fitting Coating: Manufacturer's standard asphaltic coating, approximately one mil thick in accordance with AWWA C 151, applied to the outside of pipe and fittings.
- C. Provide adaptors, nipples, caps, etc., as required.
- D. Flanged Adapters: For joining plain-end pipe to flanged fittings, valves and pumps.
- 1. Acceptable Manufacturers:
    - a. Dresser Manufacturing Division of Dresser Industries, Inc.; Dresser Style 127.
    - b. Rockwell-International; 912.
    - c. R. H. Baker & Co., Inc.; Series 601.
    - d. Or Equal.

## 2.02 PIPING SPECIALTIES

- A. Valve Boxes: Cast iron extension roadway type, three-piece construction, and of screw adjustment design.
  - 1. Boxes shall have 4 1/4-inch minimum shaft diameter and a lock cover marked SEWER.
  - 2. Boxes hot coated inside and out with a tar or asphalt compound.
  - 3. Provide box compatible with valve for operating clearances.
- B. Flexible Insulation on Piping: Insulation manufactured by closed cell, 5 to 6 pounds cubic feet density foamed plastic, with thermal conductivity of 0.26 BTUH per square foot per degree per inch at 70 degrees F. mean temperature, water vapor transmission rating of less than 0.1 perms. per inch, and a self-extinguishing fire-rating; ASTM E 84. Insulation manufactured to meet requirements of ASTM C 534. Use insulation manufacturers's companion joint making/sealing adhesive to make permanent insulation joints.
  - 1. Fitting Insulation (Flexible): Insulate fittings and valve bodies with sleeves of same insulation thickness used on adjacent piping and having an inside diameter larger enough to fit over the insulation on adjacent piping.

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5. Provide extension stems with bronze bushed stem guides where required.
  6. Valve ends shall conform to the following:
    - a. Flanged: ANSI B16.1.
- B. Gate Valves:
1. General:
    - a. Design working pressure at 200 psi.
    - b. Valves of rising stem type except when installed underground.
    - c. Valve stuffing box of such design that valve can be packed under pressure when in fully open position.
  2. Valves Smaller Than 3-inches in Diameter:
    - a. Solid bronze with tapered split wedge disc.
    - b. Physical properties of brass pressure-containing parts shall conform to ASTM B62.
    - c. Stems fabricated of ASTM B371, Alloy A (rolled silicon brass), ASTM B584 Copper Alloy No. 876 (silicon bronze plus silicon brass), or other material equally resistant to dezincification.
  3. Tapping Valve:
    - a. Oversized seat rings.
    - b. Raised male face on flanged end for bolting to tapping sleeve.
    - c. Mechanical or push-on joint with slotted holes for bolting to tapping machine.
  4. Valve Boxes: Cast iron extension roadway type, three-piece construction, and of screw adjustment design.
    - a. Boxes shall have 4 1/4-inch minimum shaft diameter and cover marked SEWER.
    - b. Boxes hot coated inside and out with a tar or asphalt compound.
- C. Plug Valves (Straightway Type):
1. Designed for a minimum working water pressure of 175 psi for valves through 12 inches.
  2. Provide non-lubricated eccentric type plug valve with valve bodies of cast iron conforming to ASTM A 126 Grade B or valve bodies of semi-steel with coated plug suitable for wastewater and corrosion resistant seats.
  3. Port areas for valves sized for at least 80 percent of full pipe area.
  4. Provide T-wrench for operation.
  5. Acceptable Manufacturers:
    - a. Henry Pratt Company; Eccentric, Non-Lubricated Plug Valve.
    - b. DeZurik; Series 100 Eccentric Valves.
    - c. Homestead Industries, Inc.; Ballcentric Valves.
    - d. Dresser Industries, Inc.; X-Centric Valve.
    - e. Or Equal.
- D. Bronze Ball Valve:
1. Valve of solid bronze body, ASTM B 584, and having straight-through flow passage.
  2. Seats and O-rings of Buna-N.
  3. Valves shall be quarter-turn operated with a T-handle or round handle suitable for use in confined spaces and which will allow sufficient space for operation within the valve box. Handle shall indicate whether valve is in open or closed position.

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4. Threaded end valves available in sizes 1/4 inch through 2 inches shall be rated 200 psi.
5. Ball and Stem: Brass, chrome finish, ASTM B 140.
6. Acceptable Manufacturers:
  - a. Crane Company.
  - b. Or Approved Equal.

### 2.05 AIR RELEASE AND CLEANOUT CHAMBERS

- A. Air Release Chambers: Precast manholes as specified in Section 02601.
- B. Cleanout Chambers: Provide chambers composed of sections of reinforced concrete Class III pipe, aggregate base, and frame and cover. Dimensions are as indicated on the Detail Drawings.
  1. Frames and Covers: Cast iron, ASTM A48. The word SEWER cast on cover. Neenah R-5900-C, or equal.
- C. Use ductile iron pipe and ductile iron or cast iron fittings within air release and cleanout chambers except where other type of pipe is indicated on the Detail Drawings.

## PART 3 - EXECUTION

### 3.01 INSPECTION

- A. As specified in Section 02722.
- B. Remove rejected pipe from the Project immediately to avoid confusing rejected pipe with new pipe.

### 3.02 PREPARATION

- A. As specified in Section 02722.
- B. Earthwork: Perform earthwork for sewer installation as specified in Section 02221.

### 3.03 PRESSURE WASTEWATER SEWER CONSTRUCTION METHODS

- A. Construct in accordance with applicable requirements of Section 02722 with the following additional requirements.
  1. Unless indicated otherwise, install piping with not less than four feet of cover.
  2. Concrete Thrust Blocks: Provide concrete thrust blocks at each fitting, and at locations where horizontal and/or vertical deflections are made in the joints of the force mains. Use Class B concrete. Design of thrust blocks as indicated on Detail Drawing.
- B. Laying Specified Types of Plastic Pipe: Perform installation and joint assembly according to ASTM D 2321 for Class I bedding material and ASTM D 2855.

- C. Laying Ductile Iron Pipe: Perform installation and joint assembly according to AWWA C 600, and as follows:
  - 1. Where necessary to field cut pipe, use approved pipe cutter, milling cutter or abrasive wheel saw.
  - 2. Flanged Joints: For DIP shall be faced true, fitted with gaskets, and drawn up square and tight to insure full gasket flow and satisfactory seal.
  
- D. Joints: Make joints in joining of pipe materials, specified under PART 2 and not specifically covered for installation under PART 3 of this Specification, in strict accordance with manufacturer's installation instructions and such included reference standards.
  - 1. Arrange for pipe manufacturer's representative to be present for first installation of pipe to instruct workmen on proper installation methods.
  - 2. Make joints absolutely watertight and immediately repair detected leaks and defects. Methods of repair subject to Engineer's approval.
  - 3. Threaded Joints: Cut pipe ends square, deburr and ream to size of original bore. Cut threads to American Standard tapered pipe threads, free of oil and cuttings. Use an approved joint tape or joint paste to aid in joint lubrication and sealing.
  - 4. Flanged Joints: Make joints faced true, fitted with gaskets, and drawn up square and tight to insure full gasket flow and satisfactory seal.

3.04 AIR RELEASE AND CLEANOUT CHAMBER CONSTRUCTION METHODS

- A. As specified in Section 02601 for precast manholes, and as indicated on the Detail Drawings.
  
- B. Carefully inspect installed work which is to be insulated and verify such work to be complete, including system or equipment testing, to such point where insulating work may begin.
  - 1. Provide insulation on piping and fittings that will be exposed to freezing temperatures.
  - 2. Apply insulation on clean, dry surfaces only. Perform cleaning required for removal of construction debris, spills, etc.
  - 3. Flexible Insulation Installation: Install on piping according to manufacturer's instructions, using specified adhesive to seal both longitudinal and butt joints. Insulate in-line appurtenances to the same thickness as adjoining insulation. Install in 1/2-inch thickness.
  - 4. Outdoor Installation: Weatherize Flexible Insulation exposed to weather using those protective and moisture impervious materials as recommended by the insulation manufacturer.

3.05 FIELD QUALITY CONTROL

- A. General Requirements: Conduct tests specified herein so that the pressure wastewater sewers installed in the Project are tested to the Engineer's satisfaction.

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1. Provide tools, materials (including water), apparatus and instruments necessary for force main testing.
  2. Conduct tests of every kind in the presence of and to the satisfaction of the Engineer.
  3. Provide an extra pressure gauge of known accuracy to frequently check test equipment and apparatus.
  4. Hydrostatic testing equipment and associated testing apparatus subject to Engineer's approval.
  5. When the length of the sewer exceeds 1000 feet, test the sewer in sections.
  6. Do not use in-line valves to isolate sections for testing.
- B. Cleaning Prior to Tests: Before tests are conducted, clean piping interior.
- C. Line Acceptance Test:
1. After a sewer or section thereof is constructed, backfilled, and successfully cleaned, perform a hydrostatic Line Acceptance Test as follows:
    - a. Seal sewer at downstream end with a suitable pipe plug.
    - b. Fill sewer with clear water.
    - c. Raise hydrostatic pressure to one and one-half times operating pressure measured at the low point of the particular section of main being tested.
    - d. Before measuring the leakage, a preliminary test period for the removal or absorption of air from the lines will be permitted.
    - e. Maintain test pressure for a period of not less than 4 hours.
    - f. Consider the sewer Acceptable when measured leakage does not exceed 10 gallons per day per mile per inch of pipe diameter.
- D. Repair and Retest: When the sewer or sections of sewer fail to meet test requirements, specified previously, determine source or sources of leakage and repair or replace defective material; if a result of improper workmanship, correct such. Conduct such additional tests required to demonstrate that the sewer meets specified test requirements
- E. A leakage test may be performed prior to backfilling the trenches, however, the leakage tests of the sewers or sections thereof for acceptance shall be conducted after the backfilling of the trenches has been completed.
- F. The Township reserves the right to retest (at its expense) any installed piping throughout the duration of the Construction Period.
1. Make repairs to piping found defective by such Township conducted tests.

END OF SECTION

DIVISION 3 - CONCRETE

SECTION 03100 - CONCRETE FORMWORK

PART 1 - GENERAL

1.01 QUALITY ASSURANCE

A. Design Criteria:

1. The Contractor is responsible for design, engineering and construction of formwork.
2. Design formwork in accordance with American Concrete Institute's Recommended Practice for Concrete Formwork ACI 347, and in accordance with the following:
  - a. Design forms and falsework to include assumed values of live load, dead load, weight of moving equipment operated on formwork, temporary construction material, foundation pressures, stresses, lateral stability, and such other factors pertinent to safety of structure during construction.
  - b. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent construction.

- B. Allowable Tolerances: Set and maintain concrete forms within tolerance limits stated in American Concrete Institute's Recommended Practice for Concrete Formwork ACI 347.

1.02 REFERENCES

A. American Concrete Institute:

1. ACI 347, Recommended Practice for Concrete Formwork.
2. ACI 350, Concrete Sanitary Engineering Structures.

- B. American Plywood Association: APA Grade-Trademarks.

C. U. S. Department of Commerce Product Standards:

1. PS-1-74 For Construction and Industrial Plywood.
2. PS-20-70 The American Softwood Lumber Standard.

- D. Western Wood Products Association: WWA Catalog 'A' Product Use Manual.

- E. Southern Pine Inspection Bureau (SPIB): Standard Grading Rules for Southern Pine.

1.03 SITE CONDITIONS

A. Protection:

1. Protect formwork materials before, during and after erection to ensure acceptable finished concrete work. Also protect in-place

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materials and other operations of work in connection with concrete pours.

2. In event of damage to erected forms, make necessary repairs or replacements prior to concrete pours.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

##### A. Form Lumber Materials:

1. Form framing, sheathing, struts, braces and shoring shall conform to WWPA Catalog A or SPIB Grading Rules.
2. Rough Structural and Dimension Lumber: Provide lumber of allowable species, surfaced four sides as applicable, and grade stamped with the appropriate WWPA or SPIB stamp indicating product compliance with PS-20-70.
3. Provide lumber free of material defects that would deform the finished concrete product.

##### B. Plywood:

1. Form Sheathing and Panels: Not less than 5/8 inch thick Exterior Type B-B Plywood Class I and II EXT-APA conforming to U.S. Product Standard PS-1-74.
2. Provide Class II only on surfaces not exposed to view.

##### C. Steel:

1. Metal Forms of a pre-engineered standard design, but conforming to the concrete sections indicated on the Drawings, may be used in lieu of wood forms.

##### D. Form Ties:

1. Provide factory fabricated, adjustable-length, removable or snap-off metal form ties conforming to ACI 347 and ACI 350.
2. Provide snap-off metal ties with ends that break at least 1-1/2 inches from the face of the wall.
3. Removable ties that leave holes larger than 7/8 inches are not permitted.
4. Form ties fabricated on the project site and wire ties or flat bands are not acceptable.
5. Wood spacers are not permitted within the pour.

- ##### E. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.

**PART 3 - EXECUTION**

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**3.01 INSPECTION**

- A. Prior to placement of concrete, inspect forms for cleanliness and accuracy of alignment.

**3.02 PREPARATION**

- A. Apply form coatings in accordance with manufacturer's specifications.
- B. Do not allow excess form coating material to accumulate in the forms.
- C. Do not allow form coatings to come in contact with construction joints or reinforcing steel.

**3.03 ERECTION**

- A. General: Construct forms in accordance with ACI 347 to required dimensions, plumb, straight and mortar tight, and paste tight where appearance is important.
  - 1. Securely brace and shore forms to prevent displacement, bowing and pillowing, and to safely support imposed concrete load.
  - 2. Provide offsets, sinkages, keyways, recesses, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and such other features as required. Use selected materials to obtain above requirements.
  - 3. Fabricate forms for easy removal without hammering or prying against concrete surfaces.
  - 4. Form intersecting planes to provide true, clean-cut corners, with edge grain of plywood not exposed to concrete.
  - 5. Build into forms, or otherwise secure in forms, items such as inserts, anchors, miscellaneous metal items, and such other embedded items as indicated on Drawings.
  - 6. Wet forms sufficiently to prevent joints in wood forms from opening prior to concrete pour.
- B. Openings: Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete.
  - 1. Securely brace temporary openings and set tightly to forms to prevent the loss of concrete mortar. Locate temporary openings on forms in as inconspicuous location as possible consistent with the requirements of the work.
  - 2. Provide openings in concrete formwork of the correct size and in the proper location to accommodate other items and operations of construction work passing through forms. Accurately place and securely support items to be built into forms.
- C. Earth Forms: Earth forms not permitted in the Project, except where the concrete is designed to bear directly against undisturbed earth.

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### 3.04 FORM REMOVAL

- A. Remove forms in accordance with ACI 347 without damage to concrete and in a manner to insure complete safety to the structure.
  - 1. Cutting form ties back from the face of the concrete is not permitted.
- B. Upon removal of forms, notify the Engineer in order that a review of the newly stripped surfaces may be made before patching.

### 3.05 RE-USE OF FORMS

- A. Forms for re-use shall meet new form requirements with respect to affect on poured concrete appearance and structural stability.
- B. Re-use of forms shall in no way delay or change the concrete pour schedule as compared to the schedule obtainable if all forms were new (in the case of wood forms) or if the total required forms were available (in the case of metal forms).

END OF SECTION

DIVISION 3 - CONCRETE

SECTION 03200 - CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 RELATED WORK

- A. Concrete Formwork: Section 03100

1.02 QUALITY ASSURANCE

1.03 REFERENCES

- A. American Concrete Institute:
  - 1. ACI 315, Details and Detailing of Concrete Reinforcement.
  - 2. ACI 318, Building Code Requirements for Reinforced Concrete.
- B. American Society for Testing and Materials.
  - 1. ASTM A 82, Specification for Steel Wire, Plain, for Concrete Reinforcement.
  - 2. ASTM A 185, Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement.
  - 3. ASTM A 307, Specification for Carbon Steel Externally Threaded Standard Fasteners.
  - 4. ASTM A 320, Specification for Alloys-Steel Bolting Materials for Low-Temperature Service.
  - 5. ASTM A 615, Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- C. Concrete Reinforcing Steel Institute: CRSI, Manual of Standard Practice for Reinforcing Concrete Construction.

1.04 SUBMITTALS

- A. Shop Drawings and Product Data:
  - 1. Prepare shop drawings of concrete reinforcement in accordance with American Concrete Institute's Standard ACI 315.
  - 2. Indicate bending diagrams, splicing and lap of rods, and shapes, dimensions and details of bar reinforcing and accessories.
- B. Test Reports:
  - 1. Submit two copies of reports showing the results of tests. Such tests conducted in accordance with the American Society for Testing and Materials Specifications.
  - 2. Test Requirements may be waived, based upon certified copies of mill test reports.

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### 1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

#### A. Storage of Materials:

1. Store reinforcing materials in a manner to prevent excessive rusting and fouling with dirt, grease and other bond-breaking coatings.
2. Identify bundles of reinforcing steel with stamped metal tags wired to steel.

### 1.06 SITE CONDITIONS

- #### A. Protection: Protect in-place reinforcing from excessive construction traffic and other work.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

#### A. Reinforcing Steel:

1. Reinforcement Bars: ASTM A 615, Grade 60, Deformed steel reinforcing bars, which shall satisfy the exceptions in ACI Building Code, AASHTO and Federal Specifications.
2. Wire: ASTM A 82.
3. Welded Wire Fabric: ASTM A 185.
4. Metal Accessories: CRSI Manual of Standard Practice for Reinforcing Concrete Construction.

#### B. Anchors:

1. Steel Anchor Bolts: Shapes as indicated, ASTM A 307 with galvanized finish.
2. Stainless Steel Anchor Bolts: ASTM A 320 Grade B8, AISI Type 304.

### 2.02 FABRICATION

#### A. General: Perform bending of steel reinforcement by the cold bending method.

1. Do not use bars with kinks or bends not indicated on the approved Shop Drawings.
2. Perform bar shape fabricating in a manner that will not injure the material or lessen the member strength.
3. Use a designed bending machine, either hand or power-operated.
4. Do not field bend bars partially embedded in concrete unless approved by the Engineer.

#### B. Field Bending: Perform field bending of steel reinforcement using workmen skilled in the practice of field bending, and observing the following requirements.

1. Perform field bending of steel reinforcement as specified above under General.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Notify Engineer 48 hours before placing concrete so he can inspect placement of metal reinforcement.
- B. Verify that items to be embedded in concrete are secured in place and block-outs in formwork are secured in place as required. Formwork installed as work of Section 03100.

3.02 INSTALLATION

A. Placing:

- 1. Place metal reinforcement accurately and securely brace against displacement through the use of reinforcing accessories in accordance with ACI 318.
- 2. Terminate reinforcement 2-inches from face of expansion joints.
- 3. Continue reinforcement across or through construction joints.
- 4. When obstructions interfere with the placement of reinforcing, pass such obstructions by placing reinforcing around and not bending the reinforcing to clear the obstructions.
- 5. Install welded wire fabric as indicated, lapping joints 6-inches and wiring securely. Extend welded wire fabric to within 2-inches of sides and ends of slabs.
- 6. Do not lay metal reinforcement on formwork. Raise reinforcement as concrete is placed.
- 7. Support reinforcing using metal accessories; products other than metal accessories not permitted.

B. Splicing:

- 1. Splice metal reinforcement as indicated and in accordance with ACI 318.
- 2. Welding of crossing bars (tack welding) is not permitted without approval of Engineer.
- 3. Secure metal reinforcement at intersections with not less than 16-gauge annealed wire or appropriate size clips.

C. Anchor Bolts Setting: Set at locations indicated on the approved Shop Drawings and secure in place to prevent movement during concrete pours.

D. Cleaning: Metal reinforcement, at the time concrete is placed, shall be free from rust, scale or other coatings that will destroy or reduce bond.

E. Concrete Reinforcement Protection:

- 1. Provide protection for reinforcement during concrete pours in accordance with ACI 318, unless indicated otherwise on the Drawings.
- 2. On exterior exposed work, no ties or spacers will be permitted to remain within 3/4 inches of the finished surfaces.

END OF SECTION

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5. ASTM C 143, Test Method for Slump of Portland Cement Concrete.
6. ASTM C 150, Specification for Portland Cement.
7. ASTM C 156, Test Method for Water Retention By Concrete Curing Materials.
8. ASTM C 171, Specification for Sheet Materials for Curing Concrete.
9. ASTM C 172, Method of Sampling Fresh Concrete.
10. ASTM C 173, Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
11. ASTM C 192, Method of Making and Curing Concrete Test Specimens in the Laboratory.
12. ASTM C 231, Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
13. ASTM C 260, Specification for Air-Entraining Admixtures for Concrete.
14. ASTM C 309, Specification for Liquid Membrane - Forming Compounds for Curing Concrete.
15. ASTM C 494, Specification for Chemical Admixtures for Concrete.
16. ASTM C 881; Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
17. ASTM C 882; Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete.
18. ASTM D 570, Test Method for Water Absorption of Plastics.
19. ASTM D 638; Test Method for Tensile Properties of Plastics.
20. ASTM D 732; Test Method for Shear Strength of Plastics by Punch Tool.
21. ASTM D 790; Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

D. U. S. Army Corps of Engineers Specifications:

1. U. S. Corps of Engineers CRD-C 572 Specification for Waterstop.

### 1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's descriptive product data and current specifications covering named manufactured products herein. Include installation instructions.
- B. Samples: Submit samples of materials being used when requested by the Engineer including names, sources and descriptions.
- C. Design Mix: Prior to production of concrete, submit for approval a design mix indicating materials proportions and water-cement ratio. Use materials in such proposed design mix as specified herein. Make such adjustments in the proposed design mix as directed by the Engineer.
- D. Certificates: Furnish the Engineer and local authorities requiring same, certificates originated by the batch mixing plant certifying ready mixed concrete as manufactured and delivered to be in conformance with ASTM C 94.
- E. Delivery Tickets: A delivery ticket shall accompany each load of concrete from the batch plant.

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1. Tickets must be signed by the Contractor's representative, noted as to time and place of pour and kept in a record at the site. Make such records available for inspection upon request by the Engineer.
2. Information presented on the ticket shall include the tabulation covered by ASTM C 94, 16.1.1 through 16.2.8, as well as any additional information the local codes may require.

### 1.05 SITE CONDITIONS

- A. AGI Compliance: Cast-in-place concrete work shall conform to ACI 301 except as modified by these Specifications.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Cement:
  1. Portland Cement: ASTM C 150 of the following Type(s):
    - a. Type II, Moderate Sulfate Resistance.
    - b. Type III, High Early Strength.
  2. Only one brand and manufacturer of approved cement shall be used for exposed concrete.
- B. Normalweight Concrete Aggregates: Processed aggregate meeting requirements of ASTM C 33 and subject to the following limitations.
  1. Coarse Aggregate Size: Maximum size of coarse aggregate shall not exceed the following requirements but in no case larger than 1½-inches.
    - a. One-fifth narrowest dimension between sides of forms within which concrete is to be cast.
    - b. Three-fourths of the minimum clear spacing between reinforcing bars or between reinforcing bars and forms.
    - c. One-third the slab thickness for unreinforced slabs.
- C. Water: Potable quality, free from deleterious amounts of acids, alkalis, and organic substances.
- D. Concrete Admixtures:
  1. Calcium Chloride: Not permitted.
  2. Provide admixtures produced and serviced by established, reputable manufacturers and use in compliance with manufacturer's recommendations.
  3. Air-Entraining Admixture: Use a product conforming to requirements of ASTM C 260.
  4. Water-Reducing Admixture: Use a product conforming to requirements of ASTM C 494 Type A and that is free of chloride.
  5. Water-Reducing and Retarding Admixture: Use a product conforming to requirements of ASTM C 494 Type D and that is free of chloride.
  6. Water-Reducing and Accelerating Admixture: Use a product conforming to requirements of ASTM C 494 Type E and that is free of chloride.

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- E. Waterstops: Ribbed type manufactured from virgin polyvinyl chloride plastic compound conforming to U. S. Corps of Engineers CRD-C 572.
1. 6-inch Waterstop: 6 x 3/8-inch, such as Vinylex Corporation; Cat. No. R6-38.
  2. Acceptable Manufacturers:
    - a. Vinylex Corporation (Catalog Nos. as specified above).
    - b. W. R. Grace & Company.
    - c. W. R. Meadows, Inc.
    - d. Or Equal.
- F. Curing Materials, Sheet Form: Use curing materials that will not stain or affect concrete finish or lessen the concrete strength and comply with the following requirements:
1. Burlap: Materials conforming to AASHTO M 182.
  2. Sheet Materials: Material conforming to ASTM C 171.
- G. Liquid Curing Compounds: Material conforming to ASTM C 309, Type 1, free of wax or other adhesive bond breaking ingredients.
1. Note: Where a finish material is to be applied over concrete, provide certification by the curing compound manufacturer certifying the curing compound as non-detrimental to the bond of the finish material.
  2. Acceptable Manufacturers:
    - a. Master Builders; Master Kure.
    - b. Euclid Chemical Company; Kurez Formula E-100.
    - c. L & M Construction Chemicals, Inc.; L & M Cure.
    - d. Or Equal.
- H. Epoxy Bonding Compound: Provide a high-modulus, low-viscosity, moisture insensitive epoxy adhesive having the following properties of the mixed epoxy resin:
1. Compressive Properties, ASTM D 695 at 28 days:
    - a. Compressive Strength: 8,500 psi. min.
    - b. Modulus of Elasticity: 375,000 psi. min.
  2. Tensile Properties, ASTM D 638 at 14 days:
    - a. Tensile Strength: 4,000 psi. min.
    - b. Elongation at Break: one to three percent.
    - c. Modulus of Elasticity: 275,000 psi. min.
  3. Flexural Properties, ASTM D 790 at 14 days:
    - a. Flexural Strength (Modulus of Rupture): 6,300 psi. min.
    - b. Tangent Modulus of Elasticity in Bending: 400,000 psi. min.
  4. Shear Strength, ASTM D 732 at 14 days: 5000 psi. min.
  5. Total Water Absorption, ASTM D 570 at 7 days: One percent maximum (two hour boil).
  6. Bond Strength, ASTM C 882:
    - a. Plastic concrete to hardened concrete at 14 days (moist cure): 1,700 psi. min.
    - b. Plastic concrete to steel at 14 days (moist cure): 1700 psi. min.
  7. Mixed epoxy resin adhesive shall conform to ASTM C 881, Type II, Grade 2, Class B and C.
  8. Mix Ratio: 100 percent solids, two-component; mixed one part by volume component A to one part by volume component B.
  9. Acceptable Manufacturers:

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- a. Sika Corporation; Sikadur 32 Hi-Mod.
- b. Euclid Chemical Company.
- c. L & M Construction Chemicals, Inc.
- d. Or Equal.

2.02 CONCRETE QUALITY

- A. Contractor Note: Use Class A concrete for all concrete work except where otherwise specified herein.
- B. Selection of Proportions for Normalweight Concrete: ACI 211.1.
- C. Proportions of Ingredients: Establish proportions, including water-cement ratio on the basis of field experience, with the materials specified herein.
  - 1. Field Experience: ACI 301, Method 2 and ACI 318.
- D. Water-Cement Ratio: Class A Concrete only shall have a maximum water cement ratio of 0.50.
- E. Classes of Concrete:
  - 1. Class A: 4000 psi minimum compressive strength at 28 days; 564 pounds per cubic yard minimum cement content.
  - 2. Class B: 3000 psi minimum compressive strength at 28 days; 517 pounds per cubic yard minimum cement content.

2.03 ADMIXTURES

- A. Air Entraining: Air-entrain all concrete. Total air content required as follows:

Maximum-size coarse aggregate, in.	Air content per cent by volume
1-1/2	5 ± 1
3/4 or 1	6 ± 1
3/8 or 1/2	7-1/2 ± 1

- B. Water-Reducing Admixture: Unless high temperatures occur and/or placing conditions dictate a change, all concrete shall contain the water-reducing admixture.
- C. Water-Reducing and Retarding Admixture: When high temperatures occur and/or placing conditions dictate, the Engineer may require a change from the water-reducing admixture (Type A) to a water-reducing and retarding admixture (Type D).
- D. Water-Reducing and Accelerating Admixture: When low temperatures occur and/or placing conditions dictate, the Engineer may require a change from the water-reducing admixture (Type A) to a water-reducing and accelerating admixture (Type E).

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- E. Slump: Proportion and produce concrete to have a slump, not to exceed 4 in. if consolidated by vibration. Slump, not to exceed 5 in. if consolidated by rodding, spading or other manual methods.

### PART 3 - EXECUTION

#### 3.01 INSPECTION

- A. Inspect work to receive cast-in-place concrete for deficiencies which would prevent proper execution of the finished work. Do not proceed with placing until such deficiencies are corrected.

#### 3.02 JOINTS AND EMBEDDED ITEMS

- A. Bond new concrete with hardened concrete as follows:
  1. Thoroughly clean hardened concrete of foreign matter and laitance and saturate with water. Initial concrete pour shall have a rough surface.
  2. Cover the hardened concrete with a heavy coating of grout to approximately 1/2-inch thickness. Use grout of same material composition and proportions of concrete being poured except coarse aggregate omitted. Grout shall have a slump of 6-inches minimum.
  3. Place new concrete on grout before it has attained its initial set.
  4. Other bonding methods must be approved by Engineer prior to their use.
  5. Apply Epoxy Bonding Compound over existing prepared concrete in accordance with manufacturers instructions.
- B. Waterstops:
  1. Install in construction joints, expansion joints and where required for watertightness.
  2. Hold end joints to a minimum.
  3. Make watertightness of joints the same as continuous waterstop material and to permanently develop not less than 50 percent of the mechanical strength of the parent section and to permanently retain their flexibility.
  4. Adequately support waterstops to prevent displacement and deformity of the waterstops during concrete pours.
  5. In substructures and other structures required to be watertight, install waterstops if concreting is discontinued for a sufficient length of time, which in the opinion of the Engineer, may result in seepage cracks in concrete.
- C. Other Embedded Items: Place sleeves, inserts, anchors and embedded items required for adjoining work prior to concreting. Place accurately, and support against displacement.

#### 3.03 PRODUCTION OF CONCRETE

- A. Ready-Mixed Concrete:
  1. Batched, mixed and transported in accordance with ASTM C 94.

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2. Plant equipment and facilities shall conform to the Check List for Certification of Ready Mixed Concrete Production Facilities of the National Ready Mixed Concrete Association.

### 3.04 PLACING

- A. General: In general, conduct concrete placement work in accordance with ACI 304 and such additional requirements as specified herein.
  1. Discharge of the concrete shall be completed with 1-1/2 hours or before the mixing drum has revolved 300 revolutions, whichever comes first, after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates.
- B. Preparation:
  1. Prepare formwork in advance and remove snow, ice, water and debris from within forms. Formwork as specified in Section 03100.
  2. Pre-position reinforcement in advance of concrete pours. Concrete reinforcement as specified in Section 03200.
  3. Pre-position anchors and embedded items.
  4. Wet subgrades in accordance with ACI to eliminate water loss from concrete.
  5. Do not place concrete on frozen surfaces.
- C. Conveying:
  1. Handle concrete from mixer to final deposit rapidly by methods which will prevent segregation or loss of ingredients to maintain required quality of concrete.
  2. Do not convey concrete through aluminum or aluminum alloy.
  3. Do not place concrete by pumps or other similar devices without prior written approval of Engineer.
- D. Depositing:
  1. Do not allow concrete to drop vertically more than 4 feet.
  2. Deposit in approximately horizontal layers of 12 to 18 inches.
  3. Do not allow concrete to flow laterally more than 3 feet.
  4. Carry on placing at such a rate that concrete which is being integrated with fresh concrete is still plastic.
  5. Do not deposit concrete on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within sections.
  6. Do not use concrete which has partially hardened or has been contaminated by foreign materials.
  7. Do not subject concrete to procedures which will cause segregation.
  8. Do not place concrete in forms containing standing water.
  9. Do not bend reinforcement out of position when placing concrete.
- E. Consolidation:
  1. Consolidate concrete by vibration, spading, rodding or other manual methods. Work concrete around reinforcement, embedded items and into corners: eliminate all air or stone pockets and other causes of honeycombing, pitting or planes of weakness.

2. Use vibration equipment of internal type and not the type attached to forms and reinforcement.
3. Use vibrators capable of transmitting vibration to concrete in frequencies sufficient to provide satisfactory consolidation.
4. Do not leave vibrators in one spot long enough to cause segregation. Remove concrete segregated by vibrator operation.
5. Do not use vibrators to spread concrete.
6. Have sufficient reserve vibration equipment to guard against shutdown of work occasioned by failure of equipment in operation.

F. Cold Weather Concreting: In general, perform cold weather concrete work in accordance with ACI 306R and the following additional requirements.

1. Temperature of concrete delivered at the job-site shall conform to the following temperature limitations:

Minimum concrete temperature, deg. F.		
Air temperature deg. F.	For sections with least dimension less than 12 in.	For sections with least dimension 12 in. or greater
30 to 45	60	50
0 to 30	65	55

2. If water or aggregate is heated above 100 degrees F, combine water with aggregate in the mixer before cement is added. Do not mix cement with water or with mixtures of water and aggregate having a temperature greater than 100 degrees F.
3. Provide equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather. Do not use foreign materials or materials containing snow or ice.
4. Surfaces which the concrete is to come in contact with must be free of frost, snow and ice.
5. Concrete placed in forms shall have a temperature of 50 degrees F. or higher after placement. Maintain this temperature a minimum of 5 days. Provide additional time if necessary for proper curing.
6. Housing, covering or other protection used in curing shall remain intact at least 24 hours after artificial heating is discontinued. Do not place dependence on salt or other chemicals for the prevention of freezing.

G. Hot Weather Concreting: In general, perform hot weather concrete work in accordance with ACI 305R and the following additional requirements.

1. Temperature of concrete delivered at the job-site shall not exceed 90 degrees F.
2. Cool ingredients before mixing to prevent temperature in excess of 90 degrees F.
3. Make provisions for windbreaks, shading, fog spraying, sprinkling or wet cover when necessary.

H. Underwater Concreting:

1. When permitted by Engineer, foundation concrete may be placed in still water.
2. Concrete placed in water shall contain twenty-five percent of cement over and above the amount specified for the particular class of concrete used.
3. Do not deposit concrete in water which has a temperature below 40 degrees F.
4. Place the concrete underwater continuously through a tremie pipe. Diameter of the tremie pipe shall be approximately eight times the maximum size of the largest coarse aggregate. Use seal in pipe to start concrete placement, and keep filled with concrete continuously with the end of the pipe embedded in the placed concrete at all times. If seal is lost, withdraw pipe and reseal and start charging operations again.
5. Protect placed concrete from water motion for at least 4 days and longer if required.

3.05 FINISHING

- A. Form Tie Repairs: Following form removal repair holes vacated by removable components of form ties in accordance with the following.
1. Hammer-pack holes with stiff mortar of same mix and ingredients as employed in surrounding concrete. Prepare mortar not more than 30 minutes prior to use.
  2. Render mortar patch work inconspicuous. Maintain mortar patches damp and cure as specified herein for Curing and Protection.
- B. Finishes: Finish exposed concrete surfaces true and even, free from open or rough areas, depressions or projections. Bring concrete up in vertical pours to the required elevation, strike-off with a straight edge and float-finish.
- C. Application For Finishes:
1. Spade Finish:
    - a. Surfaces to be backfilled with earth.
    - b. Surfaces to be rubbed.
  2. Floated Finish:
    - a. Surfaces to receive Steel Trowel Finish.
  3. Smooth Rubbed Finish, Exterior Applications:
    - a. Exposed surfaces of concrete structures.
    - b. Vertical surfaces of troughs, channels and such other passages for the flow of liquids.
  4. Steel Trowel Finish:
    - a. Bottom surfaces of troughs, channels and such other passages for the flow of liquids.

3.06 CURING AND PROTECTION

- A. General: Immediately after placement, protect concrete from premature drying, excessive hot or cold temperatures and mechanical injury. Perform curing by either water curing, sheet form curing or sealing methods in accordance with ACI 308. Cure concrete continuously for a minimum of 7 days at ambient temperatures above 40 degrees F.

- B. Hot Weather Curing: See Hot Weather Concreting this Section.
- C. Cold Weather Curing: See Cold Weather Concreting this Section.
- D. Liquid Curing Compound Application: Apply the liquid membrane forming compound at such rates to restrict the loss of water to not more than 0.055 g/sq. cm of surface in 72 hours when tested in accordance with ASTM C 156.

3.07 FIELD QUALITY CONTROL

A. Testing and Inspection:

- 1. Materials and operations shall be tested and inspected as work progresses. Failure to detect defective work will not prevent rejection when defect is discovered, nor will it obligate the Engineer for final acceptance.
- 2. Secure composite sample in accordance with ASTM C 172.
- 3. Mold and cure three test specimens for each strength test in accordance with ASTM C 31.
- 4. Test specimens in accordance with ASTM C 39. Test one specimen at 7 days for information and two at 28 days for acceptance.
- 5. Make one strength test for each 50 cu. yd. of concrete, unless waived by the Engineer, but not less than one test for each structure.
- 6. Make slump tests for each strength test and whenever consistency of concrete appears to vary in accordance with ASTM C 143.
- 7. Make air content test for each strength test in accordance with ASTM C 231 or ASTM C 173 except if aggregate with high absorptions are used, use the latter test method.

B. Evaluation and Acceptance:

- 1. The strength level of the concrete will be considered satisfactory if 90 percent of the strength test results and the averages of all sets of three consecutive strength test results equal or exceed specified strength and no individual test result is below specified strength by more than 500 psi.
- 2. If the strength of cylinders falls below specified compressive strengths, the Engineer shall have the right to order a change in the mix proportions for the remaining concrete being poured.

END OF SECTION

DIVISION 3 - CONCRETE

SECTION 03600 - GROUT

PART 1 - GENERAL

1.01 RELATED WORK

- A. Cast-In-Place Concrete Section 03300.
- B. Individual grouting requirements as specified in various other Sections of these Specifications.

1.02 REFERENCES

- A. American Society for Testing and Materials:
  - 1. ASTM C 191, Test Method for Time of Setting of Hydraulic Cement by Vicat Needle.
  - 2. ASTM C 596, Test Method for Drying Shrinkage of Mortar Containing Portland Cement.
  - 3. ASTM C 827, Test Method for Early Volume Change of Cementitious Mixtures.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Prevent moisture damage and contamination of materials.
- B. Store materials in undamaged condition with seals and labels intact as packaged by the manufacturer.

1.04 SITE CONDITIONS

- A. Protect against high and low temperatures and bad weather in accordance with American Concrete Institute standards for placement of concrete.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Non-Shrink Non-Metallic Grout: Factory premixed material containing no corrosive irons, aluminums, chemicals or gypsums.
  - 1. Grouts containing water reducers, accelerators, or fluidifiers shall have no drying shrinkage greater than the equivalent and cement and water mix as tested per ASTM C 596.
  - 2. Grout shall be nonshrink before initial set and show no expansion after set as tested per ASTM C 827.
  - 3. Initial set of grout not less than 60 minutes per ASTM C 191 Test.
  - 4. Use Type I (Normal) cement for grout applications not in contact with sewage.

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5. Use Type II (Sulfate Resistant) cement for grout applications in contact with sewage.
6. Acceptable Manufacturer: U.S. Grout Corporation; FIVE STAR, or equal.

### 2.02 GROUT QUALITY

- A. Non-Shrink Grout: Use ready-mix type requiring only the addition of water. Do not add other materials. Water requirement proportions shall conform to manufacturer's specifications for the desired mix consistency.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Forming:
  1. Use forming procedures that allow proper and complete placement of grout.
  2. Anchor Support elements so no movement is possible.
  3. Remove supports only after grout has hardened.
  4. Pre-treat with forming oils wood forms that may absorb moisture.
- B. Preparation of Surface:
  1. Non-Shrink Grout: Prepare in accordance with manufacturer's printed instructions.

### 3.02 MIXING

- A. Time:
  1. Non-Shrink Grout: In accordance with manufacturer's printed instructions.

### 3.03 PLACING

- A. Non-Shrink Non-Metallic Grout: Perform grout placement in accordance with the recommendations of ACI and the manufacturer's published specifications for mixing and placing. Place non-shrink non-metallic grout only where specified in other Specifications Sections.

END OF SECTION

DIVISION 11 - EQUIPMENT  
SECTION 11304 - GRINDER PUMP UNITS

PART 1 - GENERAL

1.01 RELATED WORK

- A. Trenching, Backfilling, and Compacting: Section 02221.
- B. Manholes: Section 02601.
- C. Pressure Wastewater Sewer: Section 02725.
- D. Division 3 - Concrete

1.02 QUALITY ASSURANCE

- A. Manufacturer's Qualification: Consideration will be given only to manufacturers or fabricators meeting the following qualifications:
  - 1. Three years minimum experience producing Units of equal quality to the type specified herein.
  - 2. Three years minimum experience of in-service, satisfactorily operating Units of the type specified herein.
  - 3. Manufactured grinder pump units shall have been tested to certify capability to perform, as specified herein, in either individual or low pressure sewer system applications.
  - 4. Historical and certified data substantiating the above qualifications available to the Engineer upon request.
- B. Design Criteria: Units shall meet accepted standards for plumbing equipment for use in or near structures, and shall operate free from noise, odor or health hazards.
  - 1. Grinder: Capability of reducing the components in normal domestic sewage, including a reasonable amount of foreign objects, such as paper, wood, plastic, glass, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the 1 1/4 inch diameter discharge piping.
    - a. Position the grinder in such a way that solids are fed in an upflow direction.
  - 2. Pump: Centrifugal design only, capable of delivering 11 GPM against a normal rated total dynamic head of 92 feet. Pump of such design to allow for removal from tank, without use of tools, to the immediate area outside of tank with electrical and control connections intact.
  - 3. Pump and motor to have the capability of running dry for extended periods of time without damage to motor or seals.

4. Motor: 2 Horsepower minimum.
  5. Tank: Completely watertight, 60 gallon capacity (minimum) and designed to withstand the minimum depth of bury earthload indicated. Tank manufacturer shall calculate the fiberglass tank anti-flotation anchor and provide an appropriate design for the anchor.
    - a. Provide a 7 ft. deep tank.
  6. Inlet Size: 4-inch diameter, minimum.
  7. Discharge Size: 1 1/4-inch diameter.
- C. Requirements of Regulatory Agencies: Comply with construction code requirements of State, County, and such other political subdivision specifications as may exceed the requirements of the codes, standards and approving bodies referenced throughout these Specifications.
1. Provide electrical control panels and grinder pump units constructed in accordance with the requirements of the Underwriters Laboratory, or other nationally recognized certification agency, and labelled accordingly.
  2. Units shall comply with the applicable requirements of the Pennsylvania Department of Environmental Resources and the National Sanitation Foundation.
- D. Source Quality Control:
1. Shop Tests: In accordance with Article 1.06 of the General Instructions, factory test each unit. The manufacturer must have facilities to perform listed tests. The Engineer reserves the right to require the manufacturer to perform such additional number of tests as the Engineer may deem necessary to establish the quality of the material offered for use.
    - a. Submit the proposed types of tests in the Shop Drawing submittal.
    - b. Test to assure watertightness of the Unit for the proposed installation depth.
    - c. Test pump output in gallons per minute at 15 psi and 35 psi.
    - d. Test amperage and wattage of electrical consumption.
  2. Laboratory Tests: The Engineer reserves the right to require that laboratory tests also be conducted on Units that have been shop tested. When the Engineer so orders, furnish without compensation, labor, materials, and equipment necessary packaging, and shipping the grinder pump unit to the Test Laboratory.
  3. Provide certification that the units have been tested successfully for watertightness.
  4. Single Source Responsibility: To ensure single source responsibility and part supply, provide the pump components, tank, internal piping system and electrical controls from one grinder pump manufacturer.
- E. Initial Unit Installation: To serve as the minimum acceptable conditions of installation throughout the Project, install the first unit in the Project to demonstrate the following:
1. Bedding and concrete construction.
  2. Pipe connections to the Unit and watertightness of the complete Unit.
  3. Proper electrical work operation of the Unit.

1.03 REFERENCES

- A. American National Standards Institute:
  - 1. ANSI B2.1, Pipe Threads.
  - 2. ANSI B16.3, Malleable-Iron Screwed Fittings, 150 and 300 lb.
  - 3. ANSI C2, National Electrical Safety Code.
  
- B. American Society for Testing and Materials:
  - 1. ASTM A 48, Specification for Gray Iron Castings.
  - 2. ASTM A 536, Specification for Ductile Iron Castings.
  - 3. ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.
  - 4. ASTM B 371, Specification for Copper-Zinc-Silicon Alloy Rod.
  - 5. ASTM B 584, Specification for Copper Alloy Sand Castings for General Applications.
  - 6. ASTM C 581, Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures, Intended for Liquid Service.
  - 7. ASTM C 582, Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion Resistant Equipment.
  - 8. ASTM D 1784, Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
  - 9. ASTM D 1785, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Schedules 40, 80 and 120.
  - 10. ASTM D 2241, Specification for Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series).
  - 11. ASTM D 2466, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
  - 12. ASTM D 3139, Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
  - 13. ASTM D 3299, Specification for Filament-Wound Glass Fiber Reinforced Polyester Chemical-Resistant Tanks.
  - 14. ASTM F 477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
  
- C. Federal Specifications:
  - 1. Fed. Spec. WW-C-581D, Conduit, Metal, Rigid and Coupling Elbow and Nipple, Electrical Conduit, Zinc-Coated.
  
- D. Institute of Electrical and Electronics Engineers.
  
- E. National Bureau of Standards: Product Standard PS 15-69, Custom Molded Reinforced Polyester Chemical Resistant Process Equipment.
  
- F. National Electrical Code (NEC).
  
- G. National Electric Manufacturer's Association (NEMA) Standards of Construction.

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- H. National Fire Protection Association (NFPA): NFPA 70; National Electrical Code, and current amendments.
- I. Underwriters' Laboratories (UL) Listings and Approvals on specified Products.

### 1.04 SUBMITTALS

#### A. Shop Drawings:

1. Submit for approval completely dimensioned shop, layout or setting drawings and catalog cuts or other data as required to provide a complete description of system equipment specified in this Section.
2. Submit shop drawings certified for construction by the manufacturer which includes location of electrical connections; wiring diagrams; anchor bolt layout; details indicating construction and materials of construction; diameter of shafting; dimensions and rated horsepower of all motors; gear and bearing ratings; service factors and weights of principal parts and completely assembled equipment.
3. Submit evidence of Underwriters' Laboratories (UL) Listings and Approvals on the electrical control panel and grinder pump.

#### B. Certificates:

1. Submit certified records or reports of results of shop tests for each Unit. Such records or reports shall contain a sworn statement that shop tests have been made as specified.
2. Submit manufacturer's sworn certification that components and products will be manufactured in accordance with specified reference standards for components.

#### C. Operation and Maintenance Manuals: Within four weeks following the receipt of approved shop drawings, submit to the Engineer for review and approval, five copies of manuals prepared by the manufacturer/supplier, or the Contractor. The submission and approval of each set of manuals will be considered to be an integral part of furnishing and installation of the respective equipment or system. Incomplete or inadequate manuals will be returned to the Contractor for correction and resubmission.

1. Include the following elements in each manual:
  - a. Erection or installation instructions.
  - b. Start-up procedures.
  - c. Recommended and alternative procedures.
  - d. Schedule of preventive maintenance requirements.
  - e. Detailed maintenance procedures.
  - f. Schedule of lubrication requirements.
  - g. Data sheet listing pertinent equipment or system information, as well as the addresses and telephone numbers of the nearest sales and service representatives.

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### 1.05 DELIVERY, STORAGE AND HANDLING

- A. To prevent damage and defects, transport, store and handle the units and Products specified herein in a manner recommended by the respective manufacturers.

### 1.06 SITE CONDITIONS

- A. Environmental Requirements:
  - 1. In no instance set units on subgrade containing frost or on unacceptable subgrade which condition has been determined unacceptable by the Engineer.
- B. Electrical Interface:
  - 1. Install or mount those electrical components or apparatus as furnished by the Product manufacturers of those Products specified herein.
  - 2. Property owner will be responsible for permanent power wiring, including final connections of such to the electrical components or apparatus of the grinder pump units.

## PART 2 - PRODUCTS

### 2.01 GRINDER PUMP UNIT

- A. General: Provide prefabricated, completely assembled Unit, suitable for conveying domestic sewage and for underground installation. Unit shall have one (Simplex) or two (Duplex) grinder pumps, as indicated on the Drawings.
  - 1. Unit shall include tank, sewage grinder pump(s), mercury switch level controls, discharge piping, with hydraulically sealed discharge flange(s), pump mounting plate(s), with bottom rail supports, upper rail supports, pump guide rails, rail supports, lifting chain, or cable, control panel, control panel enclosure, electrical wiring, alarm devices, piping, and other necessary accessories as specified herein and as indicated on the Drawings.
  - 2. Provide materials, where exposed to wastewater, that have inherent corrosion protection; i.e., cast iron, fiberglass, stainless steel, PVC.
  - 3. Duplex installations shall permit the independent removal of each grinder pump from the sump basin for maintenance or inspection, and the return of the pump to service without draining or entering the sump basin.
- B. Tank: Tank construction of fiberglass reinforced polyester or precast concrete.
  - 1. Fiberglass Reinforced Polyester (FRP): Tank construction shall conform to ASTM C 582 and C 581 Standards with a minimum wall thickness of 1/4-inch.

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- a. Manufactured according to ASTM D 3299 Standards for filament wound tanks or NBS PS 15-69 Standards for contact molded tanks.
  - b. Polyester Resin: Atlac 382.
  - c. Flush, slip resistant bolt down cover with padlock.
  - d. Connections: Watertight and suitable for attaching PVC pipe; 4-inch diameter inlet and 1 1/4-inch diameter discharge with plugs or caps.
  - e. Anti-Flotation Anchor: Provide precast or field cast concrete anchor in accordance with tank manufacturer's recommendations. The tank manufacturer shall provide the design and size of the anchor as specified previously under Design Criteria.
2. Precast Concrete Manhole: Conforming to the requirements of Section 02601.
- C. Pump: Component construction as follows:
1. Casing: Pump casing, oil casing and motor casing of ASTM A48 cast iron. Pump casing construction of single volute type, ribbed to prevent excessive deflection and hydrostatically tested to twice the design. Volute sized at all points to pass solids which can pass through the impeller and internally finished to provide smooth, unobstructed flow.
  2. Impeller: Non-clogging type of ASTM A 536 ductile iron or bronze; statically, dynamically and hydraulically balanced.
  3. Pump Shaft: Stainless steel of sufficient strength and size to safely transmit the maximum torque developed by the drive unit.
- D. Grinder: Mounted immediately below pumping elements and constructed so as to eliminate clogging and jamming under normal operating conditions including starting. Unit shall create sufficient vortex action to scour tank free of deposits or sludge banks which would impair the operation of the pump. Components and construction as follows:
1. Direct drive with single, one piece motor shaft.
  2. Abrader: 316 stainless steel.
  3. Cutter Bar: 410 stainless steel, Rockwell hardness C-35.
  4. Wear Plate: Stainless steel with micrometer adjustment for high head requirements and eliminating the need for shims.
  5. Pump and grinder assembly balanced to operate without objectionable noise or vibration over the entire range of recommended operating pressures.
- E. Motor:
1. Two Hp. minimum, of 230 volt, single phase, 60 Hertz, 3,450 RPM, totally submersible design, constructed with open winding and designed to operate in clean dielectric oil for cooling winding. Air cooled stators and grease packed bearings not acceptable.
  2. Motor shaft of stainless steel and designed for extremely difficult pumping service. Motor shaft and housing sealed with two mechanical shaft seals with an oil chamber between the seals. The seals shall have carbon and ceramic seal faces.

3. Motors shall comply with Standards of IEEE and NEMA in all respects except where requirements exceed these Standards.
- F. Discharge Piping and Fittings:
1. Size: 1 1/4-inch diameter on the Simplex Unit and 1 1/2-inch diameter on the Duplex Unit.
  2. Material: ASTM D 1785 Schedule 80 manufactured from Class 12454-B Rigid PVC Compounds with a hydrostatic design stress of 13.8 MPa (2000 psi designated as PVC 1120), NPT couplings, pipe and fittings.
  3. Material Option: ASTM D 2241, SDR 21.
    - a. Pressure Class 200 psi.
    - b. Pipe Joints: Push-on or compression type, joint performance ASTM D 3139, rubber gasket suitable for domestic sewage service ASTM F 477.
- G. Valves: Include a check valve, gate valve and hydraulically sealed discharge flange in pump discharge piping.
1. Provide valves of the same type by the same manufacturer; suitable for the intended service.
  2. Markings factory cast on the bonnet or body of each valve indicating manufacturer's name or mark, year of valve casting, size of valve, directional flow arrow and designation of working water pressure.
  3. Valve pressure-temperature ratings of not less than the design criteria applicable to system components.
  4. Valves shall open to the left (counterclockwise).
  5. Provide extension stems with bronze bushed stem guides where required. Provide a top support and one intermediate support unless the unsupported stem length exceeds four feet, in which case provide an additional support every two feet of valve stem length.
  6. Valve ends as indicated on the Detail Drawings and unless indicated otherwise shall conform to the following:
    - a. Screw End: Threaded in accordance with ANSI B2.1.
  7. Check Valve: Ball check valve designed for a minimum water working pressure of 150 pounds per square inch and factory tested to double that pressure before shipment. Check valve bodies to provide excess area through the valves to assure full delivery of line capacity. Include with each Unit one separate 1 1/2-inch check valve for installation in the discharge line between the Grinder Pump and the sewer main. Valve to be as specified with the exception of the joint.
    - a. Double union type manufactured from PVC 12454-B conforming to ASTM D 1784 with Vitron O ring seals.
  8. Gate Valve:
    - a. General:
      - 1) Design working water pressure at 200 psi.
      - 2) Valves of rising stem pipe.
      - 3) Valve stuffing box of such design that valve can be packed under pressure when in fully open position.

- 4) Solid bronze with tapered split wedge disc.
  - 5) Physical properties of brass pressure containing parts shall conform to ASTM B 62.
  - 6) Stems fabricated of ASTM B 371, Alloy A (rolled silicon brass), ASTM B 584 Copper Alloy No. 876 (silicon bronze + silicon brass), or other material equally resistant to dezincification.
9. **Hydraulically Sealed Discharge Flange:** The hydraulically sealed discharge flange shall allow the pump to be removed periodically and shall result in a watertight seal when the pump is replaced. Fittings of threaded style, 150 lb. galvanized malleable iron conforming to ANSI B 16.3.

H. Controls:

1. The electric power cord to the pump shall be SO type construction suitable for submersion in sewage. The cord is to be sealed by use of a cord grip, with individual conductors additionally sealed into the cord cap assembly with epoxy sealing compound. Seal the cord cap into the motor housing with a Buna-N O-ring, providing a completely watertight electrical connection.
2. Sealed float-type mercury switches shall control sump level and high-level alarm signal. For corrosion and shock resistance the mercury tube switches are factory sealed in a solid polypropylene float, with internal weight. The float power and support wire shall have a heavy Neoprene jacket. Provide an intrinsically safe UL approved relay to be wired to each float type mercury switch.
3. Support the float switches by the cord that is connected to the junction box. Provide a junction box to be drilled and tapped for the four - 3/4-inch diameter conduits for wiring to Pump Control Panel. Provide junction box labeled for Expulsion-Proof application and conforming to the requirements under Article 500 of NEC for Class 1, Division 1, Group D, Hazardous Location.
4. (Simplex) Provide three mercury switches; one for pump start, one for pump stop, and one to signal high-level sump alarm. On sump level rise, lower mercury switch shall first be energized, then upper level switch shall next energize and start pump. With pump operating, sump level shall lower to low switch turn-off setting and pump shall stop. If level continues to rise when pump is operating, alarm switch shall energize. Level switches adjustable for level setting, from the surface.
5. (Duplex) Provide four mercury switches; one for lead pump start, one for lag pump start, one for both pumps stop and one to signal high-level sump alarm. On sump level rise, lower mercury switch shall first be energized, then upper level switch shall next energize and start lead pump. With lead pump operating, sump level will lower to low switch turn-off setting and pump shall stop. Alternating relay shall index on stopping of pump so that lag pump shall start on next operation. If sump level continues to rise when lead pump is operating, override switch shall energize and start lag pump. Both lead and lag pump shall operate together until low level switch turns off both pumps. If level continues to rise when both pumps are operating, alarm switch shall energize. If one pump should fail for any reason, the

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- second pump shall operate on the override control, and if level rises above override control, signal alarm switch shall energize. Level switches adjustable for level setting, from the surface.
6. Include in the pumping system sensors to determine thermal overload and hydraulic seal failure conditions in addition to high sump level.
  7. Control Panel: NEMA 3R Enclosure with baked gray enamel finish or fiberglass, fully enclosed and all panel hardware mounted on a separate inside plate organized to facilitate maintenance and repair. Panel factory equipped with an oxidation inhibitor and wall mounting brackets.
    - a. Provide a circuit breaker for total panel and individual breakers for pumps and alarms so that alarms remain energized when pump breaker is tripped.
    - b. (Simplex) Hardware includes start and run capacitors, start relay, circuit breaker (quick-make/quick-break action on manual operation) with bi-metallic ambient compensated overload relay with heaters to protect both start and run windings, H-O-A switch and indicator lights. Provide individual circuit breaker for alarm system.
    - c. (Simplex) Provide terminal strip for float control wires and a 120 volt AC control circuit.
    - d. (Duplex) Hardware includes two sets of start and run capacitors, start relay, circuit breaker (quick-make/quick-break on manual operation) with bi-metallic ambient compensated overload relay with heaters to protect both start and run windings, H-O-A switch and indicator lights.
    - e. (Duplex) Provide one alternating relay and terminal strip for float control wires.
    - f. Panel so designed to be wall or post mounted.
    - g. Enclosure to be lockable, with padlock. Unnecessary punchouts not permitted. Enclosure to contain the following:
      - 1) Visible red lights indicating overflow, thermal overload and hydraulic seal failure conditions.
      - 2) Audible alarm indicating overflow conditions with manual On/Off switch on exterior of enclosure. Red overflow light to remain on when alarm silenced.
      - 3) (Duplex) Pump running lights.
  8. Provide electrical surge protection device as part of the unit package.
- I. Lifting Accessories:
1. Provide stainless steel guide rails, supports, chains and shackles for raising and lowering the pumping equipment.
- J. Spare Parts: Provide manufacturer recommended, Engineer approved spare parts.
- K. Acceptable Manufacturers:
1. Barnes Pumps, Inc.
  2. Hydromatic Pumps.
  3. Myers.
  4. Or Equal.

2.02 MISCELLANEOUS MATERIAL

- A. Bedding and Backfill: Per requirements of Section 02221.
- B. Cast-In-Place Concrete: Per requirements of Division 3 - Concrete.
- C. Pipe Connections: Per requirements of Section 02725.
- D. Preservative Treated Post: Nominal dimension 6 x 6, surfaced four sides (grade stamp S4S) and grade stamped indicating product compliance with PS-20-70 according to the American Softwood Lumber Standard, and preservative treated as follows:
  - 1. Preservative treatment by the pressure impregnation process for Ground Contact in accordance with the American Wood Preserver's Association AWPA P-5.
  - 2. Preservative injected into the wood at 0.60 pounds per cubic foot of wood. Preservative density determined by assay in accordance with AWPA Standard C-1.
- E. Underground Cable, Type UF: Multi-conductor cable with each conductor of annealed uncoated copper and individual color coded PVC insulation. Conductors assembled flat with grounding wire and encased in gray sunlight resistant PVC approval imprinted jacket. Standards compliance as follows:
  - 1. UL listed as Type NMC Cable per Standard 719 for Nonmetallic-Sheathed Cables.
  - 2. UL listed as sunlight resistant Type UF cable per Standard 493 for underground Feeder and Branch-Circuit Cables.
  - 3. Conforming to National Electrical Code, Article 339.
  - 4. ROMEX and BX Cable not permitted for use in this Project.
  - 5. Warning Tape: Printed polyethylene, magnetic tape of three inches width minimum, color coded red and labeled in one inch lettering with the word electric.
- F. Wire and Cable Connections (Exposed Locations):
  - 1. Wire Nuts: Preinsulated UL Listed hand or tool installed solderless connectors of the spring-lock type or compression type for making splices of solid COPPER wire.
  - 2. Split Bolt Connectors or Compression Type Connectors: UL Listed connectors for making parallel or butt splices of stranded COPPER wire. Use companion preformed plastic insulating covers or tape insulation conforming to NEC requirements.
  - 3. Screw-Lock Connectors: UL Listed connectors for making terminal connections or solid COPPER wire. Contractor option to use UL Listed crimp type ring tongue connectors.

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- G. Waterproof Splice Kit (Buried and Waterproof Locations): Molded rubber composition and designed to create a watertight seal on the cable jacket as well as the splice.
1. Acceptable Manufacturers:
    - a. Elastimold Division Amerace-Esna Corp.; Fused and Single & Multi-Conductor Connector Kits.
    - b. Joy Manufacturing Company.
    - c. Or Equal.
- H. Rigid Metal Conduits: Fabricated of mild steel piping, galvanized or sherardized inside and outside, and protected against corrosion by a dichromate rinse or a zinc chromate coating. Each conduit shall bear the UL label, be defect free, furnished in 10 ft. lengths minimum, and of the following type:
1. Rigid Metal Conduit and Fittings: Product meeting requirements of NEC Article 346 for materials and uses, and Fed. Spec. WW-C-581D.
- I. Rigid PVC Conduit: High impact PVC (polyvinyl chloride) Conduit and Fittings conforming to NEMA Spec. TC-2, 90 C, UL rated and Labeled and made from compounds conforming to ASTM D 1784. Additionally, PVC conduit shall have material strengths of 5500 psi tensile, 11,000 psi flexural and 8600 psi compression; all at 78 degrees F. Provide schedule 40 conduit and fittings, except where required by NEC use schedule 80.
- J. Grounding Materials: Provide materials conforming to UL requirements for such use as NEC Article 250. Basic materials as follows:
1. Ground Rods: 3/4-inch by ten foot copperweld type.
  2. Ground Conductors: Code gauge stranded copper unless otherwise indicated.
  3. Ground Clamps: Multi-bolt type, (Clamps for pipe, lugs for bars) saddle clamp or compression type for wire.

### PART 3 - EXECUTION

#### 3.01 INSPECTION

- A. Examine units for defects that will adversely affect installation or cause latent defects in completed work. Inform Engineer of defects. Do not proceed with installation until defects have been corrected.
- B. Refer to manufacturer's instruction and installation manual before proceeding with installation of units.
- C. Verify other construction work is complete to the extent that substrates on which electrical apparatus is to be installed is ready to receive same.
- D. Verify direction of motor rotation in equipment before making final connections to electrically operated equipment.

3.02 PREPARATION

- A. Field Measurement: Submit details of proposed departures necessitated by field conditions or other causes to the Engineer for approval.
- B. Keep pipe and unit interiors cleared of debris as construction progresses.
- C. Earthwork: Perform earthwork for unit installation as specified in Section 02221 and according to the following:
  - 1. Make excavations for units to a nearly vertical plane and not to exceed the nominal dimensions of the concrete anchor outside diameter.
  - 2. If rock excavation is required, take rock out to limits specified previously.
  - 3. If surface pavement of any type is encountered, vehicle or pedestrian ways, cut such pavement to a rectangular shape as opposed to circular shape of unit. Make limits of cut not to exceed one-foot beyond excavation limit as specified previously.

3.03 INSTALLATION

- A. Install units in strict accordance with manufacturer's instruction and installation manual.
  - 1. Install a check valve between the unit and the main sewer piping in accordance with the Detail Drawings.
- B. Install units on a six inch deep compacted layer of aggregate meeting requirements of First Class Bedding. Install First Class Bedding material as backfill up to highest pipe connection.
- C. Anti-Flotation Anchor Installation, Fiberglass Tank: Form and pour concrete anchors in accordance with requirements of Division 3 - Concrete. Use Class B concrete. Prefabricated anchors, as qualified previously in this Section, are acceptable.
- D. Underground Systems: Install underground electric cable in accordance with Article 300-5 of the NEC, in accordance with previous requirements of this Section, and the following requirements exceeding NEC:
  - 1. Earthwork: Perform earthwork for buried electric cable as specified for piping under Section 02221.
  - 2. Provide two feet minimum cover over cable unless indicated otherwise on the Drawings.
  - 3. Make electrical cable penetrations through the tank absolutely watertight.

- E. Grounding: Perform grounding of electrical systems and metal enclosures in accordance with Article 250 of the NEC.
  - 1. In addition to grounding and bonding requirements of NEC as referenced in the preceding paragraph, the following shall also apply:
    - a. Use approved grounding connectors only. Clean the surfaces involved in the made-grounds before connecting and finish the installation with touch-up painting or other protective coating to prevent corrosion.
  
- F. Control Panel Installation: Fasten control panel and cable to exterior of the building or post (for post mounted) using fasteners suitable for anchoring into the particular type of surface, and fasten in accordance with current accepted trade practices. Only screw-type corrosion-resistant fasteners are acceptable.
  - 1. Install control panel four feet above existing grade, measured to the bottom of the panel.
  - 2. If post mount installation, provide post of sufficient length to permit three feet of embedment in ground and the four foot clearance requirement stated above.

3.05 FIELD QUALITY CONTROL

- A. General: Upon completion of installation of the grinder pump units, including but not limited to control panel mounting, electrical work installation and connections, pressure service lateral installation, and unit backfilling, each being performed in a manner satisfactory to the Engineer, advise the unit manufacturer that the units have been installed and are ready to be inspected and tested.
  - 1. In cooperation with the unit manufacturer, determine a mutually acceptable schedule for inspection and testing of installed units.
  - 2. Conduct the Performance Test specified herein prior to the property owner's electrical wiring and plumbing connections to the grinder pump units.
  - 3. Conduct tests as specified herein so that each unit installed in the Project is tested to the unit manufacturer's and Engineer's satisfaction. Provide the Owner with documentation of such manufacturer's acceptance test in the form of a letter to the Owner attesting to this test requirement.
  - 4. Provide tools, materials, water, temporary power, apparatus, and instruments necessary for unit testing. Conduct the specified tests in the presence of and to the satisfaction of the unit manufacturer and the Engineer.
  
- B. Performance Test: Demonstrate (with the Personnel of the Owner observing), to the satisfaction of the Engineer and manufacturer, the mechanical performance of each unit when operated in accordance with the design intent described in this Section of the Specifications.

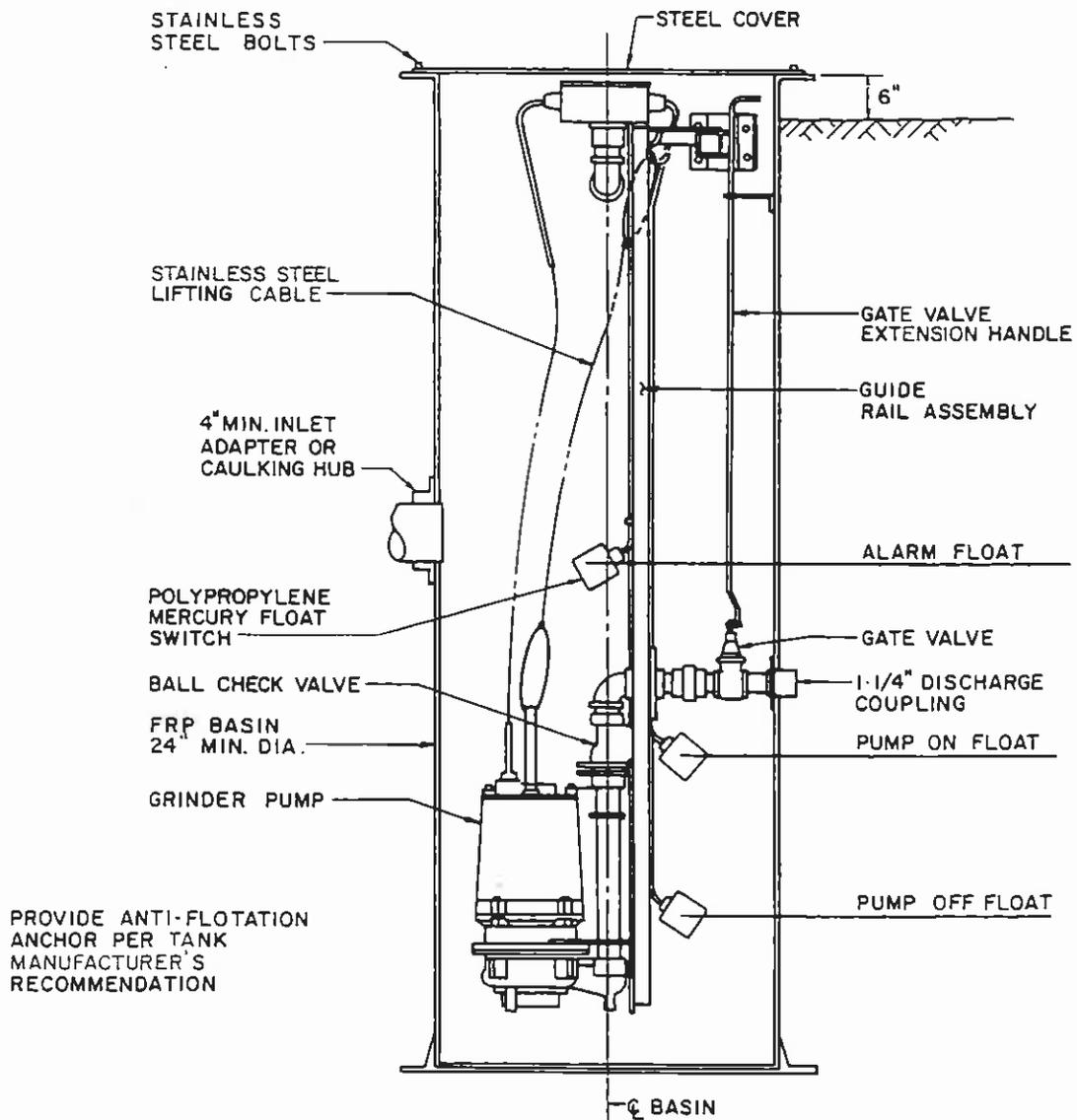
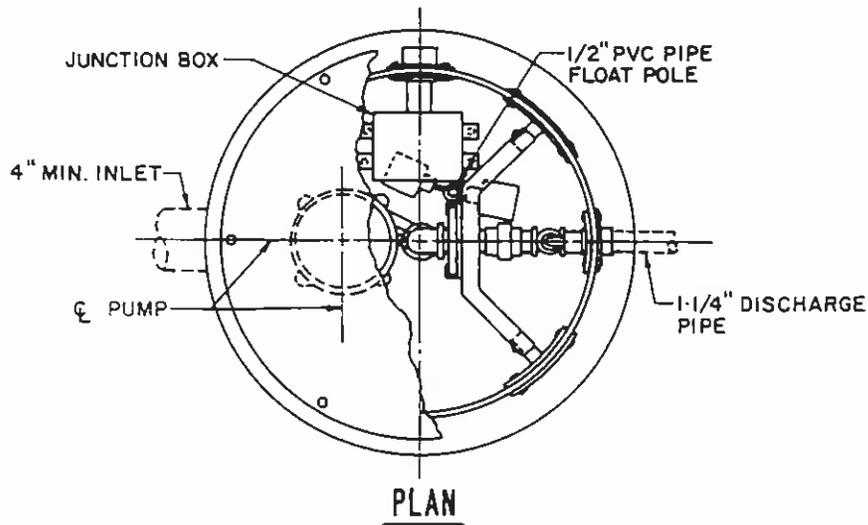
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1. Connect 120V temporary power source to the alarm circuit at the control panel.
  2. Fill the tank with sufficient water to test the high level audible and visual alarms at the control panel.
  3. Connect 240V temporary power source to the power circuit at the control panel and run the unit through a minimum of three operation cycles to check pump operation and shut-off.
  4. If the demonstrations are satisfactory to the Engineer, the test will be considered concluded. If deficiencies are found, they shall be corrected as follows and the test repeated until the Engineer determines that the unit has performed satisfactorily.
    - a. Unit manufacturer to correct pump, internal piping and control panel deficiencies.
    - b. Installer shall correct installation deficiencies.
- C. Watertightness Test, Fiberglass Tank: Perform both an exfiltration and an infiltration test of each unit in the Project.
1. Fill the completely installed units above the highest tank wall penetration (including electrical) with clear water. Allow a one hour stabilization period and then commence a three consecutive day exfiltration test.
  2. Measure and record the water level, with the Engineer observing, both at the beginning and end of the test period.
  3. An acceptable exfiltration test will be when no water leakage in the closed unit is detectable by the measurements.
  4. Conduct an infiltration test of the completely installed units over a three consecutive day time period with the Engineer observing.
  5. An acceptable infiltration test will be when no water enters the closed unit.
- D. Perform precast manhole test as specified in Section 02601.
- E. Electrical Systems Test: Unless waived in writing by the Engineer, perform tests and trials in the presence of a duly authorized representative of the Engineer. When the presence of such representative is so waived, furnish to the Engineer sworn statements, in duplicate, of the tests made and the results thereof.
1. Inspection: Have the work inspected by an authorized inspection agency, and such other agencies having jurisdiction, for compliance with National Electrical Code and obtain certificates of approval, acceptance, and compliance with code regulations. Work shall not be deemed complete until such certifications have been delivered to the Owner.
  2. Testing: Test materials, supplies and parts and assemblies thereof, entering into the Work, in conformity with the best currently approved method for the particular type and class of work.
    - a. Render the entire installation free from short circuits and improper grounds. Test feeders cable disconnected from the power source. Then test the entire power circuit and the panel with the pumping equipment operating. In no case, shall the insulation resistance be less than one hundred thousand ohms.

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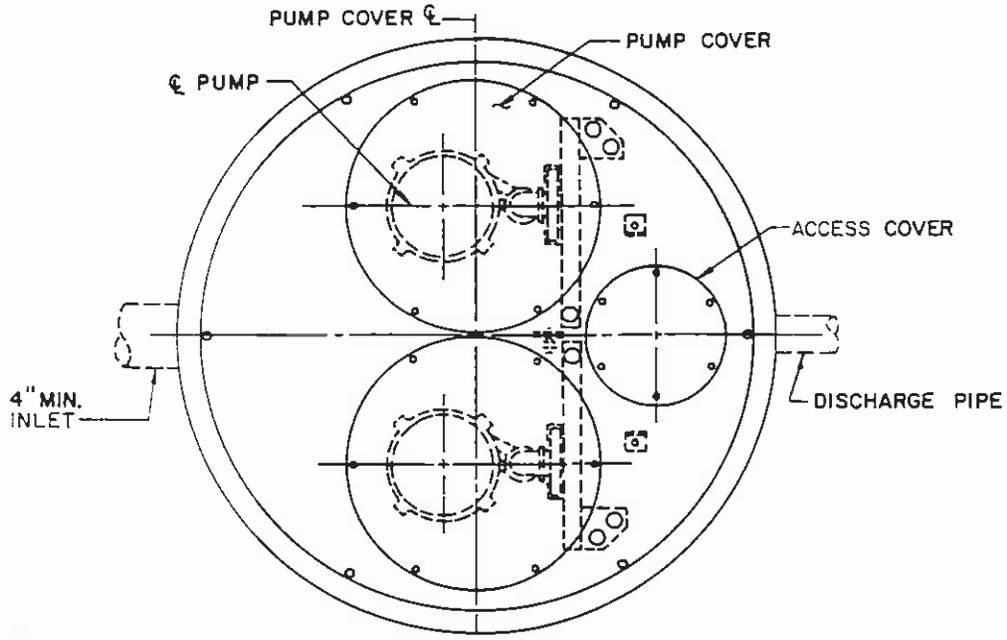
- b. Perform initial electrical system tests using meggers, ammeters, voltmeters, insulation resistance testers, and high-pot testers prior to placing electrical systems into complete operation.
  - 1) Use meggers with an adjustable 2.5/5.0 KV range which will permit reading of 0.05 to 100,000 Megohms. The minimum testing voltage obtained by adding 1000 volts to twice the rated voltage of the cable, device, apparatus or equipment. In no case shall the insulation resistance be less than one Megohm. However, the recommended insulation resistance measurements of each test shall conform to IEEE and ANSI Standards.
- c. Correct failures in a manner satisfactory to the Engineer or his authorized representative.

END OF SECTION

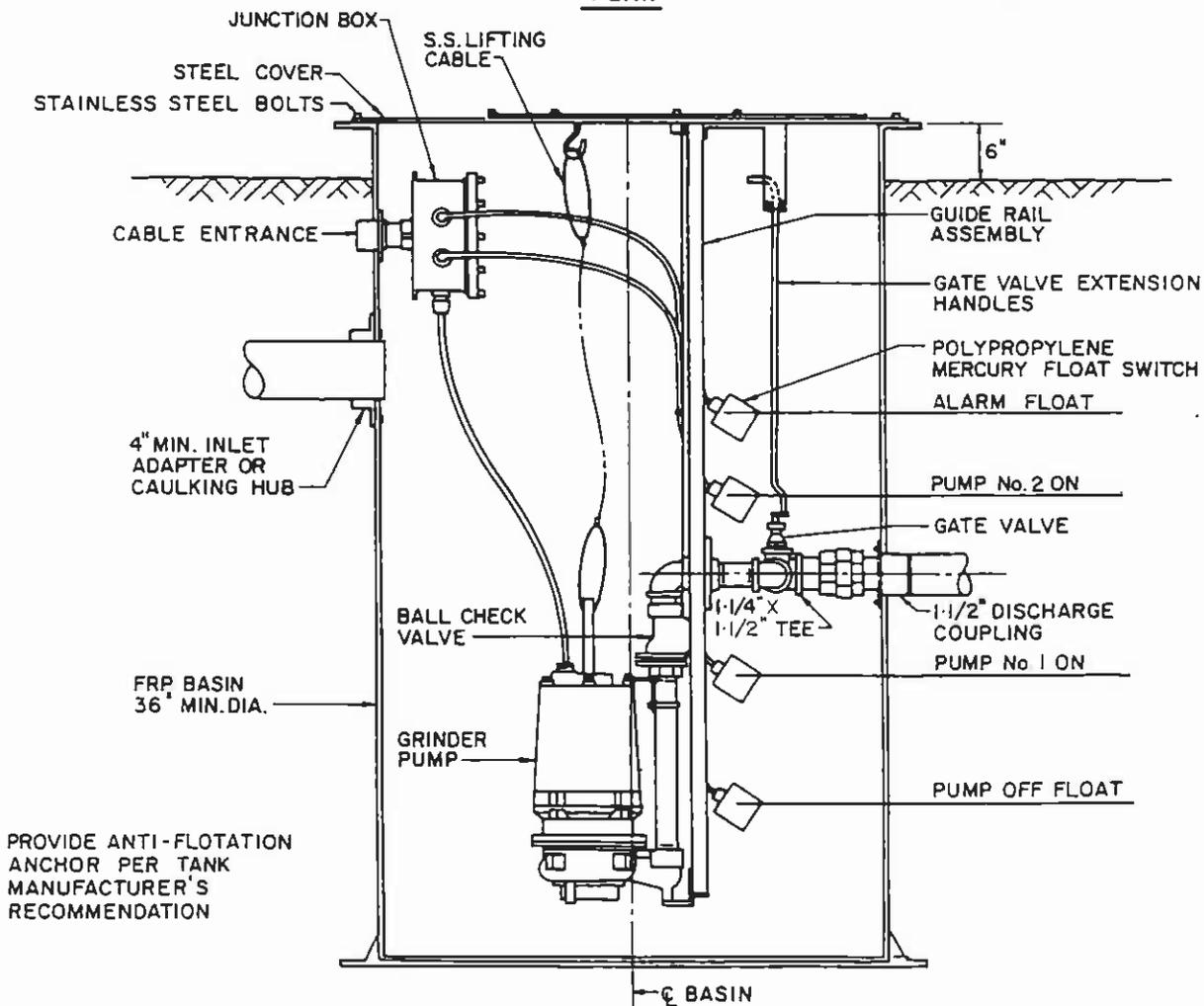


**SIMPLEX GRINDER PUMP** 

GANNETT FLEMING



PLAN

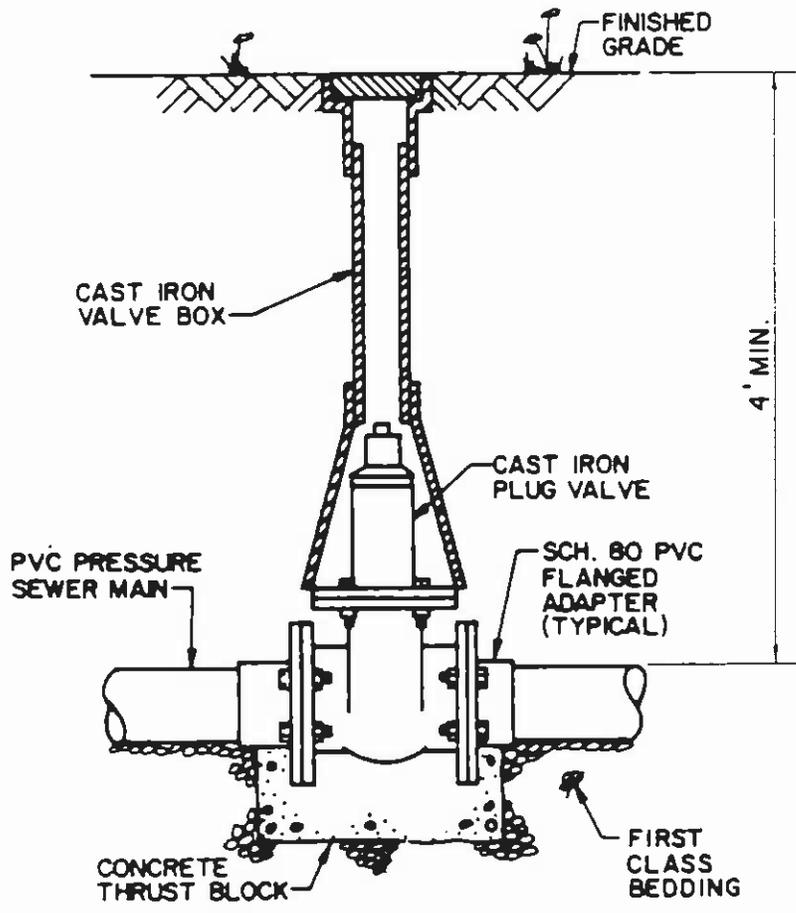


PROVIDE ANTI-FLOTATION ANCHOR PER TANK MANUFACTURER'S RECOMMENDATION

SECTIONAL ELEVATION

DUPLEX GRINDER PUMP

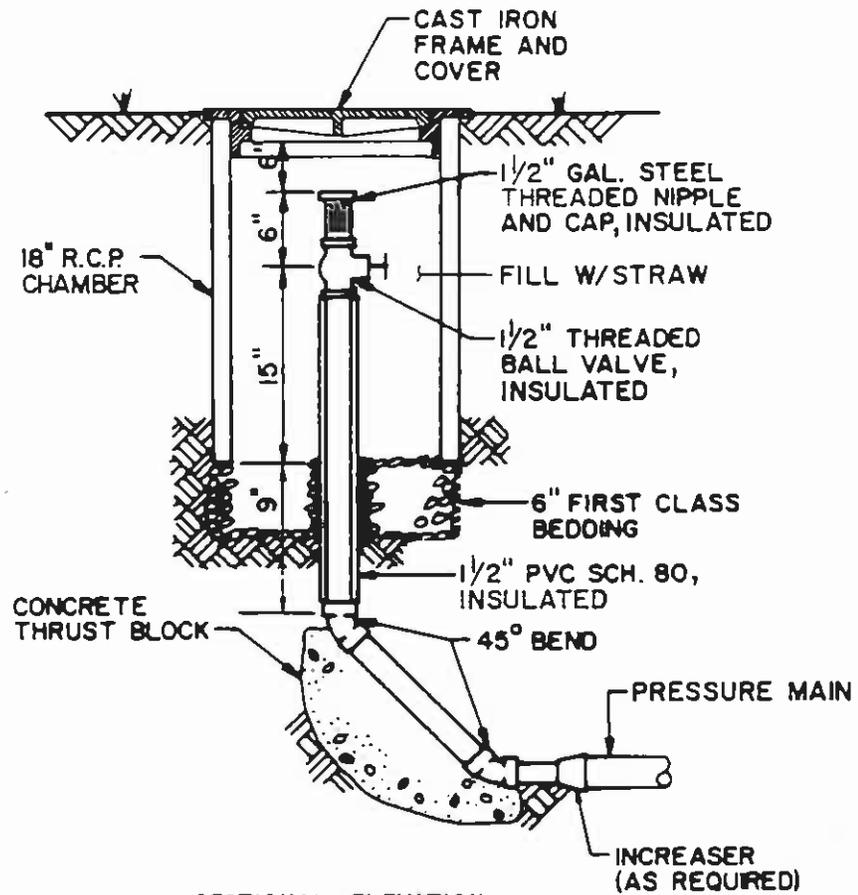




SECTIONAL ELEVATION

IN-LINE VALVE (V-3)

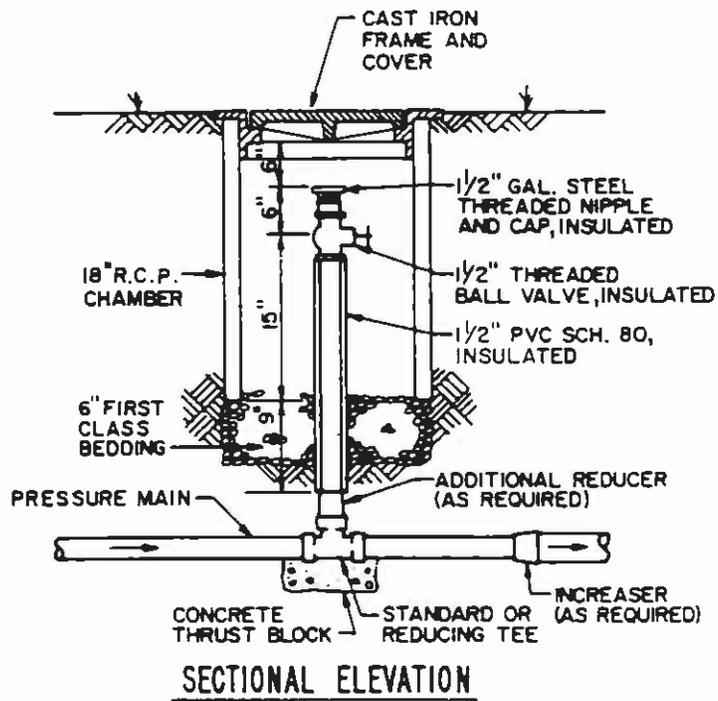
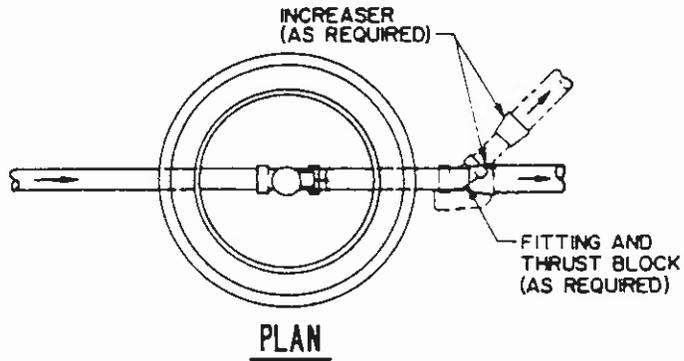
PRESSURE WASTEWATER SEWER



SECTIONAL ELEVATION

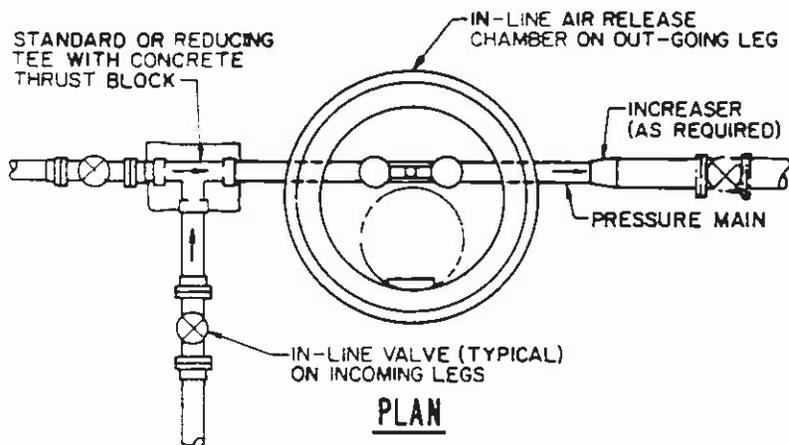
TERMINAL CLEANOUT (TC)

PRESSURE WASTEWATER SEWER

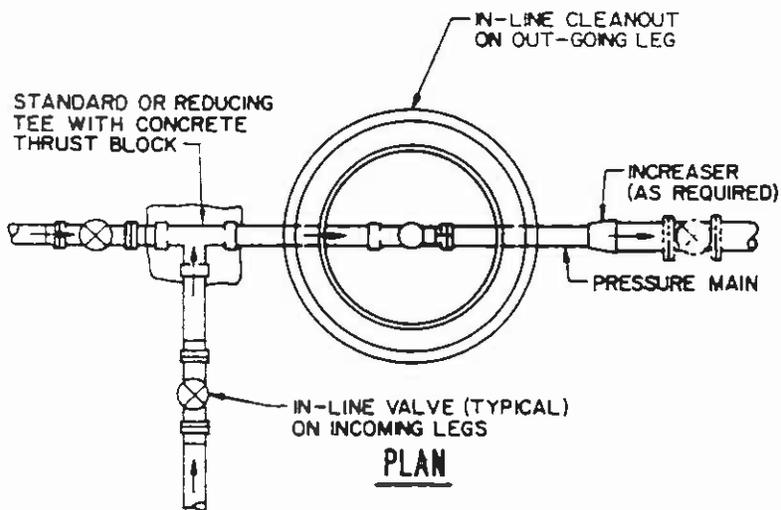


IN-LINE CLEANOUT (IC)

PRESSURE WASTEWATER SEWER



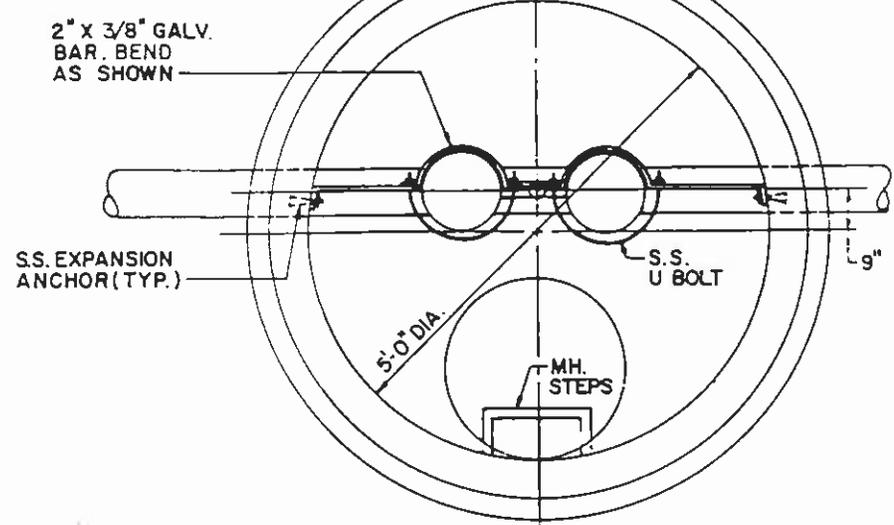
AIR RELEASE JUNCTION CHAMBER (AJ)



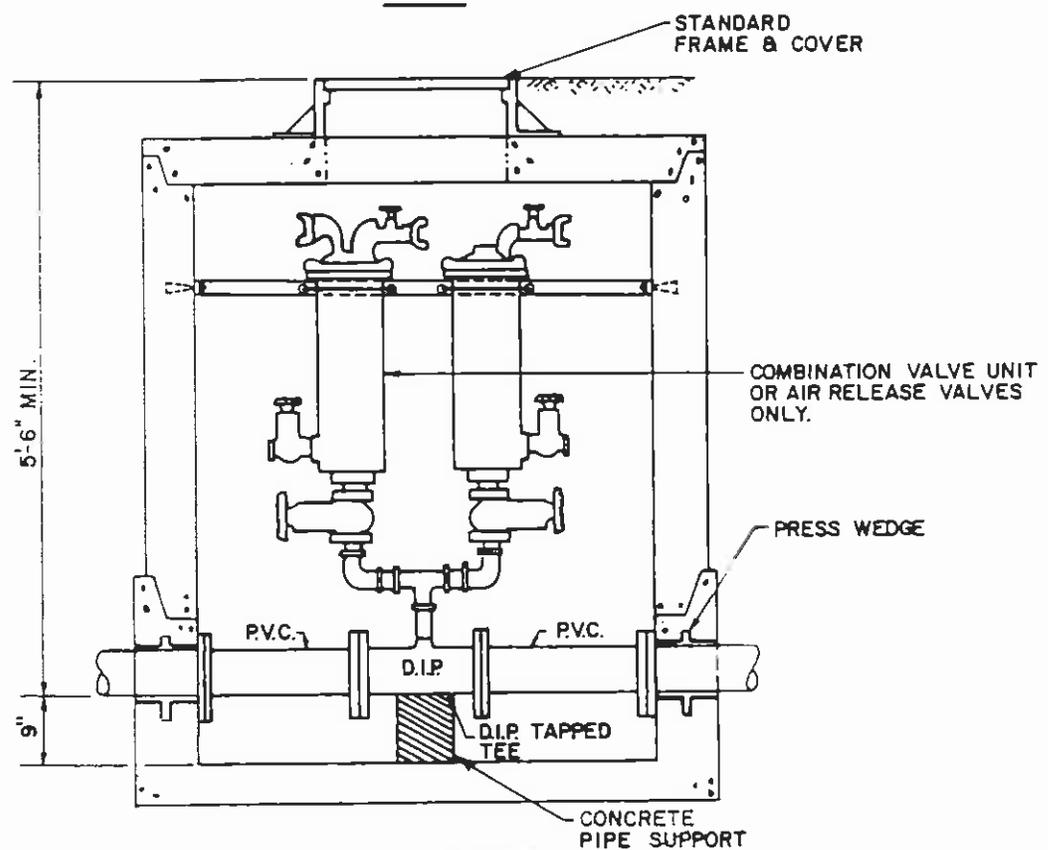
JUNCTION CLEANOUT (JC)

PRESSURE WASTEWATER SEWER

NOTE: FASTENING HARDWARE TO BE 304 STAINLESS STEEL.



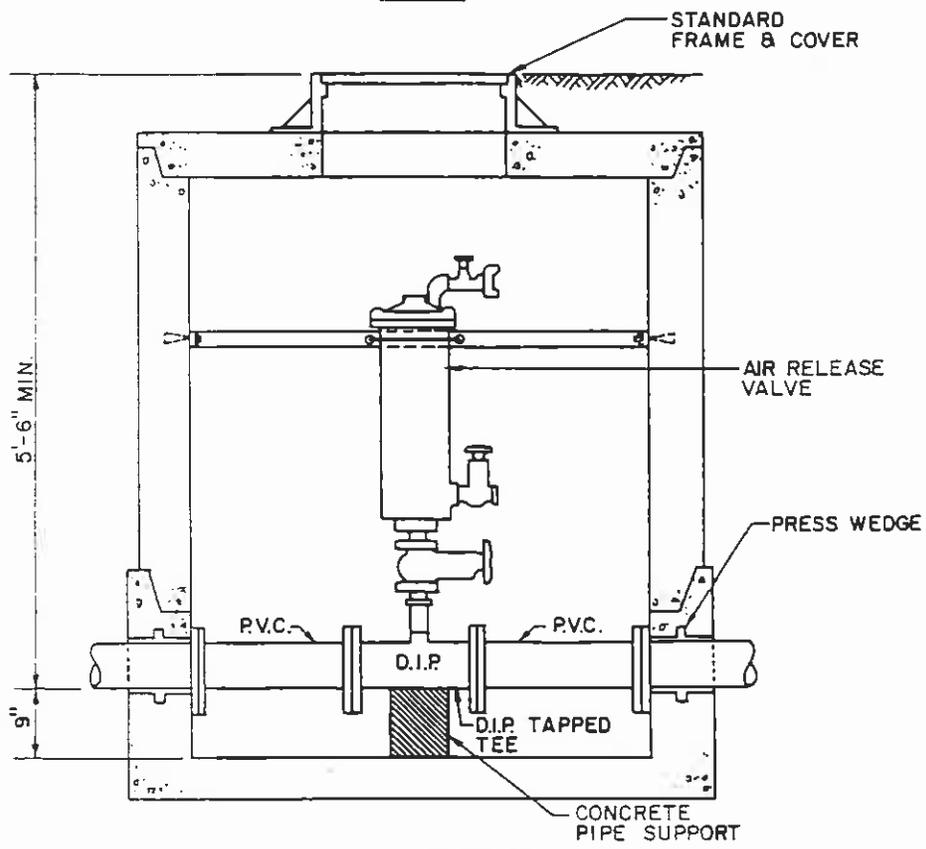
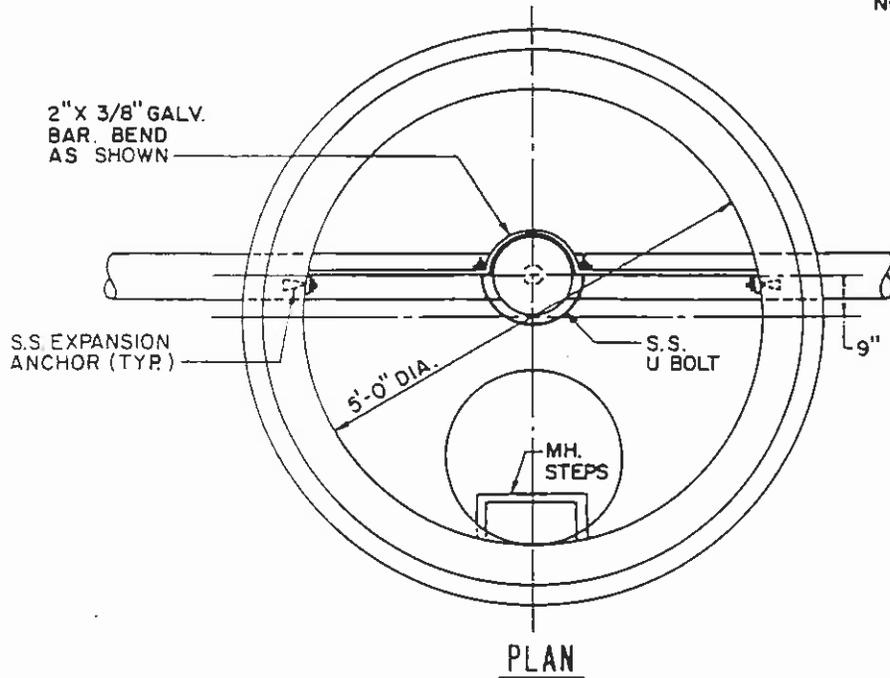
PLAN



SECTIONAL ELEVATION

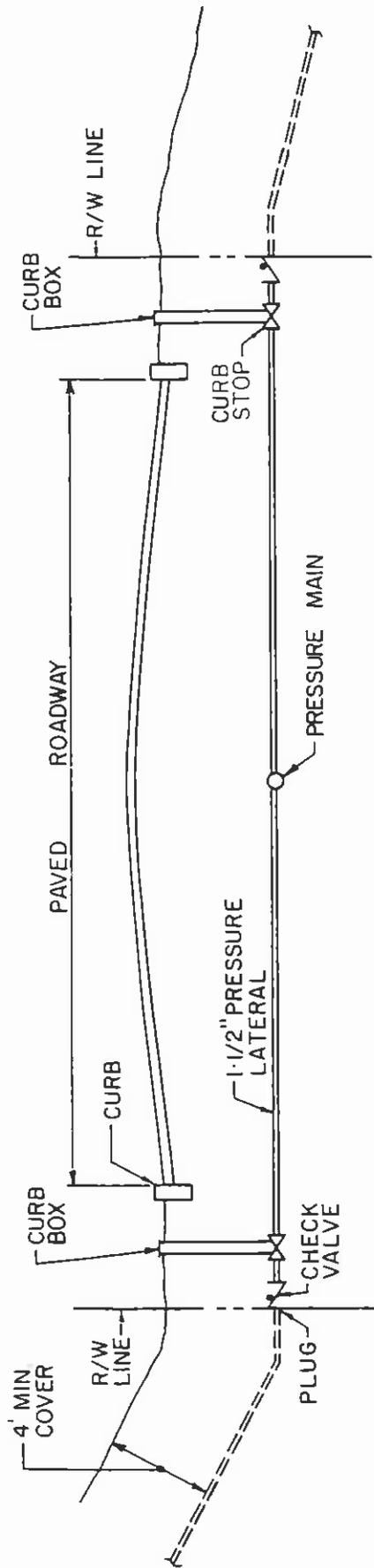
AIR RELEASE CHAMBER (AD)  
PRESSURE WASTEWATER SEWER

NOTE: FASTENING HARDWARE TO BE 304 STAINLESS STEEL.

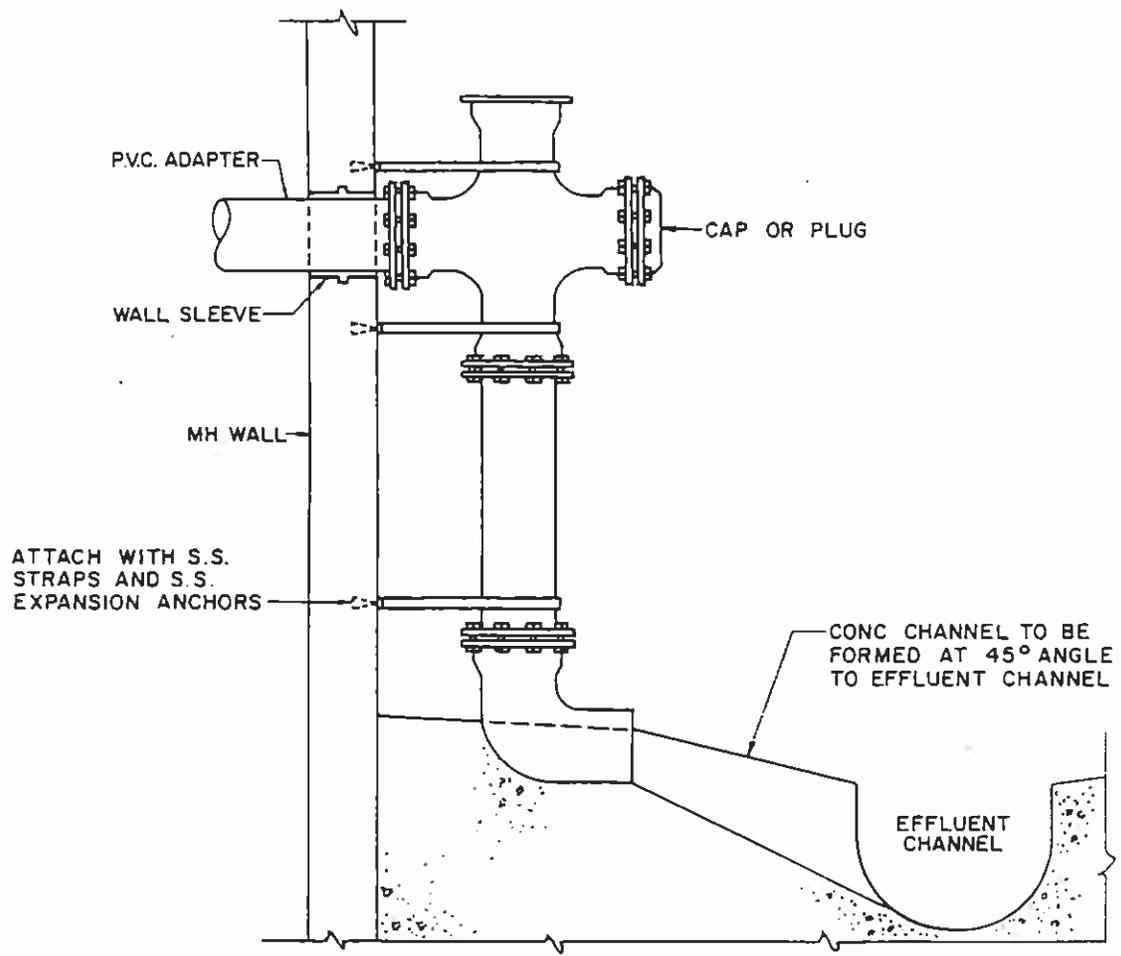


**AIR RELEASE CHAMBER** (AS)

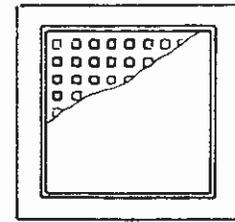
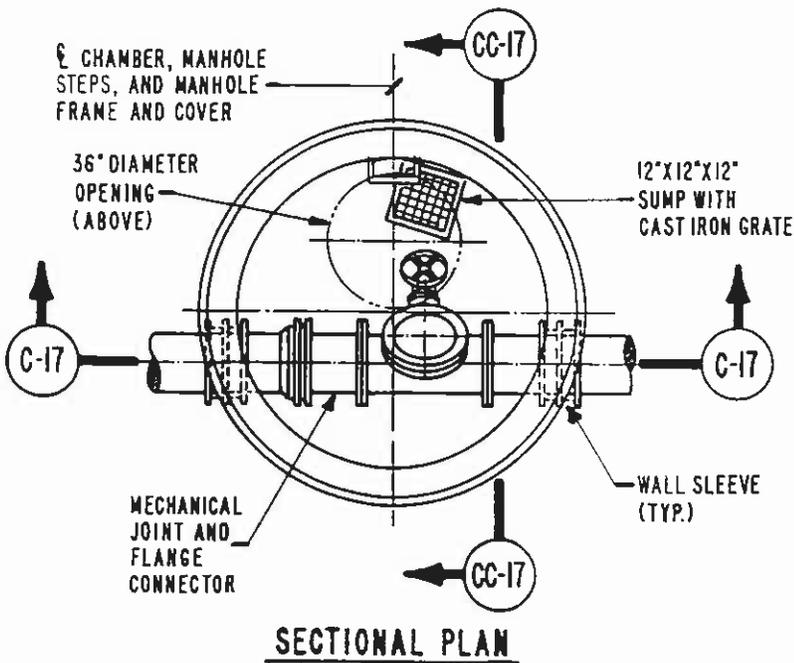
**PRESSURE WASTEWATER SEWER**



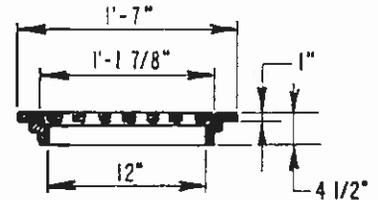
PRESSURE LATERAL (PL)



LOW PRESSURE  
DROP CONNECTION (DC)

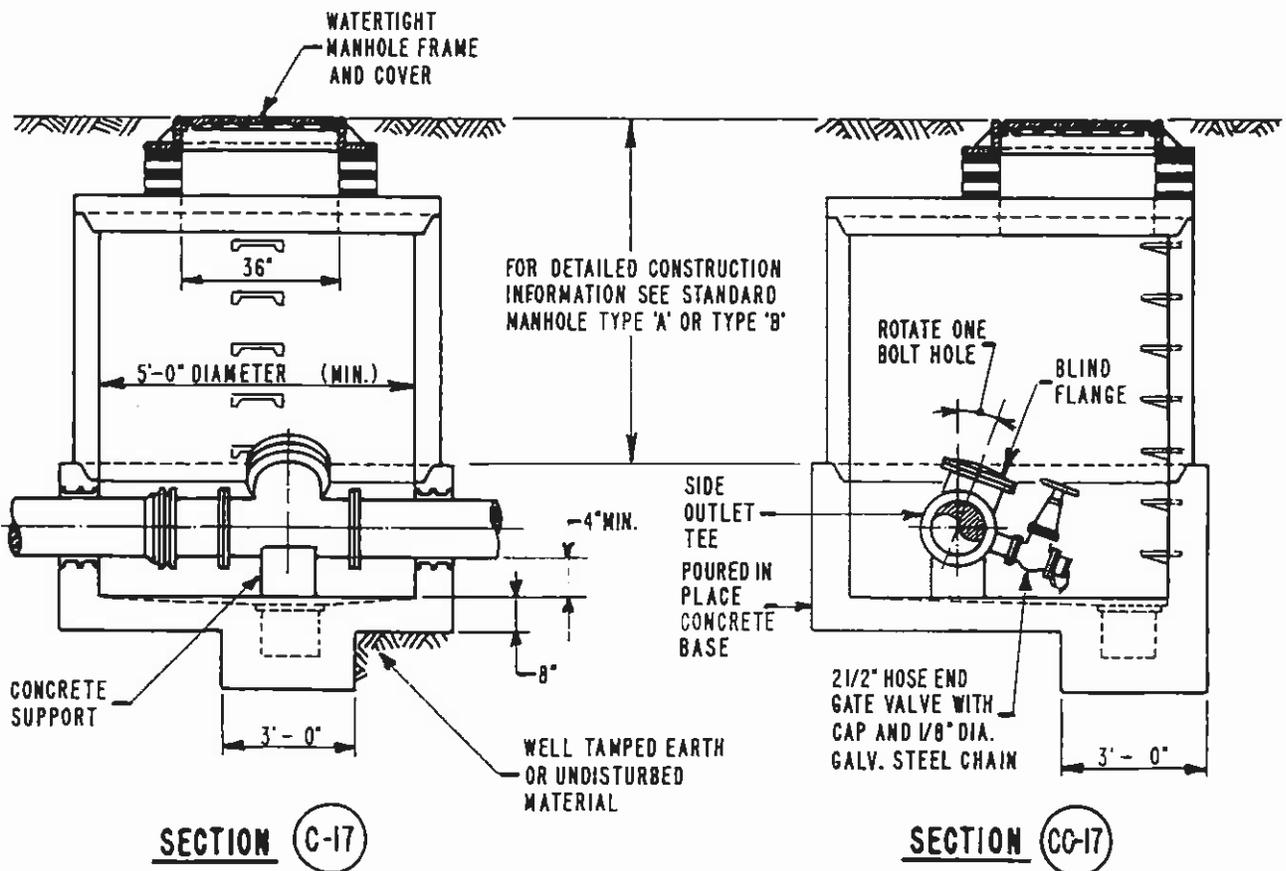


**PLAN**



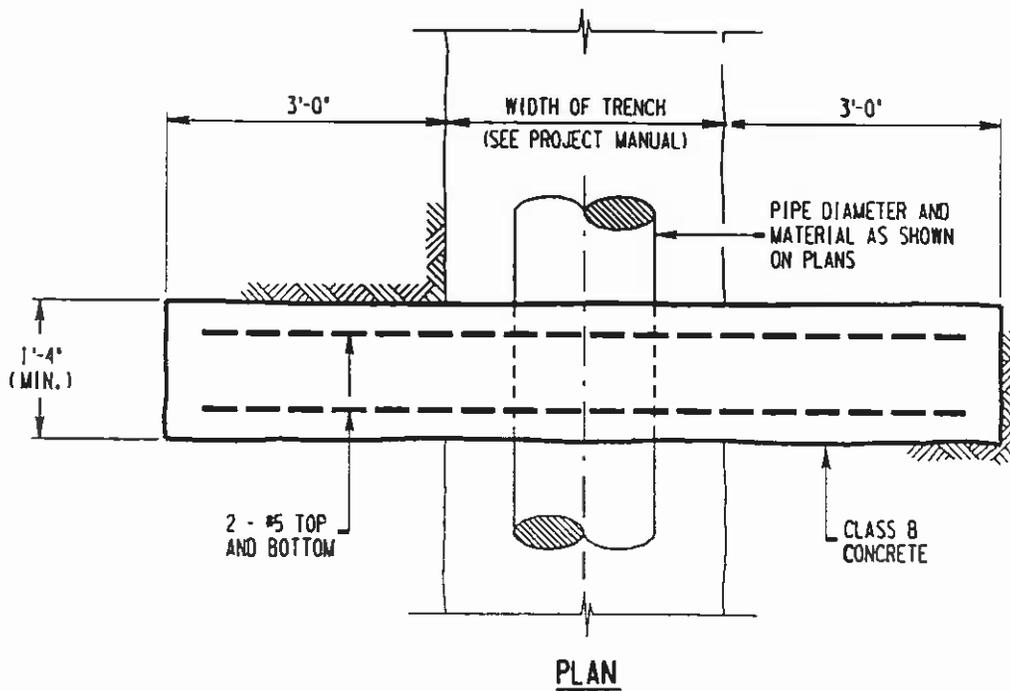
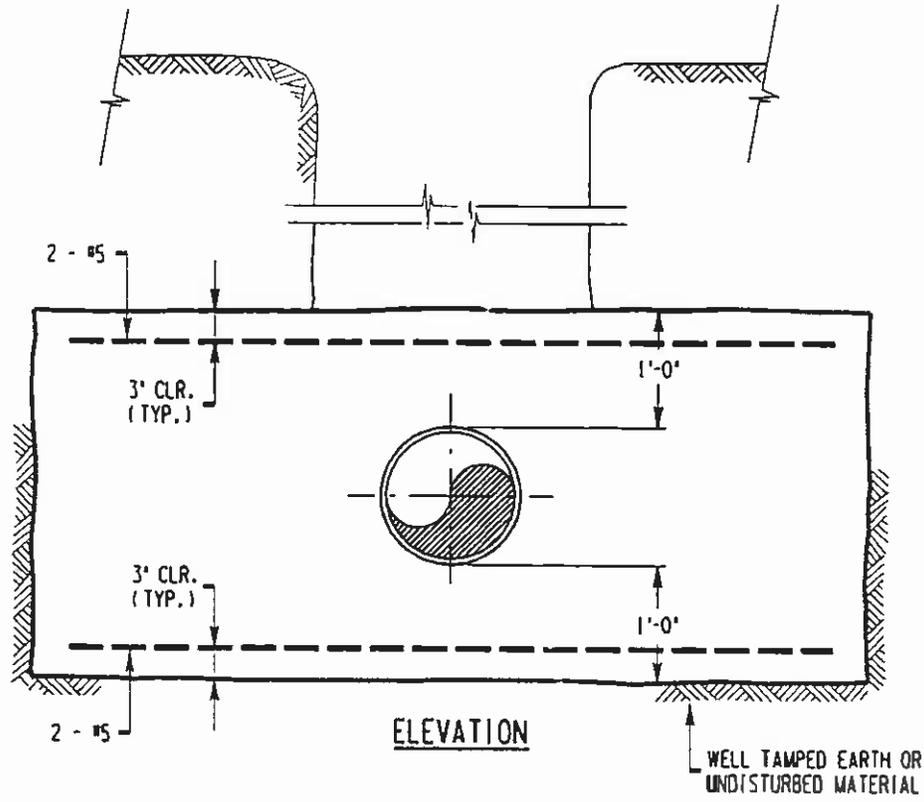
**SECTIONAL ELEVATION**

**SUMP FRAME AND GRATE**



**CLEANOUT CHAMBER**

GANNETT FLEMING



**CONCRETE ANCHOR**

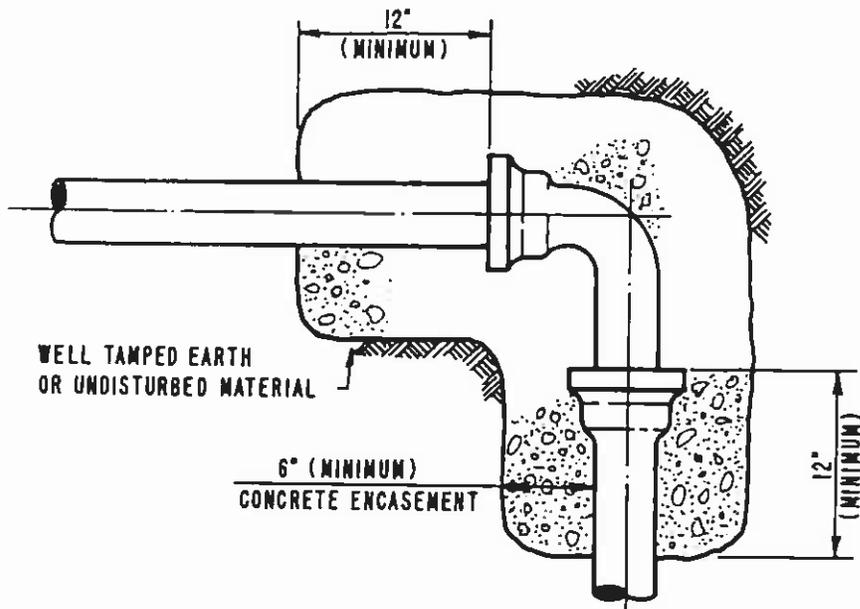


MISC3.dgn

MICRO-STATION

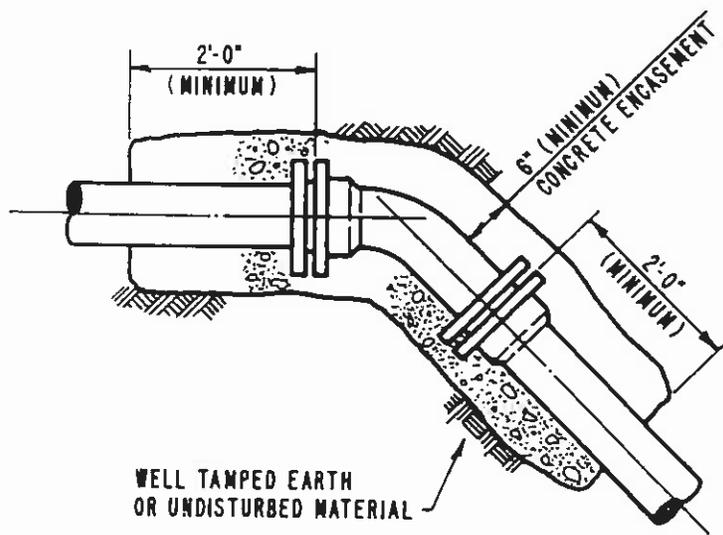
CONANC

GANNETT FLEMING



PLAN OR ELEVATION

TYPICAL GRAVITY LINE FITTINGS NOTED

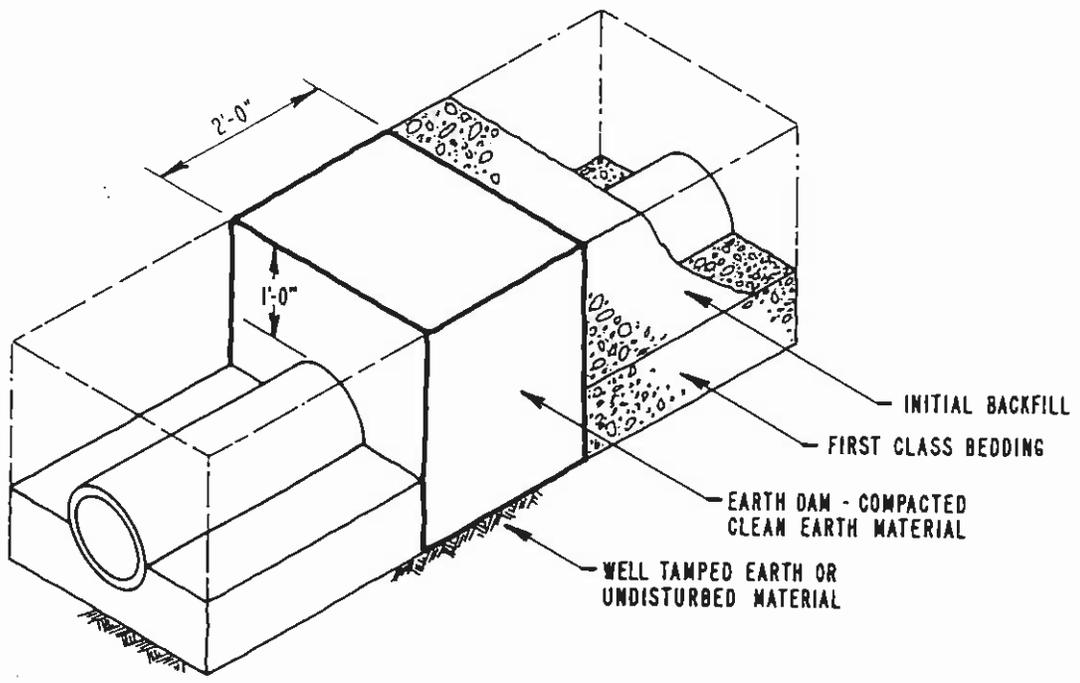


PLAN OR ELEVATION

TYPICAL ALL PRESSURE LINE FITTINGS

CONCRETE THRUST BLOCKS

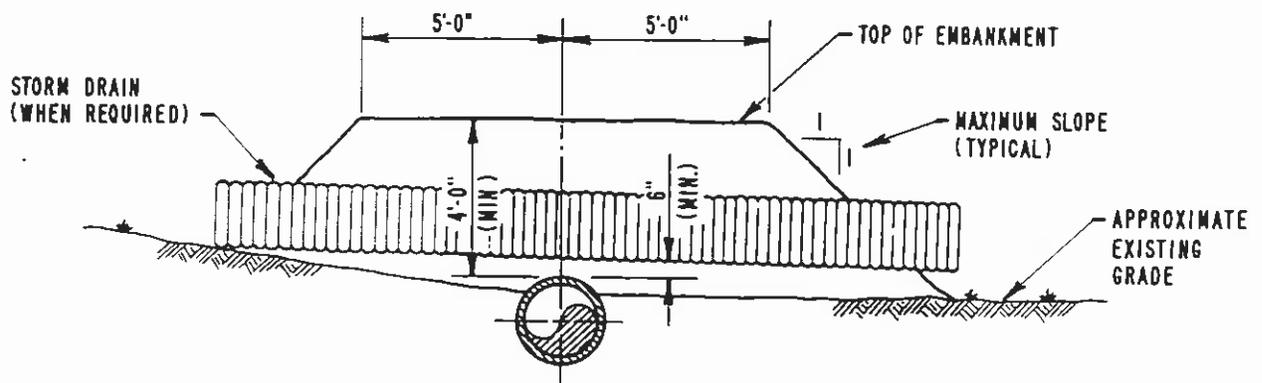




ISOMETRIC VIEW

EARTH DAM

(E-6)

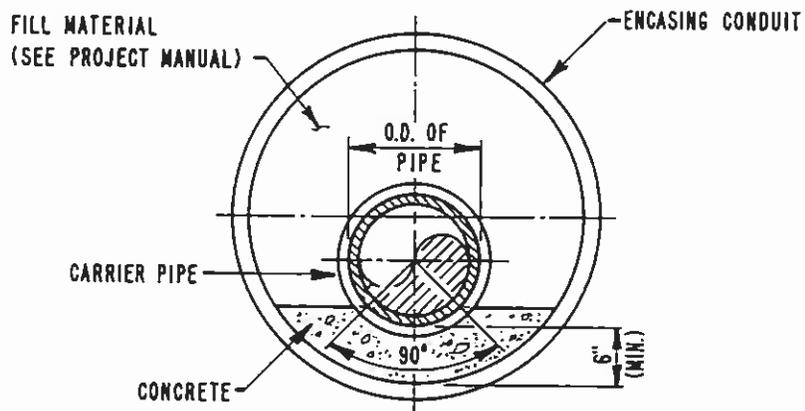


SECTIONAL ELEVATION

EMBANKMENT



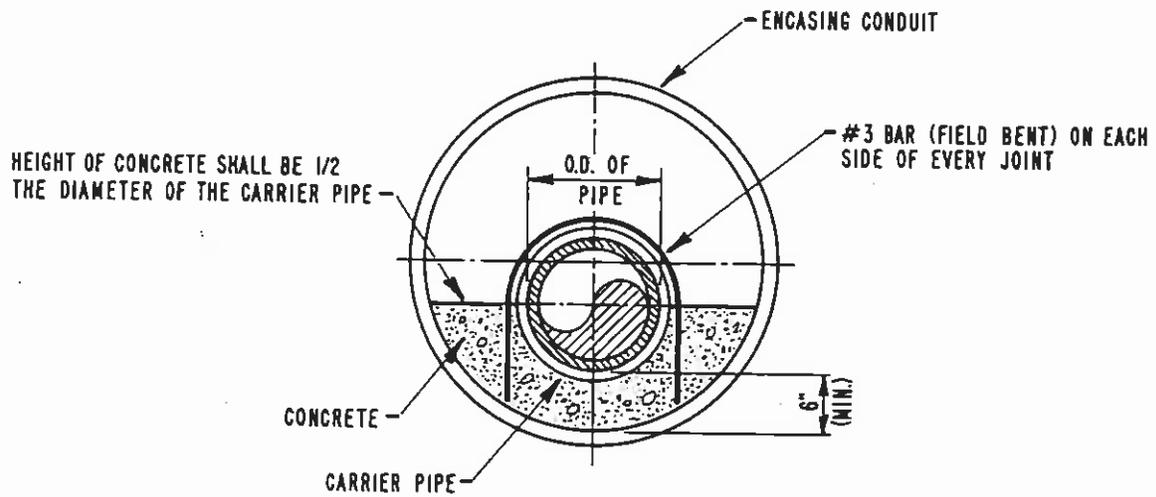
GANNETT FLEMING



SECTIONAL ELEVATION

ENCASING CONDUIT

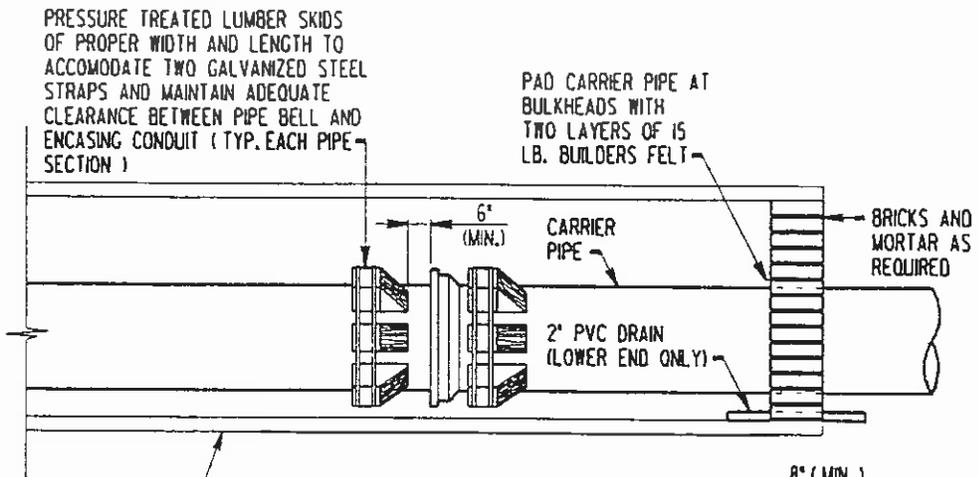




SECTIONAL ELEVATION

ENCASING CONDUIT  
(ANCHORED)

(E-9)



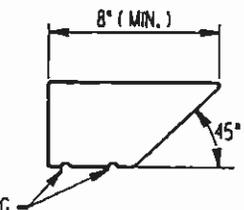
**SIDE ELEVATION**

ENCASING CONDUIT

**ENCASING CONDUIT NOTES**

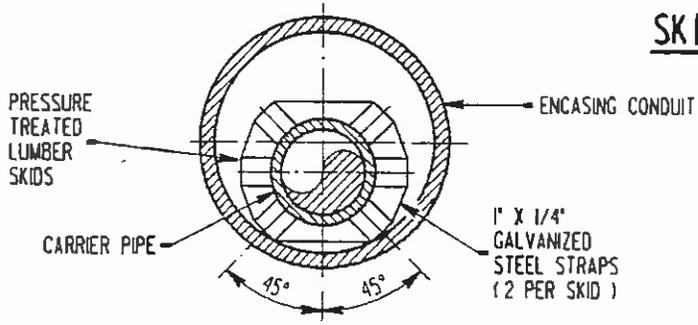
1. SKIDS TO BE LUBRICATED WITH GREASE TO FACILITATE INSTALLATION OF CARRIER PIPE.

2-1" WIDE NOTCHES FOR STEEL STRAPPING



**SIDE ELEVATION**

**SKID**



**FRONT ELEVATION**

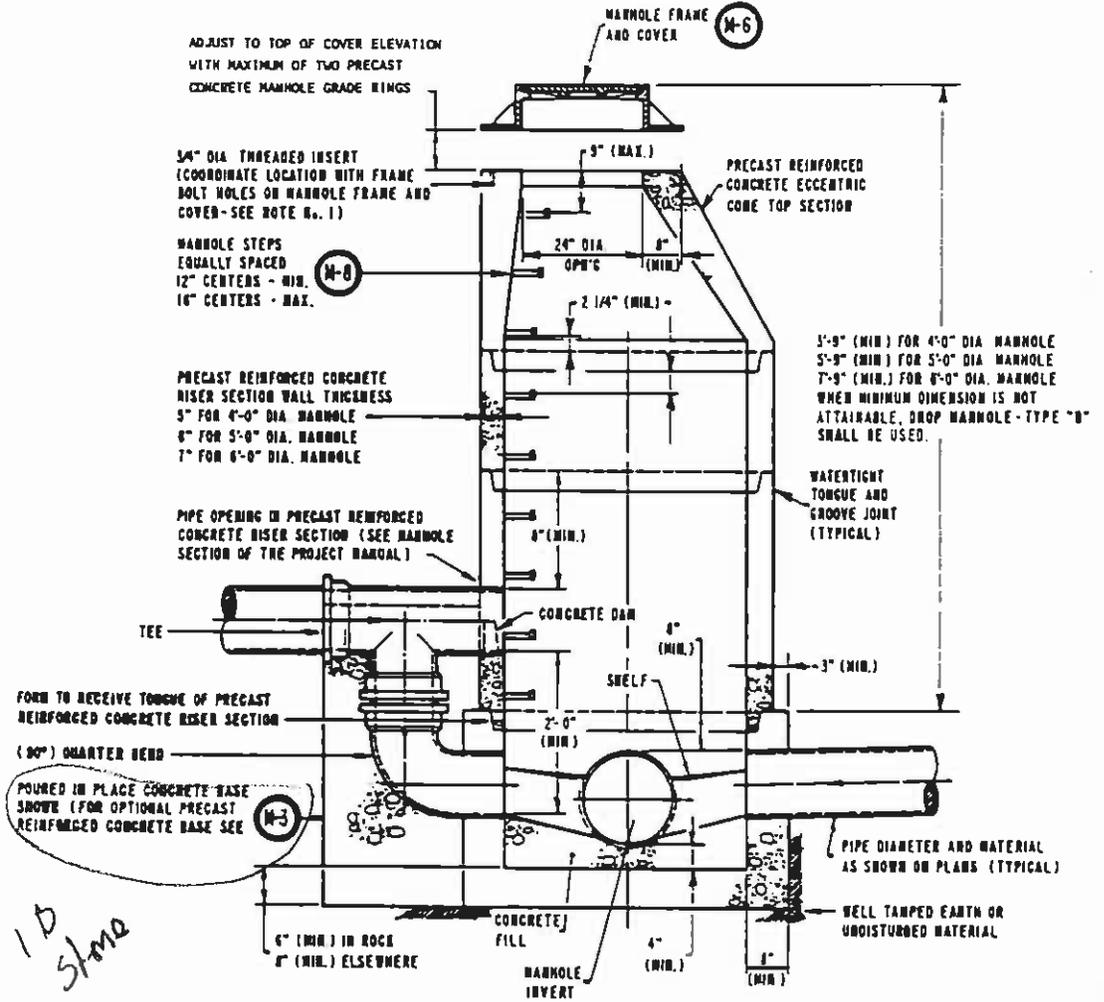
**ENCASING CONDUIT**  
( REMOVABLE CARRIER PIPE )



MISC2.dgn

MICRO-STATION

ECOND

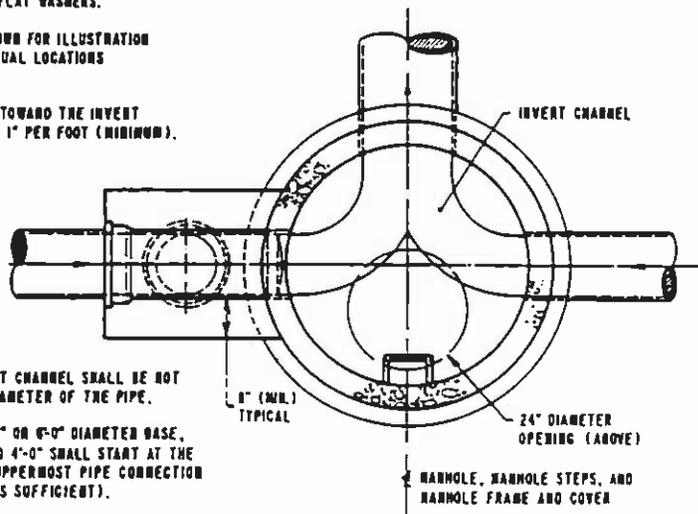


*1/8 slope*

**SECTIONAL ELEVATION**

**DROP MANHOLE - TYPE "A" NOTES**

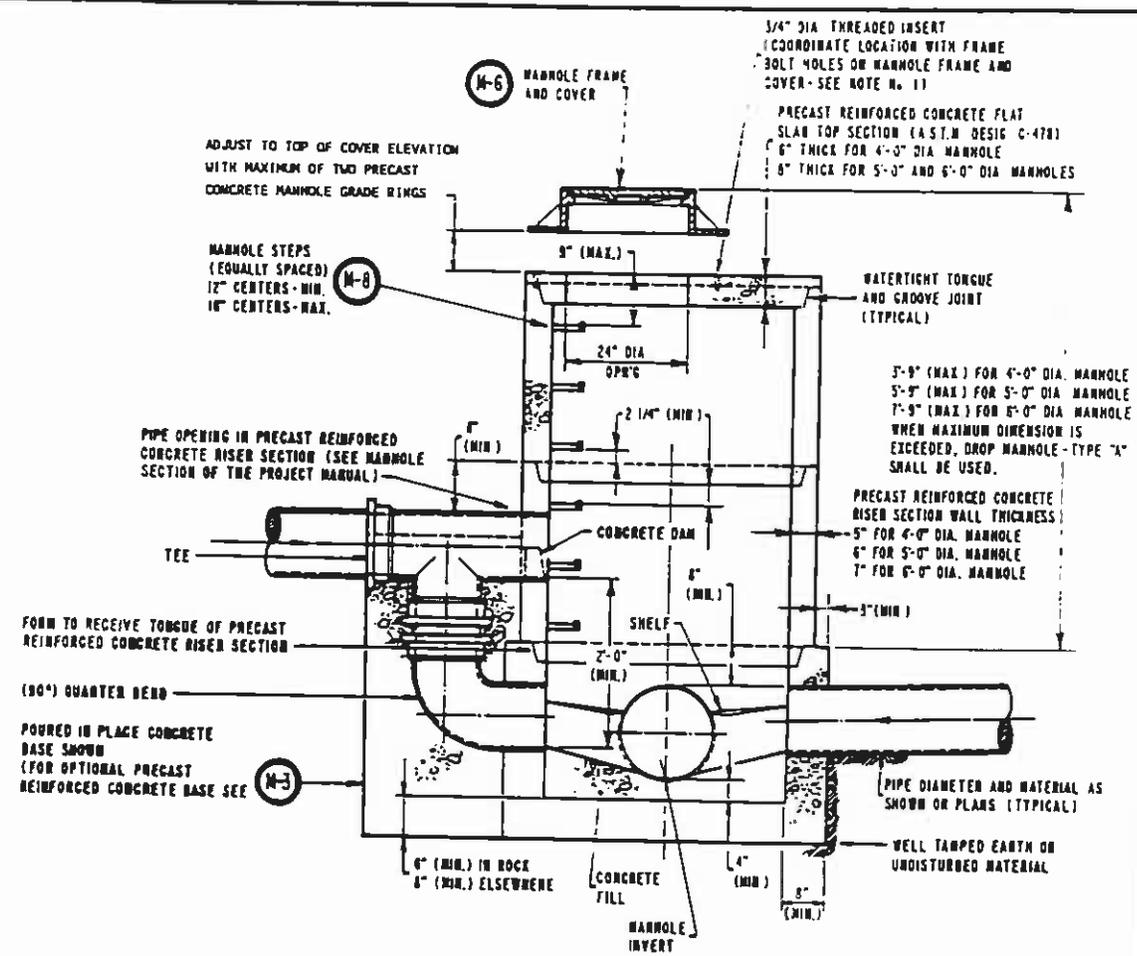
1. MANHOLE FRAME TO BE BOLTED IN PLACE WITH TWO 3/4" DIA. BOLTS AND FLAT WASHERS.
2. ORIENTATION OF PIPES SHOWN FOR ILLUSTRATION PURPOSES ONLY. FOR ACTUAL LOCATIONS SEE PLANS.
3. THE SHELF SHALL SLOPE TOWARD THE INVERT CHANNEL AT THE RATE OF 1" PER FOOT (MINIMUM).
4. FOR PIPE CONNECTION TO CONCRETE BASE, SEE MANHOLE SECTION OF THE PROJECT MANUAL.
5. FOR LENGTH OF PIPE CONNECTIONS TO MANHOLES, SEE MANHOLE SECTION OF THE PROJECT MANUAL.
6. THE DEPTH OF THE INVERT CHANNEL SHALL BE NOT LESS THAN 3/4 OF THE DIAMETER OF THE PIPE.
7. FOR MANHOLES HAVING 5'-0" OR 6'-0" DIAMETER BASE, REDUCTION IN DIAMETER TO 4'-0" SHALL START AT THE FIRST JOINT ABOVE THE UPPERMOST PIPE CONNECTION TO WALL (WHERE DEPTH IS SUFFICIENT).
8. FINISHED GRADE SHALL BE FLUSH WITH TOP OF COVER OR MANHOLE FRAME AND COVER, UNLESS OTHERWISE NOTED.



**PLAN BELOW  
ECCENTRIC CONE TOP SECTION**

**DROP MANHOLE - TYPE "A" M-1**

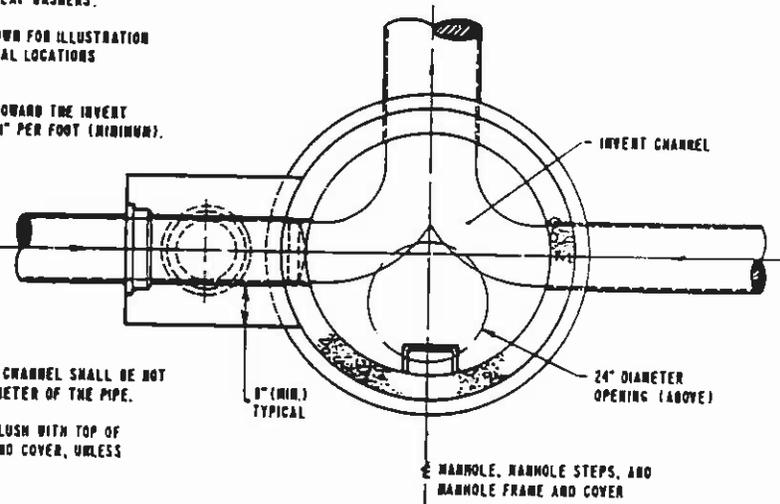
REV. APRIL 1982



**SECTIONAL ELEVATION**

**DROP MANHOLE - TYPE "B" NOTES**

1. MANHOLE FRAME TO BE BOLTED IN PLACE WITH TWO 3/4" DIA. BOLTS AND FLAT WASHERS.
2. ORIENTATION OF PIPES SHOWN FOR ILLUSTRATION PURPOSES ONLY. FOR ACTUAL LOCATIONS SEE PLANS.
3. THE SHELf SHALL SLOPE TOWARD THE INVERT CHANNEL AT THE RATE OF 1" PER FOOT (MINIMUM).
4. FOR PIPE CONNECTION TO CONCRETE BASE, SEE MANHOLE SECTION OF THE PROJECT MANUAL.
5. FOR LENGTH OF PIPE CONNECTIONS TO MANHOLES, SEE MANHOLE SECTION OF THE PROJECT MANUAL.
6. THE DEPTH OF THE INVERT CHANNEL SHALL BE NOT LESS THAN 3/4 OF THE DIAMETER OF THE PIPE.
7. FINISHED GRADE SHALL BE FLUSH WITH TOP OF COVER OR MANHOLE FRAME AND COVER, UNLESS OTHERWISE NOTED.

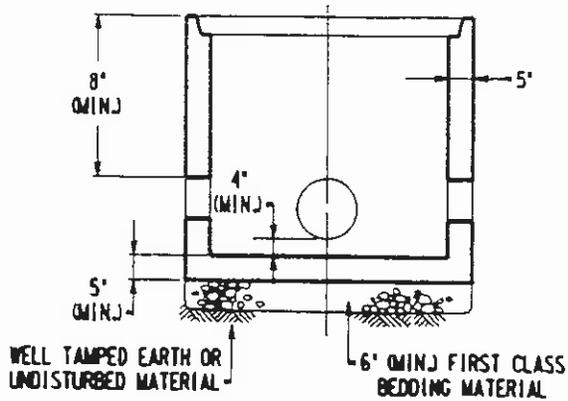


**PLAN BELOW FLAT SLAB TOP SECTION**

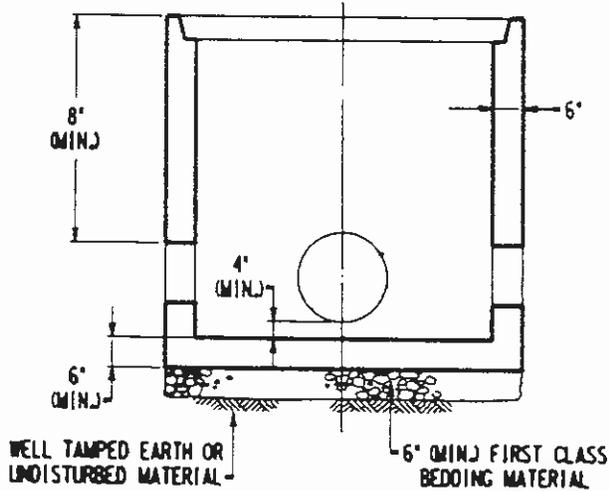
**DROP MANHOLE - TYPE "B" M-2**

01  
 Dwg. NO. A-27031A  
 GARRETT FLEMING

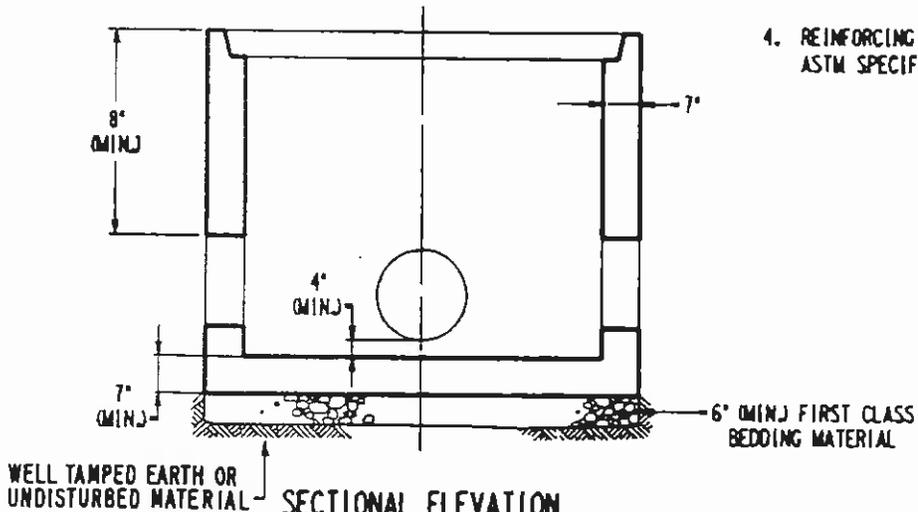




**SECTIONAL ELEVATION  
4'-0" DIAMETER**



**SECTIONAL ELEVATION  
5'-0" DIAMETER**



**SECTIONAL ELEVATION  
6'-0" DIAMETER**

**PRECAST REINFORCED CONCRETE  
MANHOLE BASE NOTES**

1. FOR PIPE OPENINGS THRU PRECAST REINFORCED CONCRETE MANHOLE WALLS, SEE MANHOLE SECTION OF THE PROJECT MANUAL.
2. ORIENTATION AND DIAMETER OF PIPE OPENINGS SHOWN FOR ILLUSTRATION PURPOSES ONLY. SEE PLANS FOR LOCATION AND DIAMETER.
3. PRECAST REINFORCED CONCRETE MANHOLE BASE TO CONFORM TO ASTM SPECIFICATION C-478.
4. REINFORCING STEEL TO CONFORM TO ASTM SPECIFICATION A-185.

MISC. 490

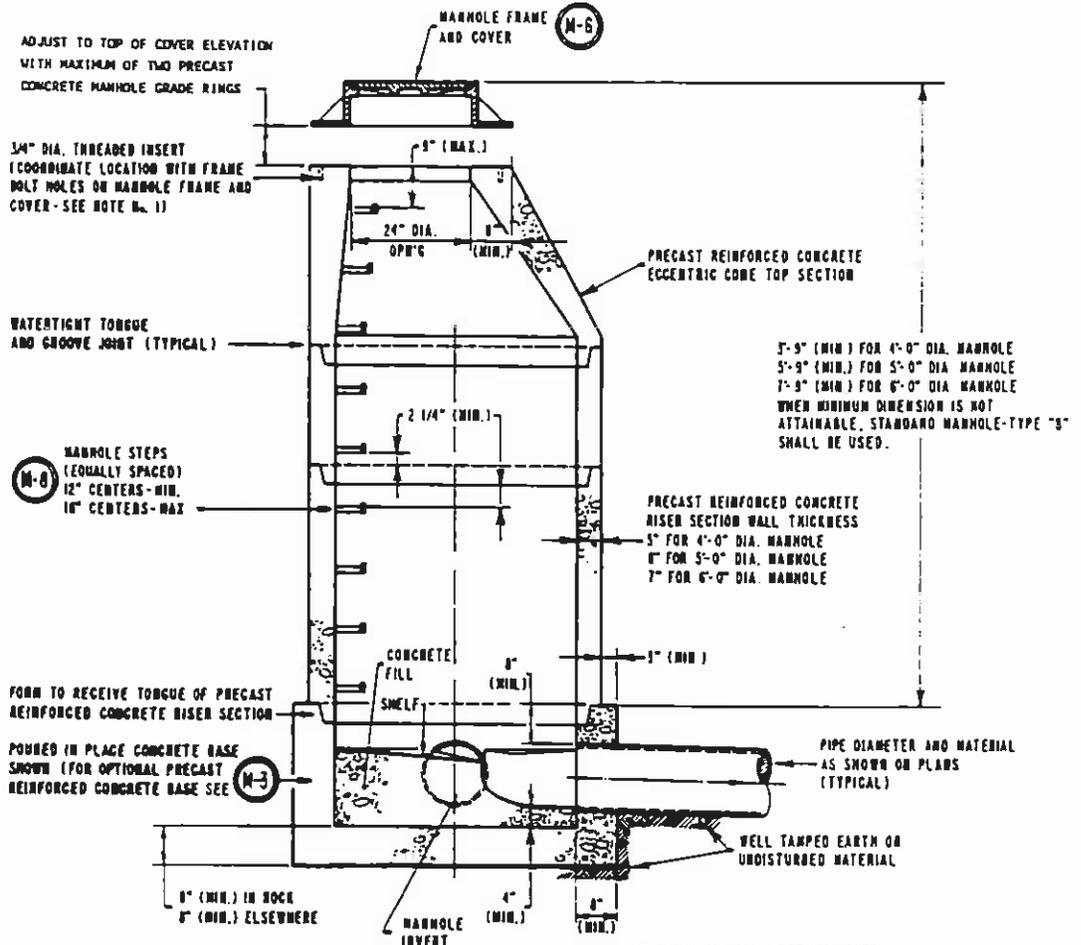
MICRO-STATION

PREMB

**PRECAST REINFORCED CONCRETE MANHOLE BASES**



GANNETT FLEMING



3'-9" (MIN.) FOR 4'-0" DIA. MANHOLE  
 5'-9" (MIN.) FOR 5'-0" DIA. MANHOLE  
 7'-9" (MIN.) FOR 6'-0" DIA. MANHOLE  
 WHEN MINIMUM DIMENSION IS NOT ATTAINABLE, STANDARD MANHOLE-TYPE "B" SHALL BE USED.

PRECAST REINFORCED CONCRETE RISER SECTION WALL THICKNESS  
 5" FOR 4'-0" DIA. MANHOLE  
 6" FOR 5'-0" DIA. MANHOLE  
 7" FOR 6'-0" DIA. MANHOLE

MANHOLE STEPS (EQUALLY SPACED)  
 12" CENTERS - MIN.  
 16" CENTERS - MAX

FORM TO RECEIVE TONGUE OF PRECAST REINFORCED CONCRETE RISER SECTION

POURED IN PLACE CONCRETE BASE SHOWN (FOR OPTIONAL PRECAST REINFORCED CONCRETE BASE SEE M-3)

PIPE DIAMETER AND MATERIAL AS SHOWN ON PLANS (TYPICAL)

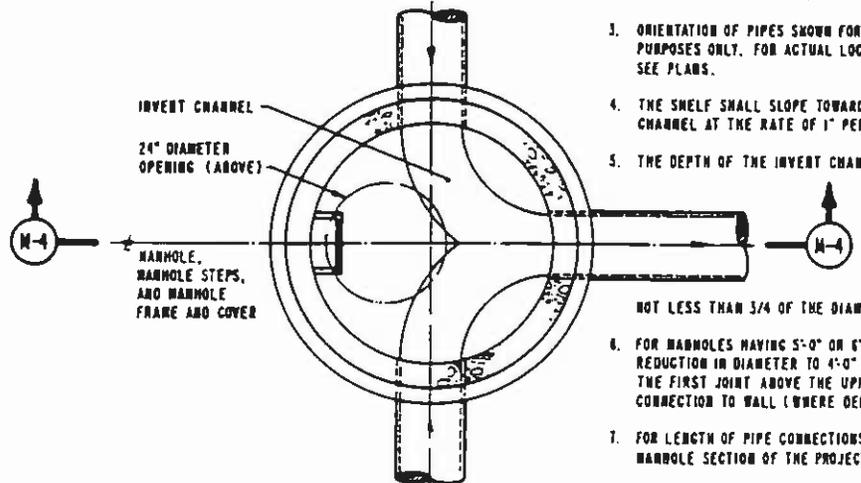
8" (MIN.) IN ROCK  
 6" (MIN.) ELSEWHERE

WELL TAMPED EARTH OR UNDISTURBED MATERIAL

SECTION M-4

STANDARD MANHOLE-TYPE "A" NOTES

1. MANHOLE FRAME TO BE BOLTED IN PLACE WITH TWO 3/4" DIA. BOLTS AND FLAT WASHERS.
2. FOR PIPE CONNECTION TO CONCRETE BASE, SEE MANHOLE SECTION OF THE PROJECT MANUAL.
3. ORIENTATION OF PIPES SHOWN FOR ILLUSTRATION PURPOSES ONLY. FOR ACTUAL LOCATIONS SEE PLANS.
4. THE SHELF SHALL SLOPE TOWARD THE INVERT CHANNEL AT THE RATE OF 1" PER FOOT (MINIMUM)
5. THE DEPTH OF THE INVERT CHANNEL SHALL BE



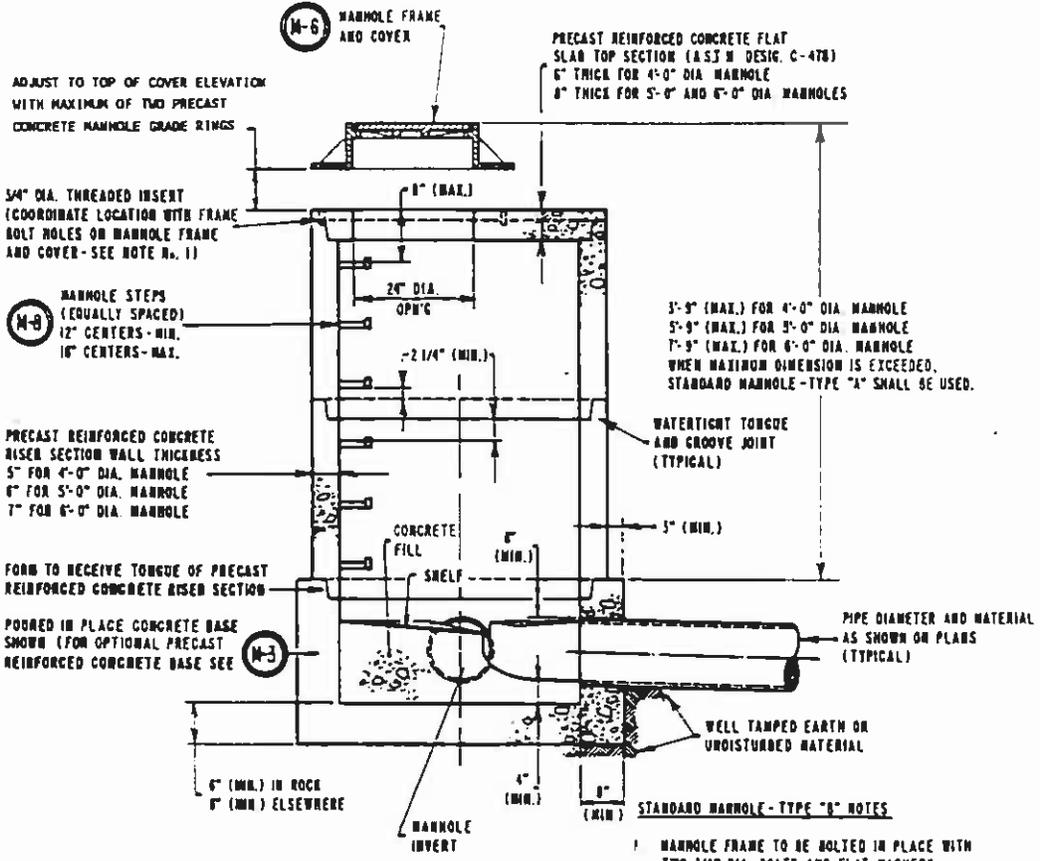
NOT LESS THAN 3/4 OF THE DIAMETER OF THE PIPE

6. FOR MANHOLES HAVING 5'-0" OR 6'-0" DIAMETER BASE, REDUCTION IN DIAMETER TO 4'-0" SHALL START AT THE FIRST JOINT ABOVE THE UPPERMOST PIPE CONNECTION TO WALL (WHERE DEPTH IS SUFFICIENT).
7. FOR LENGTH OF PIPE CONNECTIONS TO MANHOLES, SEE MANHOLE SECTION OF THE PROJECT MANUAL.
8. FINISHED GRADE SHALL BE FLUSH WITH TOP OF COVER OR MANHOLE FRAME AND COVER, UNLESS OTHERWISE NOTED

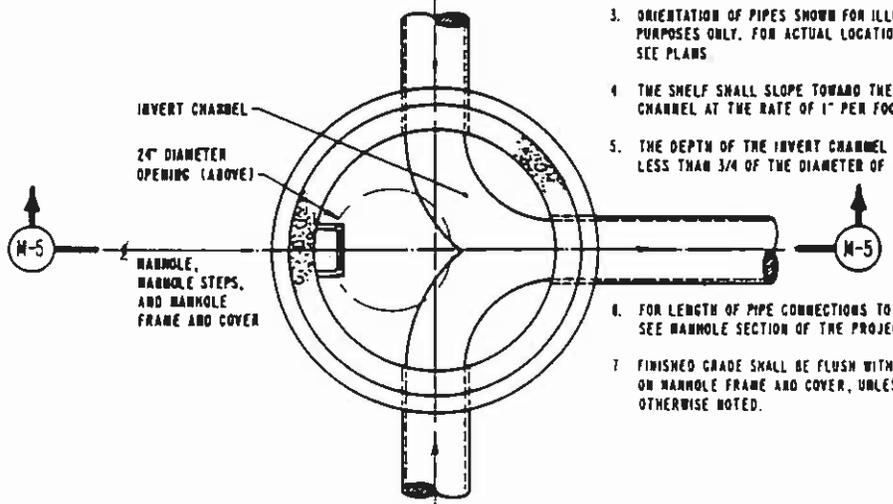
PLAN BELOW  
 ECCENTRIC CONE TOP SECTION

STANDARD MANHOLE - TYPE "A" M-4





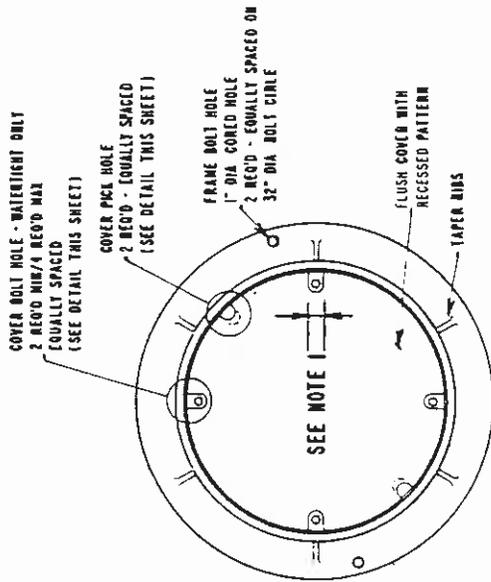
SECTION M-5



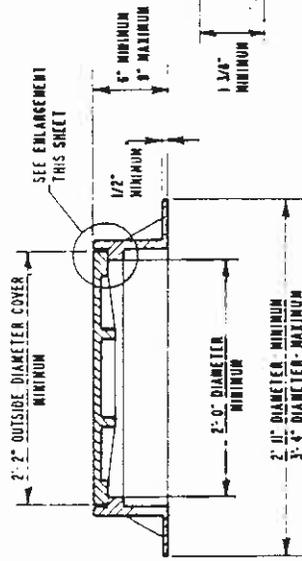
PLAN BELOW FLAT SLAB TOP SECTION

STANDARD MANHOLE - TYPE "B" M-5

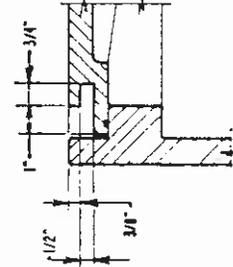
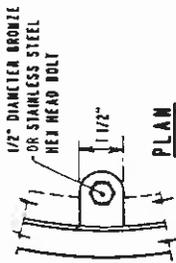
- STANDARD MANHOLE - TYPE "B" NOTES**
1. MANHOLE FRAME TO BE BOLTED IN PLACE WITH TWO 3/4" DIA BOLTS AND FLAT WASHERS
  2. FOR PIPE CONNECTION TO CONCRETE BASE, SEE MANHOLE SECTION OF THE PROJECT MANUAL.
  3. ORIENTATION OF PIPES SHOWN FOR ILLUSTRATION PURPOSES ONLY. FOR ACTUAL LOCATIONS SEE PLANS.
  4. THE SHELF SHALL SLOPE TOWARD THE INVERT CHANNEL AT THE RATE OF 1" PER FOOT (MINIMUM).
  5. THE DEPTH OF THE INVERT CHANNEL SHALL BE NOT LESS THAN 3/4 OF THE DIAMETER OF THE PIPE.
  6. FOR LENGTH OF PIPE CONNECTIONS TO MANHOLES, SEE MANHOLE SECTION OF THE PROJECT MANUAL.
  7. FINISHED GRADE SHALL BE FLUSH WITH TOP OF COVER ON MANHOLE FRAME AND COVER, UNLESS OTHERWISE NOTED.



**PLAN**



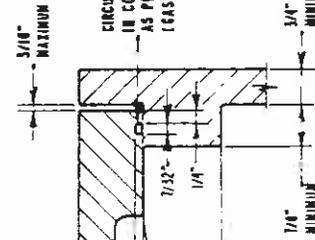
**SECTIONAL ELEVATION**



**SECTIONAL ELEVATION**

**COVER BOLT HOLE**

REQUIRED ONLY ON MANHOLES DESIGNATED  
TO HAVE "WATERTIGHT" COVERS

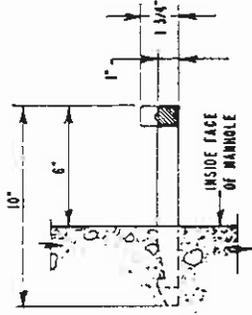
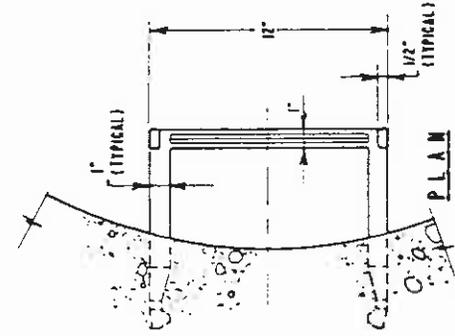


**ENLARGEMENT**

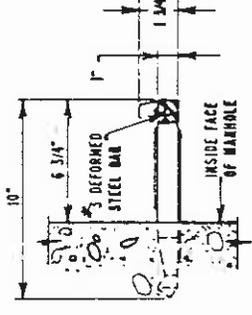
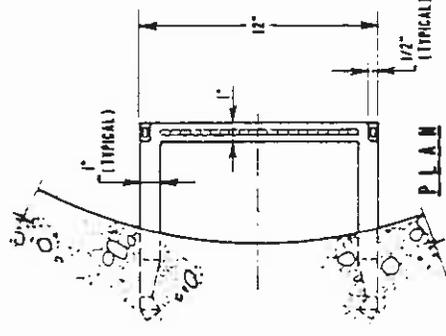
**COVER PICK HOLE**

- MANHOLE FRAME AND COVER HOLES**
1. SEE PROJECT MANUAL FOR LETTERING AND SIZE
  2. ALL MANHOLE FRAMES AND COVERS SHALL BE FOR HEAVY DUTY TRAFFIC, ASHTO HIGHWAY LOADING CLASS HS-20.

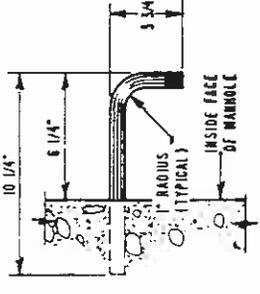
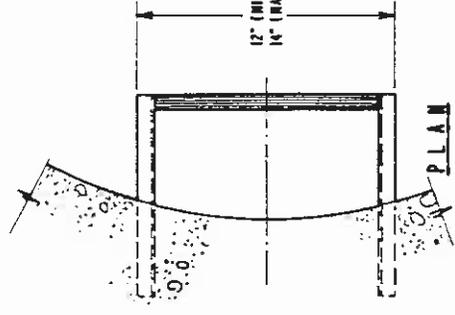
**STANDARD AND WATERTIGHT  
MANHOLE FRAME AND COVER**



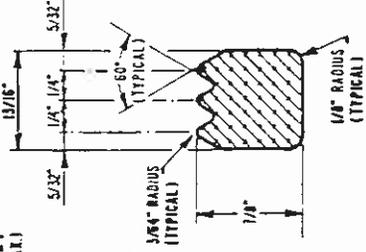
CAST IRON



REINFORCED PLASTIC



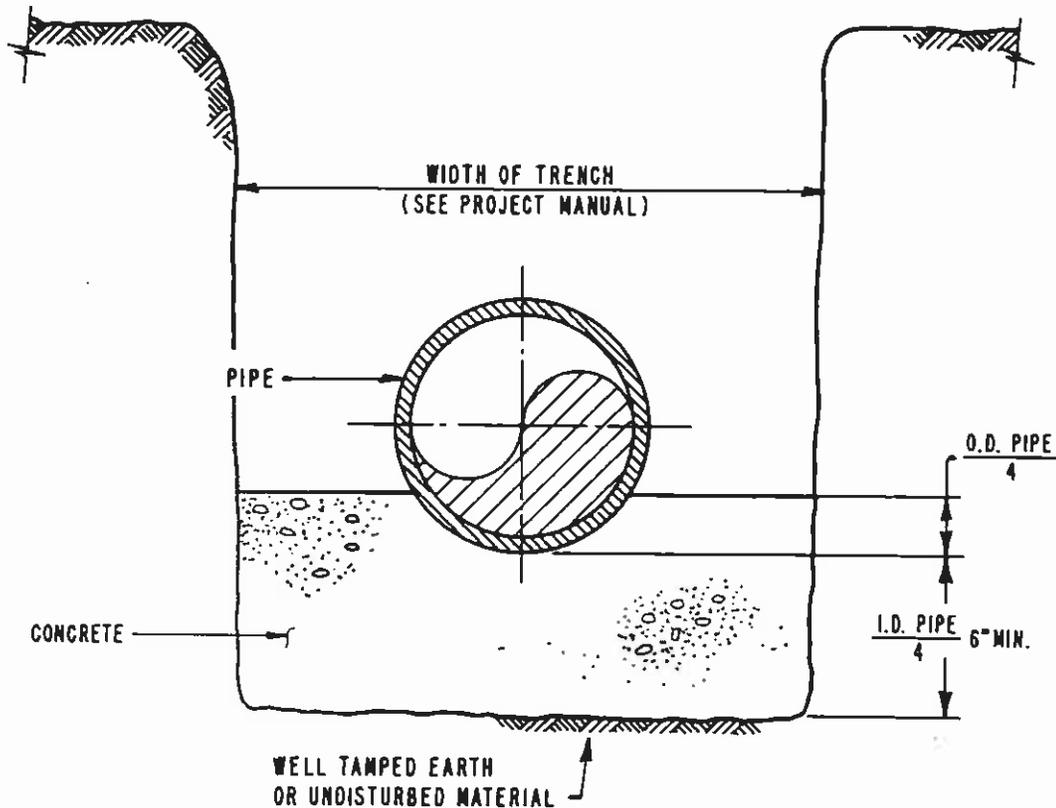
ALUMINUM  
ALLOY 6061-T6



NOTE  
PROVIDE A HEAVY COAT OF BITUMINOUS PAINT ON ALUMINUM SURFACES IN CONTACT WITH CONCRETE.

(NO)

MANHOLE STEPS

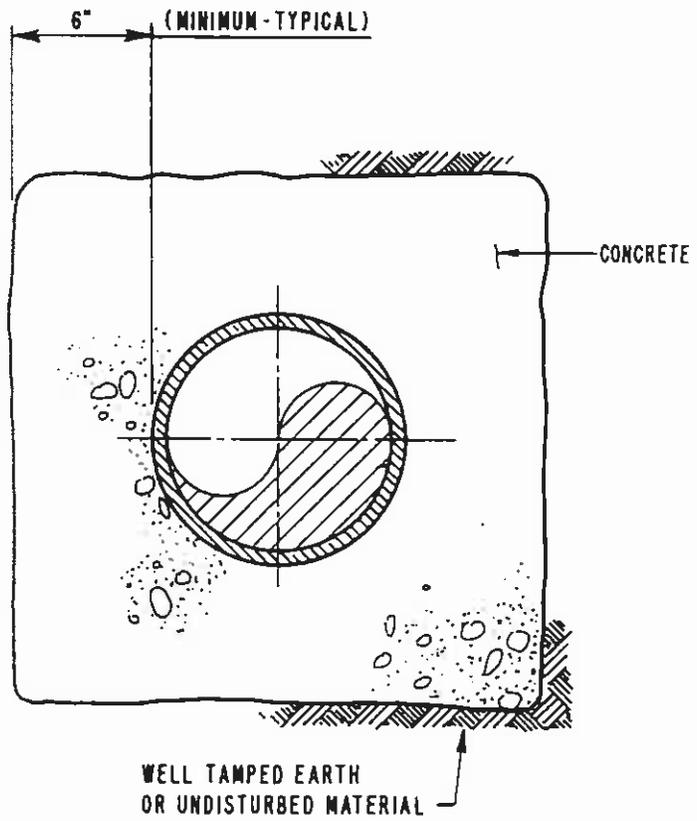


SECTIONAL ELEVATION

CONCRETE CRADLE (P-1)

PIPE BEDDING

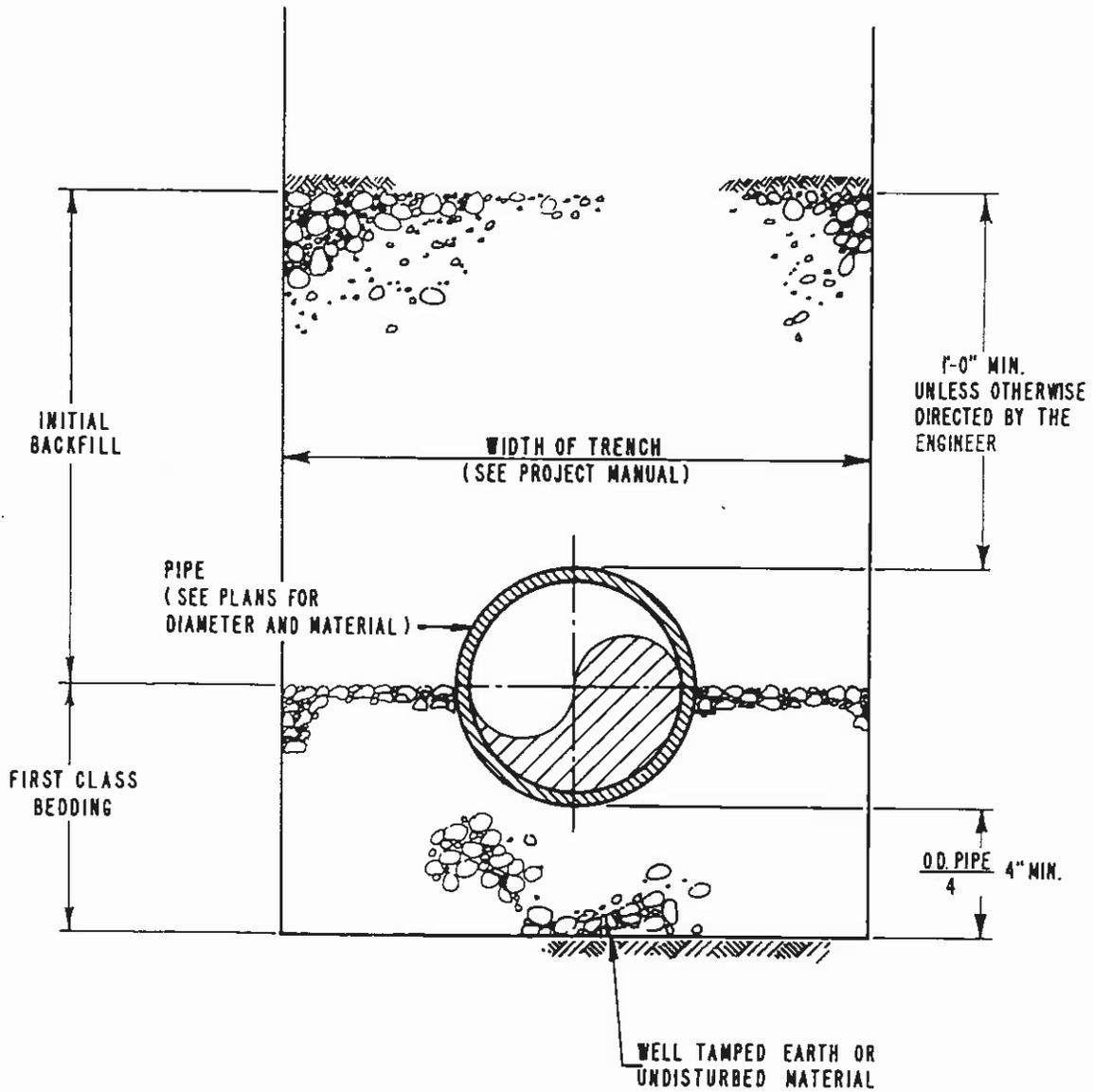
GANNETT FLEMING



SECTIONAL ELEVATION

CONCRETE ENCASEMENT

(P-2)



SECTIONAL ELEVATION

FIRST CLASS BEDDING  
AND INITIAL BACKFILL

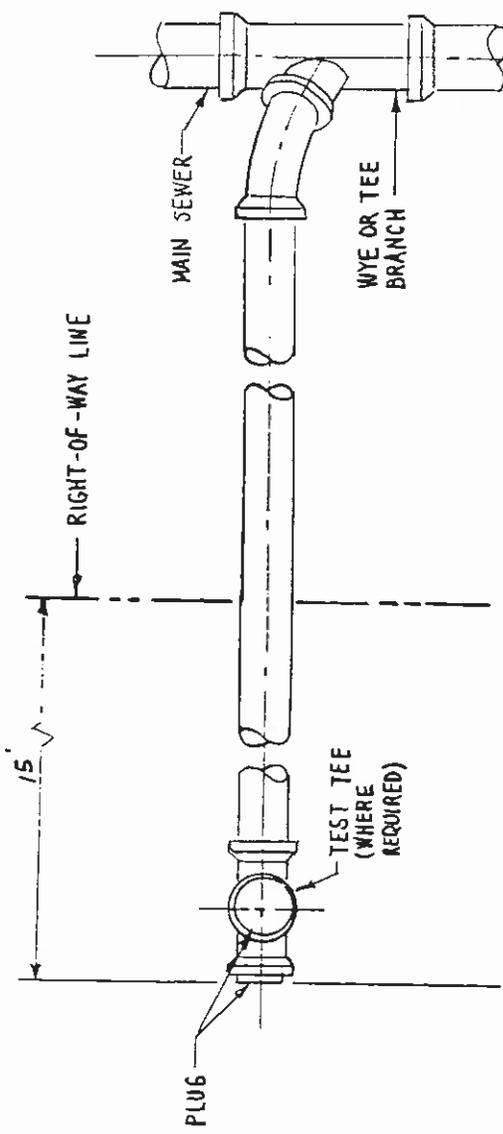


PIPE BEDDING

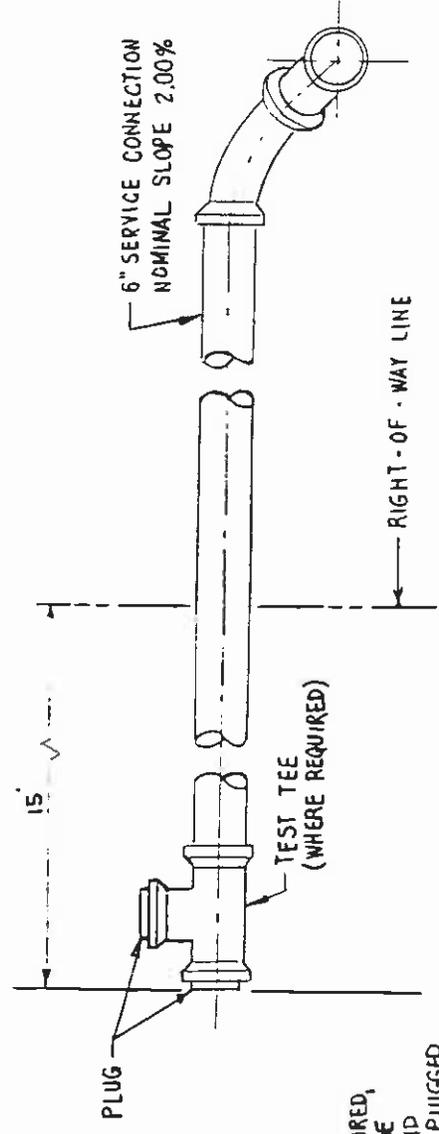
SERVICE CONNECTION

SHALLOW SEWER

(NEW STREET)



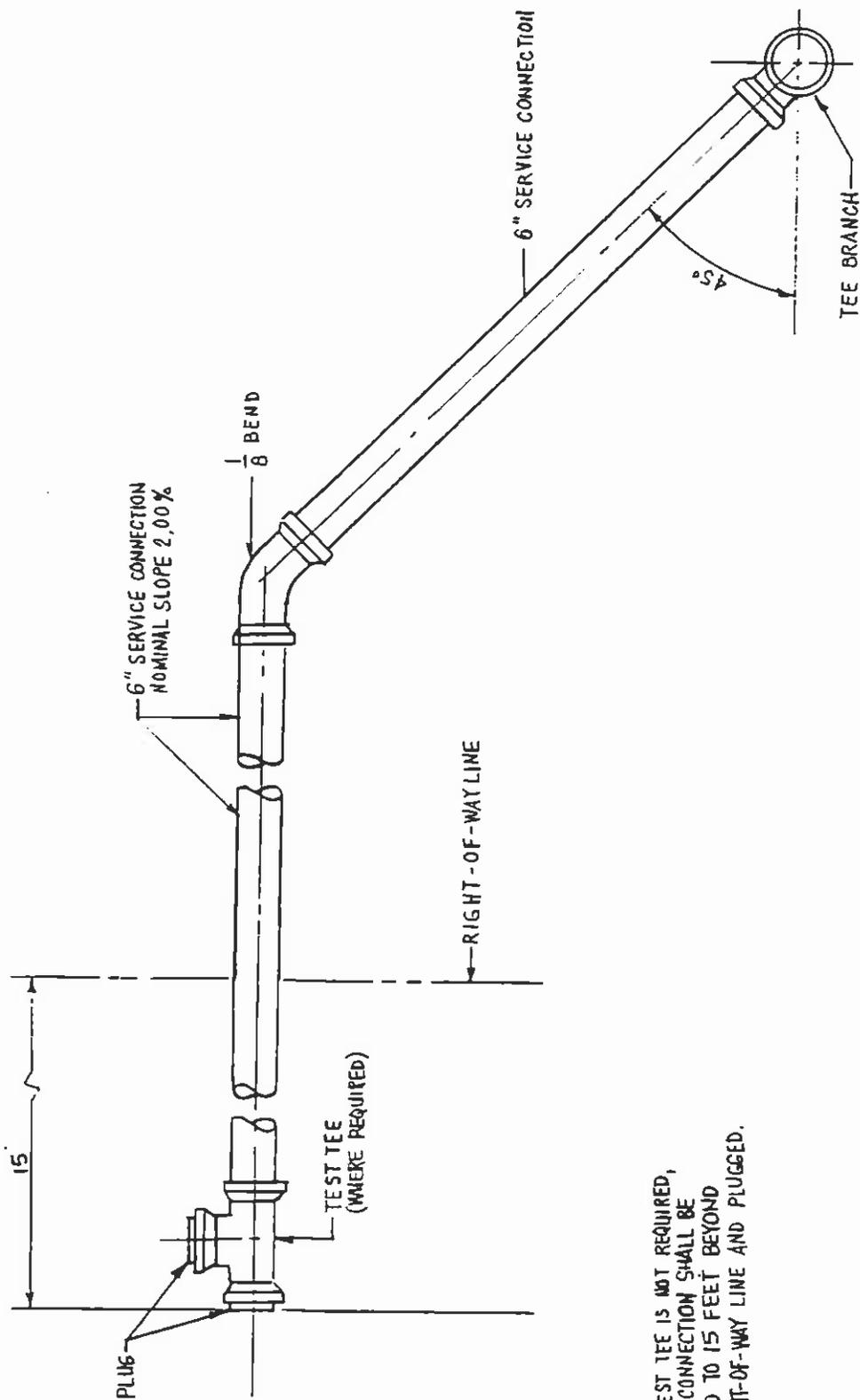
PLAN



ELEVATION

NOTE

WHERE TEST TEE IS NOT REQUIRED,  
SERVICE CONNECTION SHALL BE  
EXTENDED TO 15 FEET BEYOND  
THE RIGHT-OF-WAY LINE AND PLUGGED.



ELEVATION

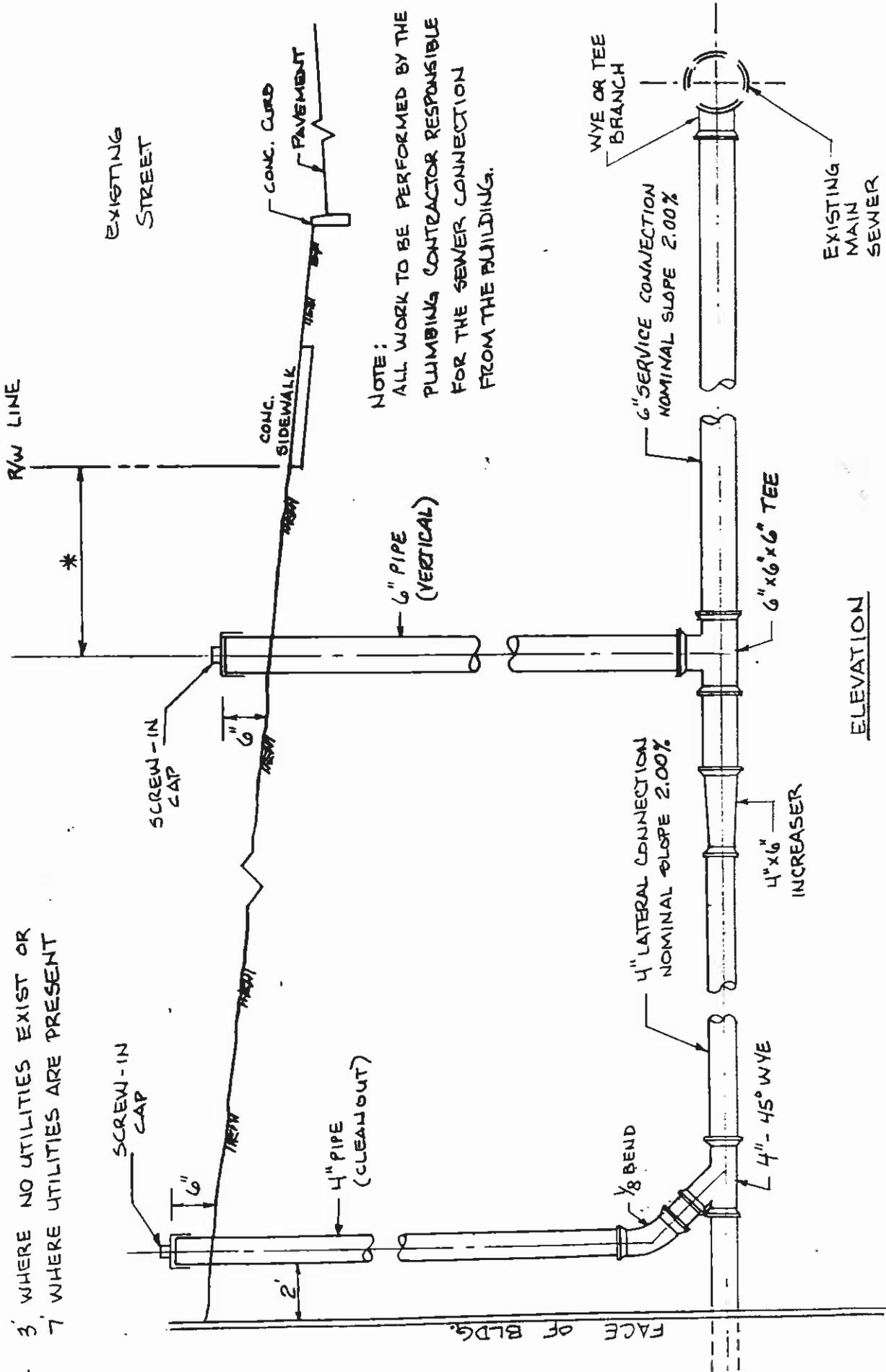
SERVICE CONNECTION  
DEEP SEWER  
(NEW STREET)

NOTE

WHERE TEST TEE IS NOT REQUIRED,  
 SERVICE CONNECTION SHALL BE  
 EXTENDED TO 15 FEET BEYOND  
 THE RIGHT-OF-WAY LINE AND PLUGGED.

LATERAL CONNECTIONS SHALL BE 50 FEET.

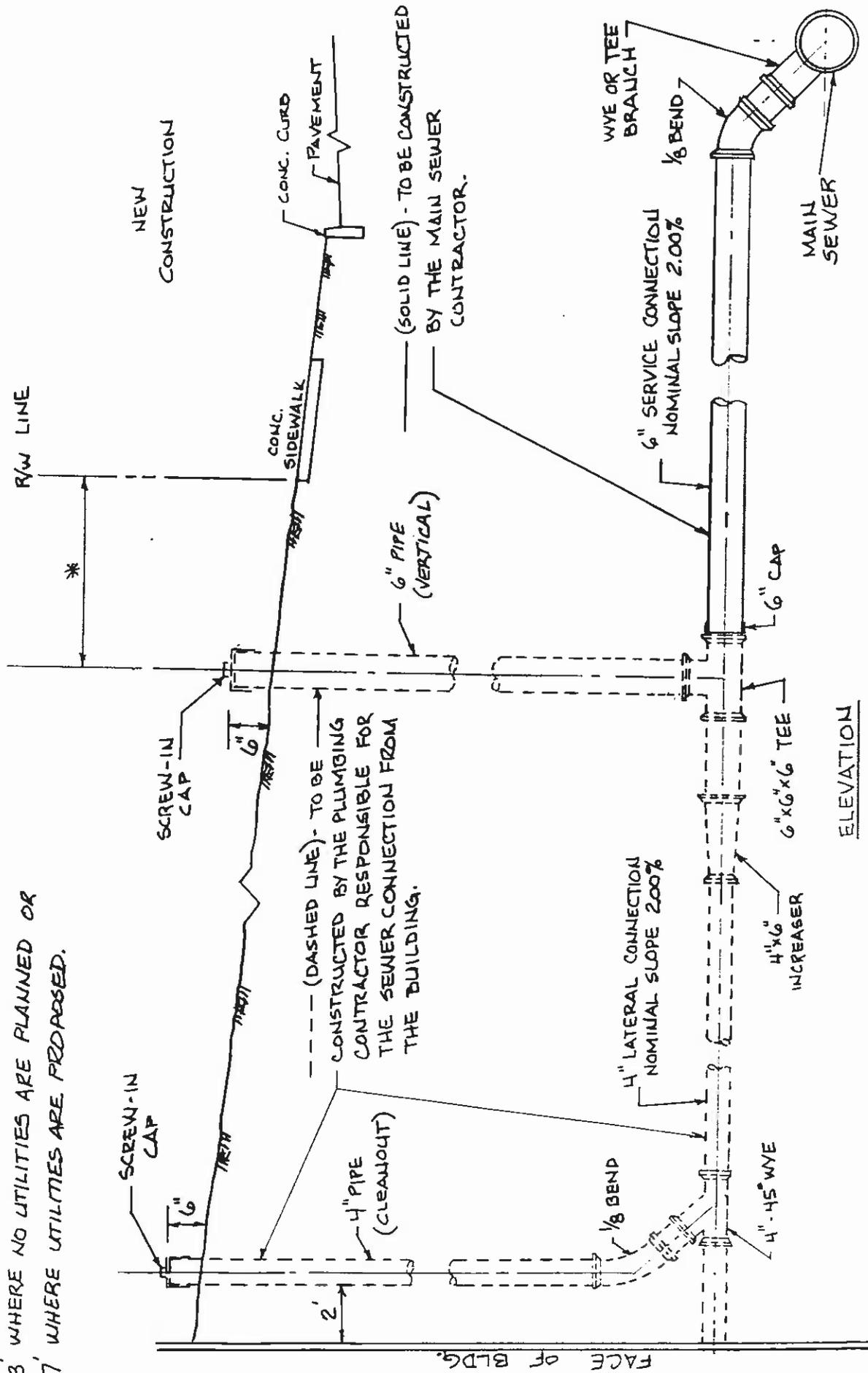
- \* 3 WHERE NO UTILITIES EXIST OR
- 7 WHERE UTILITIES ARE PRESENT



SERVICE AND LATERAL CONNECTION CONSTRUCTION  
(EXISTING STREET)

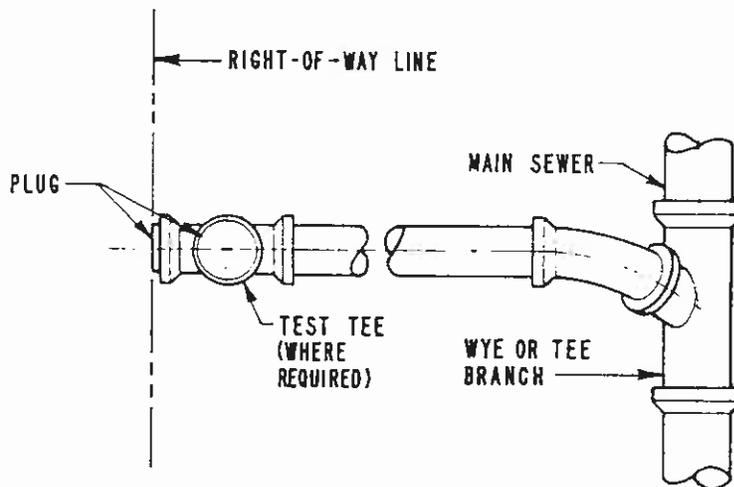
LATERAL CONNECTIONS SHALL BE 50 FEET.

- \* 3' WHERE NO UTILITIES ARE PLANNED OR
- 7' WHERE UTILITIES ARE PROPOSED.

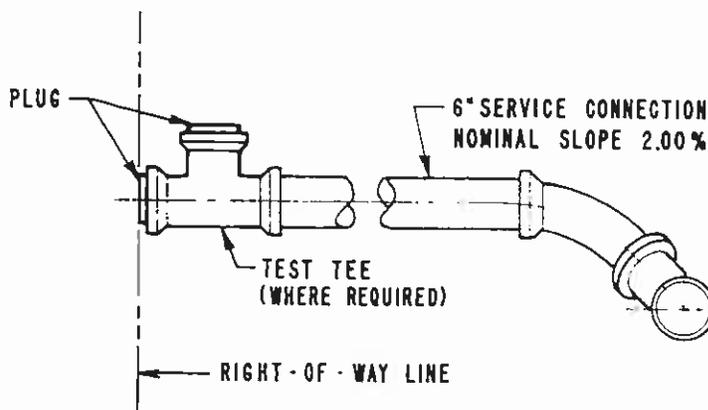


SERVICE AND LATERAL CONNECTION CONSTRUCTION  
(NEW STREET)





PLAN



ELEVATION

NOTE

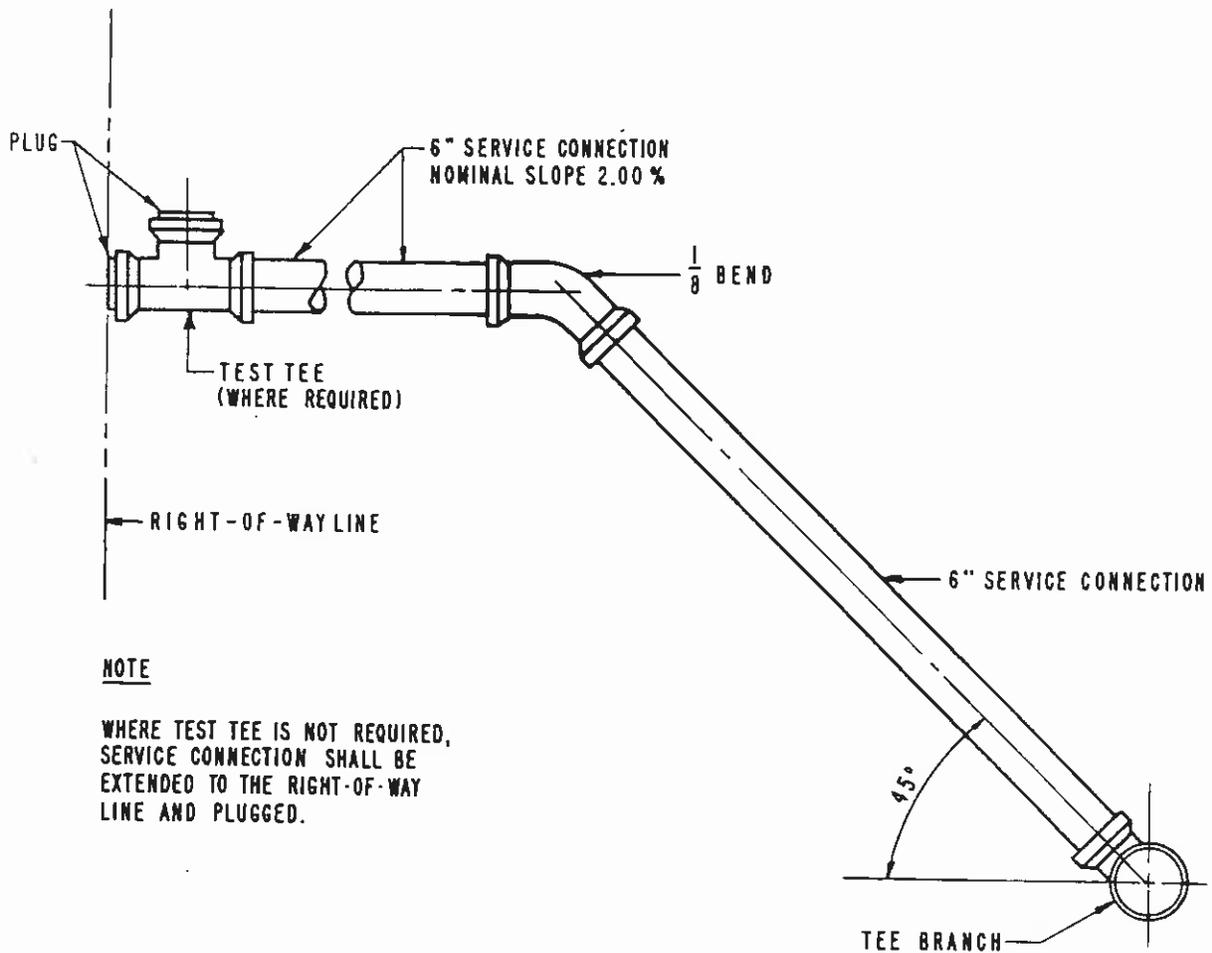
WHERE TEST TEE IS NOT REQUIRED,  
SERVICE CONNECTION SHALL BE  
EXTENDED TO THE RIGHT-OF-WAY  
LINE AND PLUGGED.

SERVICE CONNECTION

SHALLOW SEWER

( EXISTING STREET )





**NOTE**

WHERE TEST TEE IS NOT REQUIRED,  
SERVICE CONNECTION SHALL BE  
EXTENDED TO THE RIGHT-OF-WAY  
LINE AND PLUGGED.

ELEVATION

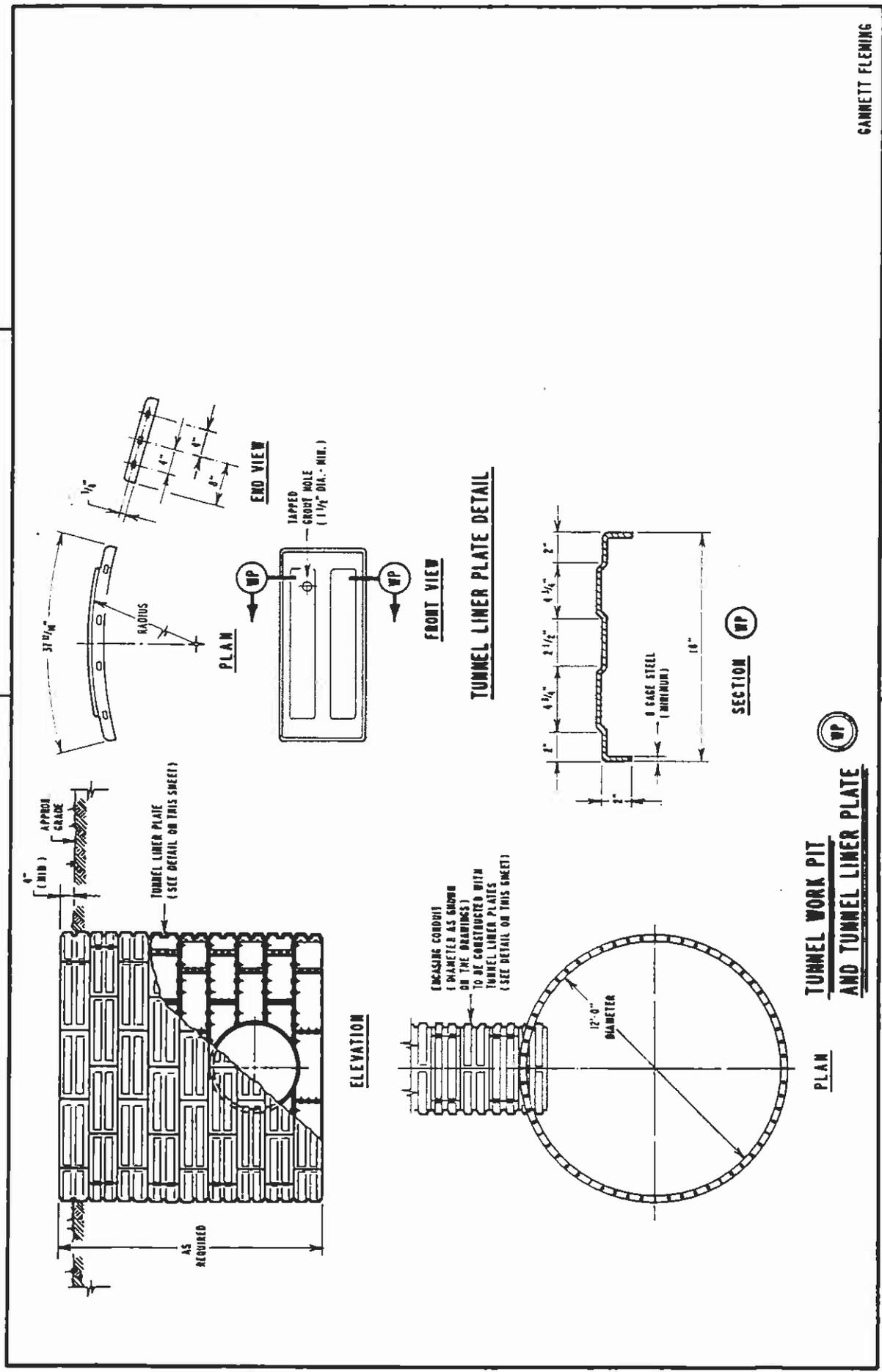
SERVICE CONNECTION

DEEP SEWER

( EXISTING STREET )







**TUNNEL WORK PIT AND TUNNEL LINER PLATE**

PLAN

SECTION

WP

WP