



Project Manual

Manual of Practice for Water Main Extensions For The City of Peculiar, MO 2014

Project No. 0313045.01



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Leaving A Legacy Of Enduring Improvements To Our Communities
Purpose Statement



**MANUAL OF PRACTICE FOR
WATER MAIN EXTENSIONS
For
PECULIAR, MISSOURI**

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DETAILED SPECIFICATIONS



PART 1 - GENERAL**1.00 FOREWORD**

- A. The provisions of this Section take precedence over the other provisions in these Specifications.

1.01 INSURANCE

- A. Insurance for this Contract shall be types and amounts as outlined below:
1. Contractor's Liability:
 - a. Workers' Compensation:
 - (1) State: Statutory
 - (2) Applicable Federal: Statutory
 - (3) Employer's Liability:
 - \$2,250,000.00 Each Accident
 - \$2,250,000.00 Disease, Policy Limit
 - \$350,000.00 Disease, Each Employee
 - (4) Broad Form All States Endorsement:
 - (5) Benefits required by union labor contracts: As applicable.
 - b. Commercial General Liability:
 - \$2,250,000.00 General Aggregate
 - \$2,250,000.00 Products-Completed Operations Aggregate
 - \$2,250,000.00 Personal and Advertising Injury
 - \$2,250,000.00 Each Occurrence
 - c. Products and Completed Operations Insurance shall be maintained for a minimum period of 2 years.
 - d. The general aggregate shall apply to this project only.
 - e. Automobile Liability (owned, non-owned, hired):
 - \$2,250,000.00 Bodily Injury & Property Damage
 - (Combined Single Limit)
 - f. Umbrella Excess Liability:
 - (1) Total insurance on all risks to be a minimum of \$2,250,000.00
 - g. Owner's protective liability in the name of the Owner and Engineer in the amount of \$2,250,000.00. A copy of the policy shall be furnished to owner and engineer before notice to proceed will be issued.
 2. Property Insurance:
 - a. The Contractor will purchase property insurance including coverage for all materials and equipment to be incorporated or used in the Project when stored off the site or when in transit.
 - b. The Contractor shall purchase the following:
 - (1) All-Risk type in the amount equal to completed value.
 3. Bonds:
 - a. Performance Bond and Payment Bond:
 - (1) Required.

- b. Required bonds shall be in the amount of:
 - (1) Performance:
 - (a) 100% of Contract Sum.
 - (2) Payment:
 - (a) 100% of Contract Sum and as required to comply with Section 107.170 RsMo.
 - (3) Form of bonds shall be:
 - (a) EJCDC or AIA and as required by Section 107.170 RsMo.
 - 4. Other instructions related to bonds or insurance:
- B. The insuring company shall deliver to the Owner together with all certificates of required insurance a letter signed by an authorized representative and certifying that all provisions of the insurance requirements are complied with. Form of the letter is bound in these Specifications following the proposal form, except copy of Owner's protective liability policy shall be required in addition thereto.
 - C. The Contractor may not begin work of any nature until all insurance requirements are met and approved by the Owner's attorney.

1.02 SPECIFICATIONS

- A. The specifications which shall govern the materials and equipment to be furnished and the work to be performed in the construction of the work under this Contract are identified and indexed in the Table of Contents at the beginning of this volume.
- B. No attempt has been made in the designated specifications to segregate work to be performed by any trade or subcontract under any one specification or part thereof. Any segregation between the trade or craft jurisdictional limits will be solely a matter of agreement between the Contractor and his employees and his subcontractors.

1.03 CHANGES, APPROVAL OF MATERIALS, AND AUTHORITY OF CONSTRUCTION REPRESENTATIVE

- A. Wherever the words "or equal" appear in the Plans and Specifications the Engineer shall be the sole judge as to whether an alternate product is equal to the product or trade name mentioned.
- B. The Contractor shall submit to the Engineer at least six copies of shop drawings, catalog data, supporting data, specifications, etc., on all items of equipment and materials before ordering same. No equipment or material of any kind may be placed in the work until the Contractor and the Construction Representative have received written approval either by letter or by drawings, etc., stamped "Approved-Final." It shall also be the Contractor's responsibility to point out any variations from the Engineer's specifications in any items submitted for approval.
- C. The project shall be constructed in accordance with the Contract Plans and Specifications unless a change order is received in writing from the Kansas City office of Larkin Group,

Inc. The Construction Representative will make general inspection of the construction, but will have no authority to make or to allow changes in design or construction. Request for changes desired by the Contractor shall be submitted by him in writing to the Engineer sufficiently in advance to allow proper investigation and consideration. Otherwise, the Engineer will not be responsible for delays.

1.04 MAINTENANCE OF TRAFFIC

- A. The Contractor shall conduct his work so as to interfere as little as possible with public travel, whether vehicular or pedestrian; whenever it is necessary to cross, obstruct, or close roads, driveways, and walks, whether public or private. The Contractor shall at his own expense provide and maintain suitable and safe bridges, detours, or other temporary expedients for the accommodation of public and private travel, and shall give reasonable notice to owners of private drives before interfering with them; provided however, that such maintenance of traffic will not be required at any point where the Contractor has obtained permission from the owner and tenant of private property, or from the authority having jurisdiction over the public property involved, to obstruct traffic at any designated point thereon and for the duration of whatever period of time as may be agreed upon.

1.05 EXISTING UNDERGROUND INSTALLATIONS AND STRUCTURES

- A. Pipe lines and other existing underground installations and structures in the vicinity of the work to be done hereunder are not indicated on the plans. The Contractor shall make every effort to locate all underground pipe lines, conduits and structures by contacting owners of underground utilities and by prospecting in advance of trench excavation.
- B. Any delays or extra cost to the Contractor caused by pipe lines or other underground structures or obstructions not shown by the plans, or found in locations different than those indicated, shall not constitute a claim for extra work, additional payment, or damages.

1.06 SUBSURFACE CONDITIONS

- A. Contractor is to satisfy himself as to the nature of the material to be encountered, including rock excavation and possible ground water and take all conditions into account in his bid.

1.07 EROSION CONTROL

- A. The Contractor will be required to exercise reasonable erosion control of disturbed areas during the construction period through the use of check dams, siltation pools, mulching, etc.

1.08 HISTORICAL/ARCHAEOLOGICAL

- A. If, during the course of construction, evidence of deposits of historical or archaeological interest is found, the Contractor shall cease operations affecting the find and shall notify the Owner, who shall notify the Missouri Department of Natural Resources and the Director, Division of Parks & Historical Preservation, P. O. Box 176, 205 Jefferson Street, Jefferson City, MO 65102, phone (573) 751-7858.
- B. No further disturbance of the deposits shall ensue until the Contractor has been notified by the Owner that he may proceed. The Owner will issue a notice to proceed only after the state official has surveyed the find and made a determination to the Environmental Protection Agency and the Owner. Compensation to the Contractor, if any, for lost time or changes in construction to avoid the find, shall be determined in accordance with changed conditions or change order provisions of these Specifications.

1.09 COMPLIANCE WITH LAWS

- A. The Contractor shall comply with all applicable Federal, State, and local laws and ordinances.

1.10 "OR EQUAL" STATEMENT

- A. When a manufacturer's name is used in these Specifications it is used to establish a standard and the words "or equal," if not stated, are implied.

1.11 PAYMENT TO CONTRACTOR

- A. The field representative and Contractor shall prepare and submit a monthly pay estimate to the Engineer for approval on or before the twentieth day of each month. Request for payment received after the first day of the month will not be considered. This will ensure that no unnecessary delays in payment to contractors will result.
- B. The Engineer will recommend or reject pay estimates within a period of 5 days after receipt of these estimates. The Owner shall pay the contractor the approved amount due within a period of thirty (30) days from the Engineer's approval.
- C. If the Owner fails to make payment thirty (30) days after approval by the Engineer, in addition to other remedies available to the contractor, then shall be added to each such payment interest at the maximum legal rate commencing on the first day after said payment is due and continuing until the payment is received by the Contractor. The legal rate of interest shall be as specified in 34.057 RSMo, latest revision.

1.12 CONSTRUCTION SCHEDULE

- A. The Contractor shall provide a schedule of construction activities within 30 days after

initiation of construction. This schedule must show anticipated progress and the estimated dollar amount that will be requested each month. This schedule must be periodically updated to ensure accuracy. The schedule shall be revised if a variation of more than 10 percent occurs.

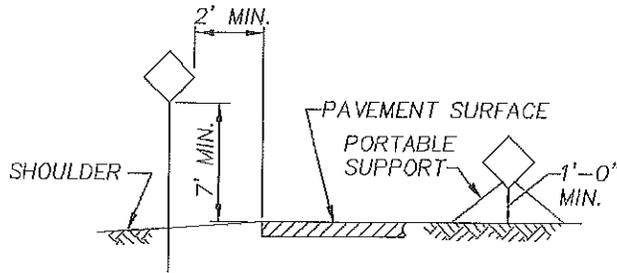
1.13 ONE HUNDRED PERCENT PERFORMANCE AND PAYMENT BOND

- A. The Contractor shall provide separate Performance and Payment Bonds, each in the amount of 100 percent of the contract amount.

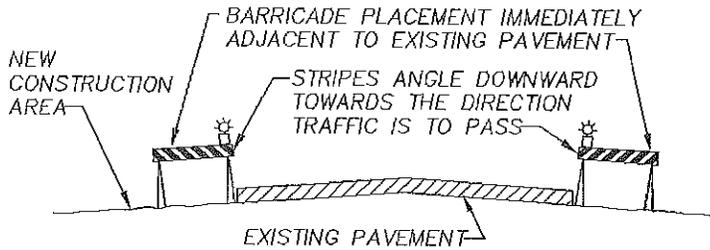
1.14 GENERAL TRAFFIC CONTROL REQUIREMENTS (ATTACHED SIGNING SHEETS)

- A. All signing and traffic control devices shall conform to the "Manual on Traffic Control Devices".
- B. The attached detail signing sheet(s) apply to a restricted roadway width caused by the Contractor's construction activities. If construction activity of the Contractor is located off the roadway, then the minimum signing will be required. W 20-1 ROAD WORK AHEAD and G 20-2 END OF ROAD WORK.
- C. Extended work areas may require additional signing.
- D. A minimum of one lane in each direction must be provided at the end of each work day.
- E. All roadways which are closed due to the Contractor's construction activities shall be provided with Detour signing and appropriate barricades.

END OF SECTION

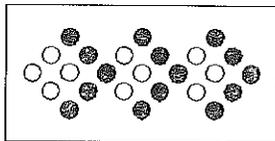


TYPICAL SIGN PLACEMENT



LATERAL PLACEMENT OF CHANNELIZING DEVICES

<u>TYPE</u>	<u>MIN. SIZE</u>	<u>MIN. # LAMPS</u>	<u>USAGE</u>
A	24"x48"	12	LOW SPEED STREETS 25-30 MPH
B	30"x60"	13	INTERMEDIATE SPEED STREETS 35-45 MPH
C	48"x96"	15	HIGH SPEED STREETS 50-55 MPH



ARROW DISPLAY SHALL BE SET IN THE (LEFT OR RIGHT) SEQUENTIAL CHEVRON MODE FOR LANE CLOSURES.

USE OF A TYPE "C" DISPLAY AT AN "A" OR "B" LOCATION OR USE OF A TYPE "B" DISPLAY AT AN "A" LOCATION IS ALLOWABLE. TYPE "B" DISPLAY MAY BE USED FOR MOVING MAINTENANCE OPERATIONS.

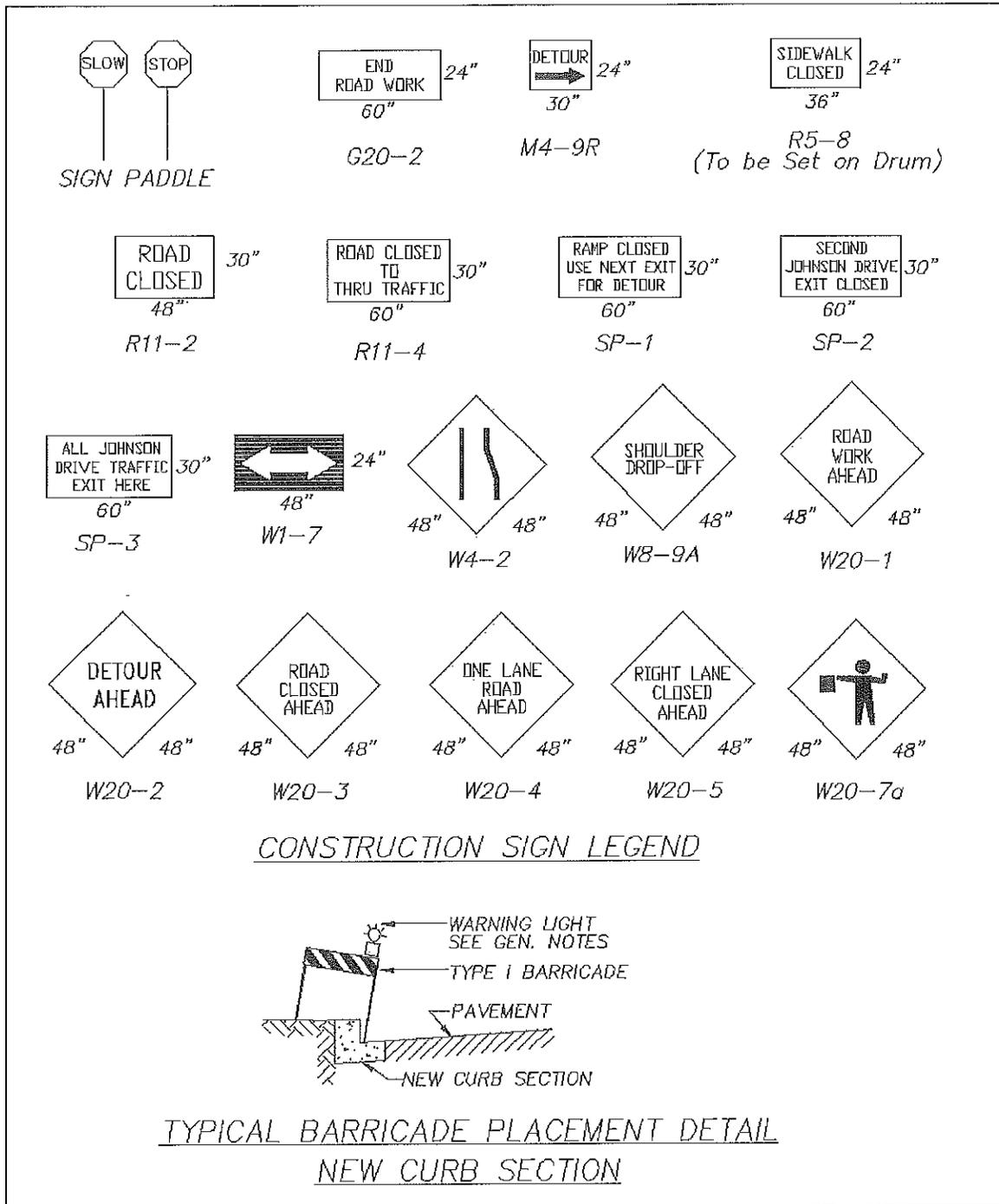
ADVANCE WARNING ARROW DISPLAY



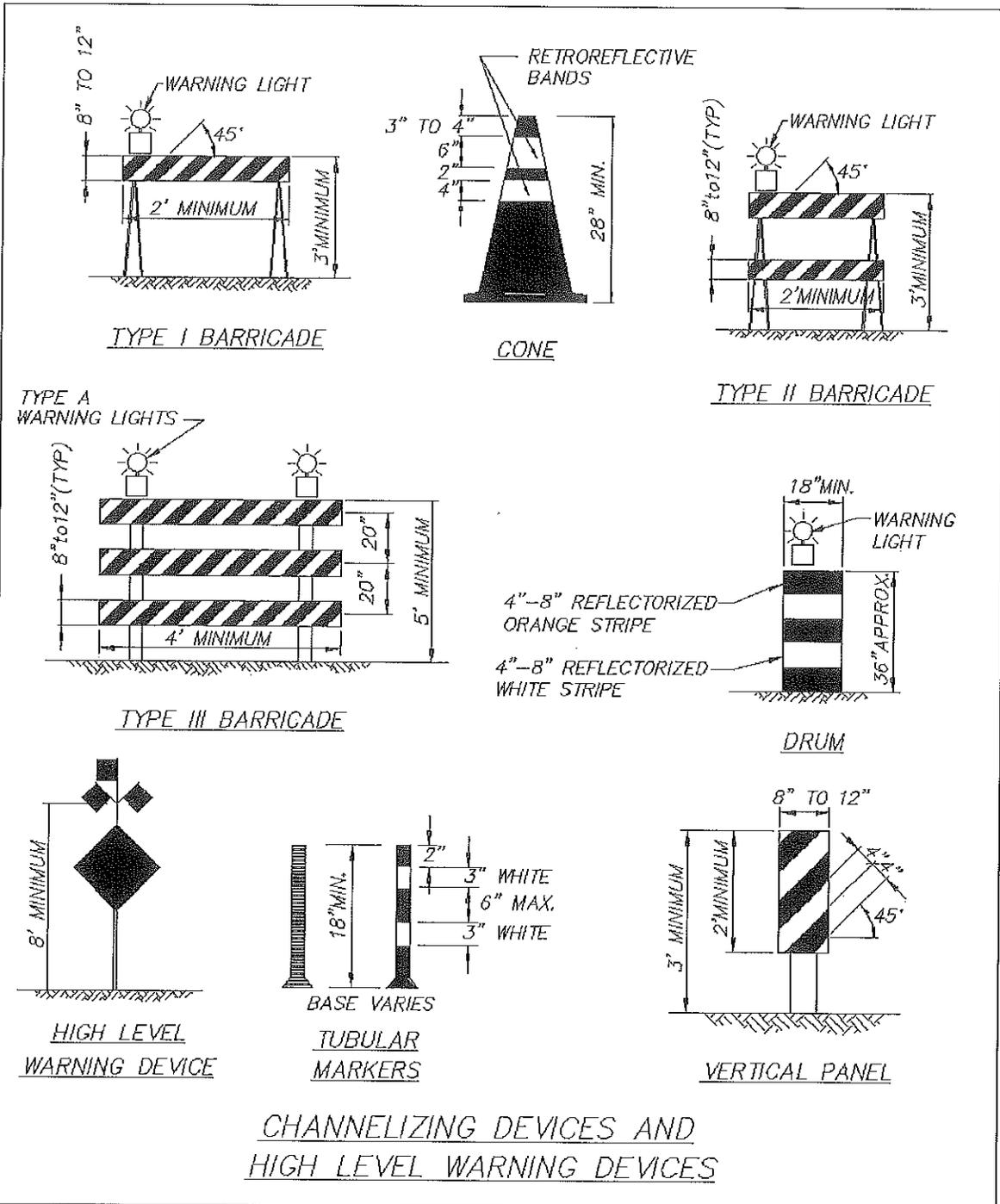
TITLE LINE #1
TITLE LINE #2
TITLE LINE #3

SHEET_NAME

Date:
Drawn By
Checked by
Approved by
File:
Job#



TITLE LINE #1	Date: Drawn By: Checked by: Approved by: File: Job#
TITLE LINE #2	
TITLE LINE #3	
SHEET_NAME	



TITLE LINE #1	
TITLE LINE #2	
TITLE LINE #3	
SHEET_NAME	

Date:	
Drawn By:	
Checked by:	
Approved by:	
File:	
Job#:	

PART 1 - GENERAL**1.01 SECTION INCLUDES**

- A. Work covers construction located within the city limits of Peculiar, Missouri or for any work done for the City of Peculiar..
- B. Contractor's duties:
1. Except as specifically noted, provide and pay for:
 - a. Labor, materials, and equipment.
 - b. Tools, construction equipment, and machinery.
 - c. Water, heat, and utilities required for construction.
 - d. Other facilities and services necessary for proper execution and completion of work.
 2. Pay legally required consumer, and use taxes. If Contractor contracts with the City a Missouri Project Exemption Certificate for sales tax will be furnished for the project.
 3. Secure and pay for, as necessary for proper execution and completion of work, and as applicable at time of receipt of bids:
 - a. Permits.
 - b. Government fees.
 - c. Licenses.
 4. Give required notices.
 5. Comply with codes, ordinances, rules, regulations, orders, and other legal requirements of public authorities which bear on performance of work.
 6. Promptly submit written notice to Engineer of observed variance of Contract Documents from legal requirements.

It is Contractor's responsibility to make certain that drawings and specifications comply with codes and regulations.

 - a. Appropriate modifications to Contract Documents will adjust necessary changes.
 - b. Assume responsibility for work known to be contrary to such requirements, without notice.
 7. Enforce strict discipline and good order among employees. Do not employ on work:
 - a. Unfit persons.
 - b. Persons not skilled in assigned task.
 8. Comply with prevailing wage law requirements.
 9. Comply with nondiscrimination requirements.
 10. Perform all supervision and work necessary to provide safe working conditions for completion of all required excavation and construction work.
 11. Verify dimensions indicated on drawings with field dimensions before fabrication or ordering of materials. Do not scale drawings.
 12. Notify Owner of existing conditions differing from those indicated on the Drawings. Do not remove or alter structural components without prior written approval.

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 8. Comply with prevailing wage law requirements.
 9. Comply with nondiscrimination requirements.
 10. Perform all supervision and work necessary to provide safe working conditions for completion of all required excavation and construction work.
 11. Verify dimensions indicated on drawings with field dimensions before fabrication or ordering of materials. Do not scale drawings.
 12. Notify Owner of existing conditions differing from those indicated on the Drawings. Do not remove or alter structural components without prior written approval.

13. All licenses, permits, certificates, bonds, etc., required in connection with the work to be performed under the provisions of these Contract Documents on highway railroad right-of-way, or special road district right-of-way shall be secured by the Contractor entirely at his own expense.

1.02 CONTRACTOR USE OF PREMISES

- A. Confine Operations at site to areas permitted by:
 1. Law.
 2. Ordinances.
 3. Permits.
 4. Contract Documents.
 5. Owner.
- B. Do not unreasonably encumber site with materials or equipment.
- C. Assume full responsibility for protection and safekeeping of products stored on premises.
- D. Move any stored products which interfere with operations of Owner.
- E. Obtain and pay for use of additional storage or work areas needed for operations.
- F. Use of site.
Exclusive and complete for execution of work, except:
 1. Contractor shall maintain access to existing facilities.
 2. Owner shall have access to existing facilities.
- G. Operation of the existing facilities:
 1. It is essential that the existing facilities be kept in operation during the construction period. Short periods of shutdown will be possible to permit modifications or connections to or tie in with existing facilities. The time period will vary with Owner usage at different times of the day.
 2. In some instances it will be necessary to complete and put new facilities into operation prior to commencing work on existing facilities which would require their removal from service.
 3. Where interruption of existing facilities are necessary, the Contractor is to plan his work in cooperation with facility operating personnel for the least possible disruption of service. Night or weekend work may be necessary. When facility operation must be suspended because of the Contractor's work, he shall have all necessary materials and equipment on hand, and have ample work force available prior to beginning the work.

1.03 POSITION, GRADIENT, AND ALIGNMENT

- A. All construction work shall be done to the lines and grades shown on the Plans. The Engineer will establish on the site the required benchmarks and base lines. Detailed survey and staking for location and grade of individual structures or other construction, as well as measurements and elevations within structures, shall be performed by the Contractor.
- B. Any work done without being properly located and established by base lines, offset stakes, benchmarks, or other basic reference points, may be ordered removed and replaced at the Contractor's expense.

1.04 PROTECTION AND MAINTENANCE OF PUBLIC AND PRIVATE PROPERTY

- A. Protect, shore, brace, support, and maintain all underground pipes, conduits, drains, and other underground construction uncovered or otherwise affected by the construction work performed. All pavement, surfacing, driveways, curbs, walks, buildings, utility poles, guy wires, and other surface structures affected by construction operations in connection with the performance of the Contract shall be restored to the original condition thereof as determined and approved by the Engineer. All replacements of such underground construction and surface structures or parts thereof shall be made with new materials conforming to the requirements of these Specifications or, if not specified, as approved by the Engineer.
- B. The Contractor shall be responsible for all damage to streets, roads, highways, railroads, shoulders, ditches, embankments, culverts, bridges, power transmission lines, oil lines, gas lines, or other public or private property or facility, regardless of location or character, which may be caused by moving, hauling, or otherwise transporting equipment, materials, or men to or from the work or any part or site thereof, whether by him or his subcontractor or subcontractors. The Contractor shall make satisfactory and acceptable arrangements with the owner of, or the agency or authority having jurisdiction over, the damaged property or facility concerning its repair or replacement or payment of costs incurred in connection with said damage.
- C. The Contractor shall conduct his work so as to interfere as little as possible with public travel, whether vehicular or pedestrian; whenever it is necessary to cross, obstruct, or close roads, driveways, and walks, whether public or private. The Contractor shall, at his own expense, provide and maintain suitable and safe bridges, detours, or other temporary expedients for the accommodation of public and private travel, and shall give reasonable notice to owners of private drives before interfering with them; provided however, that such maintenance of traffic will not be required at any point where the Contractor has obtained permission from the owner and tenant of private property, or from the authority having jurisdiction over the public property involved, to obstruct traffic at any designated point thereon and for the duration of whatever period of time as may be agreed upon.

1.05 INSPECTION BY PUBLIC AGENCIES

- A. Authorized representatives of the Engineers and Owner shall have access to the work wherever it is in preparation or progress. The Contractor shall provide proper facilities for such access and inspection.

1.06 CONTRACTOR'S RESPONSIBILITY FOR MATERIALS

- A. The Contractor shall be responsible for the condition of all materials furnished by him, and he shall replace at his own cost and expense any and all such material found to be defective in design or manufacture, or which has been damaged after delivery. This includes the furnishing of all materials and labor required for replacement of any installed material which are found to be defective at any time prior to the expiration of 1 year from the date of final payment.

10.7 SITE

- A. Necessary easements for construction of water lines under this contract will be provided by the Owner. Information on water construction easement width may be obtained from the Owner. The Contractor shall confine his operations to the site or easement provided, or make other arrangements with the property owner. Any and all cost agreed to between the Contractor and property owners for special arrangements shall be paid by the Contractor and shall not constitute a claim for extra payment.

1.08 PROTECTION OF WATER SUPPLIES

- A. Water supply interconnections:
There shall be no physical connection between a public or private potable water supply system and a sewer, or appurtenance thereto which would permit the passage of any sewage or polluted water into the potable supply.

1.09 EXPLANATION OF PROPOSAL

- A. The Owner reserves the right to select any or all alternates. The best and lowest bid will be determined by bidder's qualifications and the low total price for the base bid and the alternate bid items selected by the Owner.
- B. Bid:
 - 1. The bid includes complete construction of the project, ready for use.
 - 2. Construct work under the unit price or lump sum prices as called for in the Proposal.
- C. Contractor guarantees his/her work for a one (1) year period after completion of the project.

1.10 "OR EQUAL" STATEMENT

- A. When a manufacturer's name is used in these Specifications it is used to establish a standard and the words "or equal", if not stated, are implied.

PART 2 - PRODUCTS

Not applicable to this section.

PART 3 - EXECUTION

Not applicable to this section.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Shop Drawings, Product Data, and Samples required by specification sections.

1.02 RELATED SECTIONS

- A. Section 01700: Project Closeout
- B. Section 01720: Project Record Documents

1.03 SHOP DRAWINGS

- A. Original drawings, prepared by Contractor, subcontractor, supplier or distributor, which illustrate some portion of the Work; showing fabrication, layout, setting or erection details.
- B. Prepared by a qualified detailer.
- C. Identify details by reference to sheet and detail numbers shown on Contract Drawings.
- D. Reproductions for submittals:
Opaque diazo prints or blueprints, or blacklines on bond.

1.04 PRODUCT DATA

- A. Manufacturer's standard schematic drawings:
 - 1. Modify drawings to delete information which is not applicable to project.
 - 2. Supplement standard information to provide additional information applicable to project.
- B. Manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations, and other standard descriptive data.
 - 1. Clearly mark each copy to identify pertinent materials, products or models.
 - 2. Show dimensions and clearances required.
 - 3. Show performance characteristics and capacities.
 - 4. Show wiring diagrams and controls.

1.05 CONTRACTOR RESPONSIBILITIES

- A. Review Shop Drawings, Product Data, and Samples prior to submission.

- B. Verify:
 - 1. Field measurements.
 - 2. Field construction criteria.
 - 3. Catalog numbers and similar data.
- C. Coordinate each submittal with requirements of Work and of Contract Documents.
- D. Contractor's responsibility for errors and omissions in submittals is not relieved by Engineer's review of submittals.
- E. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved by Engineer's review of submittals, unless the Engineer gives written acceptance of specific deviations.
- F. Notify Engineer, in writing at time of submission, of deviations in submittals from requirements of Contract Documents.
- G. Begin no work which requires submittals until submittal approval.
- H. After Engineer's review, distribute copies.

1.06 SUBMISSION REQUIREMENTS

- A. Schedule submissions at least 10 days before dates approved submittals will be needed.
- B. Submit number of copies of Shop Drawings, Product Data, and Samples which Contractor requires for distribution plus three copies which will be retained by the Engineer.
- C. Submit number of Samples specified in each of Specification sections.
- D. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date.
 - 2. Project title and number.
 - 3. Contractor's name and address.
 - 4. The number of each Shop Drawing, Product Data, and Sample submitted.
 - 5. Notification of deviations from Contract Documents.
 - 6. Other pertinent data.
- E. Submittals shall include:
 - 1. Date and revision dates.
 - 2. Project title and number.
 - 3. The names of:
 - a. Engineer.
 - b. Contractor.
 - c. Subcontractor.
 - d. Supplier.

- e. Manufacturer.
- f. Separate detailer when pertinent.
4. Identification of product or material.
5. Relation to adjacent structure or materials.
6. Field dimensions, clearly identified.
7. Specification section number.
8. Applicable standards, such as ASTM number or Federal Specification.
9. A blank space, 3 inches by 5 inches, for the Engineer's stamp.
10. Identification of deviations from Contract Documents.
11. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of field measurements and compliance with Contract Documents.

1.07 RESUBMISSION REQUIREMENTS

- A. Shop Drawings:
 1. Revise initial drawings as required and resubmit as specified for initial submittal.
 2. Indicate on drawings any changes which have been made other than those requested by Engineer.
 3. Product Data and Samples:
Submit new data and samples as required for initial submittal.

1.08 DISTRIBUTION OF SUBMITTALS AFTER REVIEW

- A. Distribute copies of Shop Drawings and Product Data which carry Engineer's stamp, to:
 1. Contractor's file.
 2. Job-site file.
 3. Record Documents file.
 4. Subcontractors.
 5. Supplier.
 6. Fabricator.
- B. Distribute samples as directed.

1.09 ENGINEER'S DUTIES

- A. Review submittals with reasonable promptness.
- B. Review for:
 1. Design concept of project.
 2. Information given in Contract Documents.

- C. Review of separate item does not constitute review of an assembly in which item functions.
- D. Affix stamp and initials or signature indicating review of submittal.
- E. Return submittals to Contractor for distribution.

END OF SECTION

PART 1 - GENERAL**1.01 SECTION INCLUDES:**

- A. Substitutions and product options.

1.02 RELATED SECTIONS

- A. Section 01340: Shop Drawings, Product Data, and Samples.

1.03 PRODUCTS LIST

- A. Within 30 days after date of Contract, submit to Engineer 5 copies of complete list of all products which are proposed for installation.
- B. Tabulate list by each Specification section.
- C. For products specified under reference standards, include with listing of each product:
 - 1. Name and address of manufacturer.
 - 2. Trade name.
 - 3. Model or catalog designation.
 - 4. Manufacturer's data:
 - a. Performance and test data.
 - b. Reference standards.

1.04 CONTRACTOR'S OPTIONS

- A. For products specified only by reference standards, manufacturer shall submit data for approval 10 days prior to bid date.
- B. For products specified by naming several products or manufacturers, select any product and manufacturer named.
- C. For products specified by naming one product, Contractor must submit a request, as required for substitution, for any product not specifically named.

1.05 SUBSTITUTIONS

- A. During bidding, Engineer will consider written requests from prime Bidders for substitutions, received at least 10 days prior to bid date; requests received after that time will not be considered.
- B. Submit five copies of request for substitution. Include in request:
1. Complete data substantiating compliance of proposed substitution with Contract Documents.
 2. For products:
 - a. Product identification, including manufacturer's name and address.
 - b. Manufacturer's literature.
 - (1) Product description.
 - (2) Performance and test data.
 - (3) Reference standards.
 - c. Samples.
 - d. Name and address of similar projects on which product was used, and date of installation.
 3. For construction methods:
 - a. Detailed description of proposed method.
 - b. Drawings illustrating methods.
 4. Itemized comparison of proposed substitution with product or method specified.
 5. Data relating to changes in construction schedule.
 6. Relation to separate contracts.
- C. In making request for substitution, Bidder represents:
1. He has personally investigated proposed product or method, and determined that it is equal or superior in all respects to that specified.
 2. He shall provide the same guarantee for substitution as for product or method specified.
 3. He shall coordinate installation of accepted substitution into work, making such changes as may be required for work to be complete in all respects.
 4. He waives all claims for additional costs related to substitution which consequently becomes apparent.
 5. Cost data is complete and includes all related costs under his contract, but excludes:
 - a. Costs under separate contracts.
 - b. Engineer's redesign.
- D. Substitutions will not be considered if:
1. They are indicated or implied on Shop Drawings or Project Data submittals without formal requests submitted in accord with Paragraph 1.04.
 2. Acceptance will require substantial revision of Contract Documents.
- E. Engineer will notify Bidders of all approved substitutions by Addendum listing manufacturers of each item.

END OF SECTION

PART 1 - GENERAL**1.01 SECTION INCLUDES**

- A. Administrative procedures, closeout submittals, and forms to be used at substantial completion and at final completion of the Work.

1.02 RELATED SECTIONS

- A. Section 01710: Cleanup
- B. Section 01720: Project Record Documents

1.03 SUBSTANTIAL COMPLETION

- A. Contractor:
 - 1. Submit written certification to the Engineer, that project, or designated portion of project, is substantially complete.
 - 2. Submit list of major items to be completed or corrected.
- B. Engineer will make an inspection within 7 days after receipt of certification, together with Owner's representative.
- C. Should the Engineer consider that work is substantially complete:
 - 1. Contractor shall prepare and submit a list of items to be completed or corrected, as determined by the inspection.
 - 2. Engineer will prepare and issue a Letter of Substantial Completion, containing:
 - a. Date of substantial completion.
 - b. Contractor's list of items to be completed or corrected, verified, and amended.
 - c. The time within which Contractor shall complete or correct work of listed items.
 - d. Time and date Owner will assume possession of Work or designated portion thereof.
 - e. Responsibilities of Owner and Contractor for:
 - (1) Utilities.
 - (2) Operation of mechanical, electrical, and other systems.
 - (3) Maintenance and cleaning.
 - (4) Security.
 - f. Signatures of:
 - (1) Contractor.
 - (2) Owner.
 - (3) Engineer.

3. Owner occupancy of Project or designated portion of Project.
 - a. Contractor shall:
 - (1) Obtain certificate of occupancy.
 - (2) Perform final cleaning in accordance with Section 01710.
 - b. Owner will occupy Project, under provisions stated in Certificate of Substantial Completion.
 4. Contractor:
Complete work listed for completion or correction within designated time.
- D. Should the Engineer consider that work is not substantially complete:
1. They shall immediately notify Contractor, in writing, stating reasons.
 2. Contractor:
Complete work and send second written notice to the Engineer, certifying that Project or designated portion of Project, is substantially complete.
 3. Engineer will review work.

1.04 FINAL PROJECT REVIEW

- A. Contractor shall submit written certification that:
 1. Contract Documents have been reviewed.
 2. Project has been reviewed for compliance with Contract Documents.
 3. Work has been completed in accordance with Contract Documents.
 4. Equipment and systems have been tested in presence of Owner's representative and are operational.
 5. Project is completed, and ready for final review.
- B. Engineer will make final project review within seven days after receipt of certification.
- C. Should the Engineer consider that work is finally complete in accordance with requirements of Contract Documents, the Project will be closed out.
- D. Should the Engineer consider that work is not finally complete:
 1. They will notify Contractor, in writing, stating reasons.
 2. Contractor shall take immediate steps to remedy the stated deficiencies, and send second written notice to the Engineer certifying that work is complete.
 3. Engineer will review work.

1.05 CLOSEOUT SUBMITTALS

- A. Project record documents:
To requirements of Section 01720.
- B. Deliver evidence of compliance with requirements of governing authorities.
- C. Deliver Certificate of Insurance for products and completed operations.

1.06 EVIDENCE OF PAYMENTS AND RELEASE OF LIENS

- A. Contractor's affidavit of payment of debts and claims.
- B. Contractor's affidavit of release of liens, with:
 - 1. Consent of surety of final payment.
 - 2. Contractor's release of waiver of liens.
 - 3. Separate releases of waivers of liens for subcontractors, suppliers, and others with lien rights against property of Owner, together with list of those parties.
- C. All submittals shall be duly executed before delivery.

1.07 INSTRUCTION

- A. Instruct Owner's personnel in operation of all systems, mechanical, electrical, and other equipment.

1.08 FINAL ADJUSTMENT OF ACCOUNTS

- A. Submit final statement of accounting to Engineer.
- B. Statement shall reflect all adjustments.
 - 1. Original Contract Sum.
 - 2. Additions and deductions resulting from:
 - a. Previous Change Orders.
 - b. Cash Allowances.
 - c. Other Adjustments.
 - d. Deductions for uncorrected Work.
 - e. Deductions for liquidated damages.
 - f. Deductions for Reinspection Payments.
 - 3. Total Contract Sum, as adjusted.
 - 4. Previous payments.
 - 5. Sum remaining due.
- C. Engineer will prepare final Change Order, reflecting approved adjustments to Contract Sum not previously made by Change Orders.

1.09 FINAL APPLICATION FOR PAYMENT

- A. Contractor shall submit final application in accordance with requirements of Regulations of the Contract.

1.10 FINAL CERTIFICATE FOR PAYMENT

- A. Engineer will issue final certificate in accordance with provisions of Regulations of the Contract.
- B. Should final completion be materially delayed through no fault of Contractor, Engineer may issue, for Owner's approval, a Semi-Final Certificate for Payment, in accordance with provisions of Regulations of the Contract.

1.11 POST-CONSTRUCTION PROJECT REVIEW

- A. Prior to expiration of 1 year from Date of Substantial Completion, the Owner may request a visual review of Project in company with Engineer and Contractor to determine whether correction of Work is required, in accordance with provisions of Regulations of the Contract. The Contractor shall be present for the review and be ready to promptly correct any noted deficiencies. The Contractor will also provide equipment as necessary to facilitate this review.
- B. The Engineer will promptly notify Contractor, in writing, of any observed deficiencies.

END OF SECTION

PART 1 - GENERAL**1.01 SECTION INCLUDES**

- A. Project cleanup.

1.02 RELATED SECTIONS

- A. Section 01700: Project Closeout
- B. Cleaning for Specific Products or Work: Specification Section for that work.

1.03 SAFETY REQUIREMENTS

- A. Hazards Control:
 - 1. Store volatile wastes in covered metal containers, and remove from premises daily.
 - 2. Prevent accumulation of wastes which create hazardous conditions.
 - 3. Provide adequate ventilation during use of volatile or noxious substances.
- B. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
 - 1. Do not burn or bury rubbish and waste materials on project site.
 - 2. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
 - 3. Do not dispose of wastes into streams or waterways.

PART 2 - PRODUCTS**2.01 MATERIALS**

- A. Use only cleaning materials recommended by manufacturer of surface to be cleaned.
- B. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 - EXECUTION**3.01 GENERAL**

- A. Maintain premises and public properties free from accumulations of waste, debris, and rubbish caused by operations.
- B. At completion of Work, remove waste materials, rubbish, tools, equipment, machinery, and surplus materials, and clean all sight-exposed surfaces; leave project clean and ready for occupancy.

3.02 DURING CONSTRUCTION

- A. Execute cleaning to ensure that building, grounds, and public properties are maintained free from accumulations of waste materials and rubbish.
- B. Wet down dry materials and rubbish to lay dust and prevent blowing dust.
- C. At reasonable intervals during progress of Work, clean site and public properties, and dispose of waste materials, debris, and rubbish.
- D. Provide on-site dump containers for collection of waste materials, debris, and rubbish.
- E. Remove waste materials, debris and rubbish from site and legally dispose of at public or private dumping areas off Owner's property.
- F. Handle materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights.
- G. Remove from the Owner's property and from all public and private property, at Contractor's expense, all temporary structures, rubbish, excess excavation, and waste material resulting from his operations.
- H. Clean all dirt from paved surfaces, not allowing same to pack on the roadway or to create a traffic nuisance. Insofar as practicable, clean all dirt from gravel and oil aggregate surfaces.
- I. All existing sod areas shall be hand raked to remove earth deposited on or in them during construction.
- J. All ditches shall be graded and properly sloped.
- K. Shoulders where sodding, seeding, or surfacing is not required shall be bladed and shaped.

3.03 FINAL CLEANING

- A. Employ experienced workmen, or professional cleaners, for final cleaning.
- B. Broom clean paved surfaces; rake clean other surfaces of grounds.

END OF SECTION



PART 1 - GENERAL**1.01 SECTION INCLUDES**

- A. Record documents.

1.02 RELATED SECTIONS

- A. Section 01340: Shop Drawings, Project Data, and Samples

1.03 MAINTENANCE OF DOCUMENTS

- A. Maintain at job site, one copy of:
 - 1. Contract Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Reviewed Shop Drawings.
 - 5. Change Orders.
 - 6. Other Modifications to Contract.
 - 7. Field Test Records.
- B. Maintain documents in clean, dry, legible condition.
- C. Do not use record documents for construction purposes.
- D. Make documents available at all times for inspection by Engineer, appropriate State and Federal Regulatory Agencies, and Owner.
- E. Store documents in temporary field office apart from documents used for construction.
- F. Provide files and racks for storage of documents.
- G. File documents in accordance with Project Filing Format of Uniform Construction Index.

1.04 RECORDING

- A. Label each document "PROJECT RECORD" in 2 inch high printed letters.
- B. Keep record documents current.
- C. Do not permanently conceal any work until required information has been recorded.
- D. Contract Drawings: Legibly mark to record actual construction:

1. Depths of various elements of sewer pipe and manholes in relation to survey datum.
 2. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.
 3. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.
 4. Field changes of dimension and detail.
 5. Changes made by Change Order or Field Order.
 6. Details not on original contract drawings.
- E. Specifications and Addenda: Legibly mark up each section to record:
1. Manufacturer, trade name, catalog number, and Supplier of each product and item of equipment actually installed.
 2. Changes made by Change Order or Field Order.
 3. Other matters not originally specified.
- F. Shop Drawings: Maintain as record documents; legibly annotate following drawings to record changes made after review.
1. Electrical controls.
 2. Equipment.
 3. Structural.
 4. Mechanical.

1.05 SUBMITTAL

- A. At completion of project, deliver record documents to the Engineer.
- B. Accompany submittal with transmittal letter, in duplicate, containing:
1. Date.
 2. Project title and number.
 3. Contractor's name and address.
 4. Title and number of each record document.
 5. Certification that each document as submitted is complete and accurate.
 6. Signature of Contractor, or his authorized representative.

END OF SECTION

PART 1 - GENERAL**1.01 DESCRIPTION**

- A. An investigation of subsoil has not been made for this project. Ground water and rock may be encountered in excavations. Depth of ground water may vary seasonally.

1.02 ADDITIONAL INFORMATION

- A. The Contractor should visit the site and acquaint himself with all existing conditions. Prior to bidding, bidders may make their own subsurface investigations to satisfy themselves as to site and subsurface conditions but such subsurface investigations shall be performed only under time schedules and arrangements approved in advance by the Owner. Such exploratory excavation shall be made in a manner and location that will not disturb piping or other buried utilities or facilities.
- B. The Contractor shall satisfy himself as to the nature of the material to be excavated and the amount of rock or water to be handled. The Contractor shall include in his unit prices bid all costs in connection with excavation, dewatering and difficulties encountered and shall assume full risk in the matter.

END OF SECTION



PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Trenching and Trench Backfilling.
- B. Pipe embedment.

1.02 RELATED SECTIONS

- A. Section 02010: Subsurface Conditions
- B. Section 02226: Bored Excavation

PART 2 - PRODUCTS

2.01 FILL AND PIPE EMBEDMENT MATERIAL

- A. Embedment material:
 - 1. Material shall be clean river gravel or sound crushed limestone, free of cementitious, shaly or flat and flaky particles in an amount which would cause the material to cake or pack or otherwise form an unyielding support for the pipe. Gradation shall be:

3/4"	square mesh sieve -	100% passing
1/2"	square mesh sieve -	90-100% passing
No. 4	square mesh sieve -	0-15% passing
No. 8	square mesh sieve -	0-5% passing
 - 2. Where bedding rock is not required, bedding material shall be same as fill material.
- B. Fill material:

Backfill material shall be selected earth or granular fill material, free from sod, sticks and roots over 1/2 inch in diameter, and free from hard lumps, clods or rock in such quantity or concentration as to interfere with the specified compaction. Material shall be of proper moisture content for specified compaction.

PART 3 - EXECUTION**3.01 GENERAL**

- A. Trenching work shall be performed in a safe and proper manner, with suitable precautions being taken against hazards of every kind. Trenching shall provide adequate working space and clearances for the work to be performed therein.
- B. Trenching and backfilling during freezing weather shall not be done except by permission of the Engineer. No backfill materials shall be installed on frozen surfaces nor shall frozen materials, snow or ice be placed in any backfill.
- C. When operating on pavements or walks all equipment shall be rubber tired, except for excavation equipment. Excavating equipment, in such cases, shall not have grousers, cleats or lugs on the tracks. The Contractor shall take all precautions necessary to protect the existing pavements and walks.
- D. No classification of excavated materials will be made. Trenching and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition or condition thereof.
- E. Pipe lines and other existing underground installations and structures in the vicinity of the work to be done hereunder are not indicated on the Plans. The Contractor shall make every effort to locate all underground pipe lines, conduits and structures by contacting Owners of underground utilities and by prospecting in advance of trench excavation. Damage to any existing underground installation caused by the Contractor's operation shall be repaired at the Contractor's expense.
- F. Any delays or extra cost to the Contractor caused by pipe lines or other underground structures or obstructions not shown by the Plans, or found in locations different than those indicated, shall not constitute a claim for extra work, additional payment or damages.
- G. Erosion control of disturbed areas will be required during the construction period through the use of check dams, siltation pools, mulching, etc.
- H. Operation:
 - 1. Use all means necessary to control dust or mud that may interfere with operation.
 - 2. Maintain all streets and driveways free of dirt and materials from Contractor's operation.
- I. Protection:
 - 1. Use all means necessary to protect material and preserve Specification requirements.
 - 2. Replace all damaged material or material that has lost Specification requirements.

3.02 TRENCH EXCAVATION

A. General:

1. The Contractor shall not open more trench in advance of pipe laying than is necessary to expedite the work. One block or 400 feet (whichever is the shorter) shall be the maximum length of open trench permitted on any line under construction.
2. Except where tunneling is permitted by the Engineer or called for on the Plans, all trench excavation shall be open cut from the surface.
3. Trench walls shall be vertical, and braced where necessary, in streets or improved area unless otherwise authorized by Engineer.

B. Alignment and grade:

1. Water lines:

Trenches shall be carefully excavated so that the minimum cover over top of pipe will be 42 inches to existing street or ground surface, or to future surface when indicated. Greater cover at some locations along the line may be required due to street or ground profile and clearance of culverts, structures, utility lines, etc.

C. Minimum trench widths and pipe clearances:

1. Trenches shall be excavated to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing and embedment.
2. Below an elevation of 12 inches from ground level to the top of the installed pipe, the trench width shall be maintained as narrow as possible.
3. Where necessary to reduce the earth load on trench banks to prevent sliding and caving, the banks may be cut back on slopes which shall not extend lower than 1 foot above the top of the pipe.

D. Mechanical excavation:

1. The use of mechanical equipment will not be permitted in locations where its operation would cause damage to buildings, culverts, or other existing property, utilities, or structures above or below ground; in all such locations, hand excavating tools and methods shall be used.
2. Mechanical equipment used for trench excavation shall be of a type, design and construction and shall be so operated, that the rough trench excavation bottom elevation can be controlled, that uniform trench widths and vertical side walls are obtained at least from an elevation 1 foot above the top of the installed pipe to the bottom of the trench, and that the trench alignment is such that the pipe when accurately laid to specified alignment will be centered in the trench with adequate clearance between the pipe and side walls of the trench. Undercutting of the trench side wall to obtain clearance will not be permitted.

E. Bell holes:

Bell holes shall provide adequate clearance for the tools and methods used in installing the pipe. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or the granular fill when the pipe is jointed.

- F. Cutting concrete pavement and walks:
1. Cuts in concrete and asphalt pavements shall be no larger than necessary to provide adequate working space for proper installation of pipe and pipe line appurtenances. Cutting shall be started with a concrete saw (or by other cutting method approved by the Engineer) and in a manner which will provide a clean groove at least 1-1/2 inches deep along each side of the trench and along the perimeter of cuts for structures.
 2. Pavement and base pavement over trenches excavated for pipe lines shall be removed so that a shoulder not less than 6 inches in width at any point is left between the cut edge of the pavement and the top edge of the trench. The trench width at the bottom shall not be greater than at the top and no undercutting will be permitted. Pavement cuts shall be made to and between straight or accurately marked curved lines which, unless otherwise required, shall be parallel to the center line of the trench.

3.03 SHEETING AND SHORING

- A. Except where banks may be cut back on a stable slope, excavation for trenches shall be properly and substantially sheeted, braced and shored, as necessary, to prevent caving or sliding, to provide protection for the workmen and the work, and to provide protection for existing structures and facilities. Sheeting, bracing and shoring shall be designed and built to withstand all loads that might be caused by earth movement or pressure, and shall be rigid, maintaining its shape and position under all circumstances.

3.04 STABILIZATION

- A. General:
1. Trench bottoms shall be firm, dense and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workmen.
 2. Trench bottoms which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with one or more layers of granular fill material or other crushed stone or gravel embedded therein. Not more than 1/2 inch depth of mud or muck shall be allowed to remain on stabilized trench bottoms when the pipe bedding material is placed thereon. The finished elevation of stabilized subgrades for concrete structures shall not be above the subgrade elevations.
 3. All stabilization work hereunder shall be performed by and at the expense of the Contractor.
 4. If the subgrade for pipe can be stabilized with a thickness of granular fill of 12 inches or less below bottom of pipe, or subgrade of structure, such stabilization will be at the Contractor's expense.

3.05 BLASTING

- A. Blasting will not be allowed.

3.06 REMOVAL OF WATER

- A. The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and ground water entering excavations, trenches, or other part of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe line to be installed, therein is completed to the extent that no damage from hydrostatic pressure, flotation, or other causes will result.

3.07 PIPE EMBEDMENT

- A. General:
1. Place pipe embedment material on a suitably prepared subgrade in lifts not exceeding 6 inches and bring up evenly on both sides of pipe. Do not dump over side of trench in any manner that will bring earth into the embedment material or displace the pipe. Compact, vibrate, or slice with a shovel, in such manner that material fill will take its final compaction and provide uniform and solid bearing under the pipe and its haunches.
- B. Water line pipe bedding
1. Where rock has been excavated, selected earth or granular material shall be placed under the sides and around the pipe to a point 6 inches above the top of the pipe. Embedment material shall be deposited simultaneously on each side of the pipe to prevent lateral displacement of the pipe.
 2. When not in rock excavation, all buried pipe shall be installed under Laying Condition Type 2 as described in AWWA C150/A21.50, latest edition. This condition calls for flat-bottom trench with backfill lightly consolidated to the centerline of the pipe.

3.08 TRENCH BACKFILL COMPACTION

- A. General:
- All trench backfill above pipe embedment shall conform to one of the following Specifications:
1. All County and City gravel surface roads shall be backfilled entirely with approved crushed rock or river gravel. The disposal of unsuitable material excavated will be the responsibility of the Contractor.
 2. Ninety percent compacted backfill. Under streets, drives or state or county highways surfaced with gravel, crushed stone, "blacktop" or other low or intermediate type surfacing. In street, road, highway, railway or alley rights-of-way. In traveled ways. In established lawns. Any line within 5 feet of back of

- curb or 5 feet of street surfacing if no curb, either perpendicular to or parallel to the street shall be considered as under the street surfacing, and 90 percent compaction shall apply.
3. Ninety-five percent compacted backfill. Under concrete, asphaltic concrete, brick, concrete structures or other high type pavements. Under concrete walks, curbs, gutters and culverts. Under all types of street surfacing where trench cut is approximately at right angle to roadway.
 4. In areas not listed above, backfill shall be compacted to equal to the surrounding ground.
 5. Six inches of topsoil shall be placed in the top of trenches that are to be covered with sod or to be seeded.
 6. If specified density cannot be obtained with available earth, the Contractor shall furnish and haul granular fill material or suitable earth at his expense. Unsuitable earth shall be disposed of at the Contractor's expense.
 7. The Engineer will call for density tests to be made whenever deemed necessary. The specified density will be the minimum allowed and the obtainment thereof will be entirely the Contractor's responsibility.
 8. Thickness of backfill layers will be determined by the coordination of test results with field performance and equipment used. The Contractor will be expected to maintain established procedures except where unusual conditions arise. If greater than 12 inch thick compacted layers are used, the Contractor shall hand excavate to the test level as directed by the Engineer and then refill the test excavation with compacted backfill to the specified density.
 9. All completed lines shall be returned, in the opinion of the Engineer, as nearly as possible to original condition, including reseeded, resodded or repaving.

3.09 DRAINAGE MAINTENANCE

- A. Trenches across roadways, driveways, walks, or other trafficways adjacent to drainage ditches or water courses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the trafficway, to prevent impounding water after the pipe has been laid. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by the Contractor. Backfilling shall be done so that water will not accumulate in unfilled or partially filled trenches. All material deposited in roadway ditches or other water courses crossed by the line of trench shall be removed immediately after backfilling is completed and the section, grades, and contours of ditches or water courses shall be restored to their original condition. Surface drainage shall not be obstructed longer than necessary.

3.10 FINAL GRADING AND DISPOSAL OF EXCESS EXCAVATED MATERIALS

- A. General:
 1. Except as otherwise indicated, all excess excavated materials shall be disposed of by the Contractor away from the site of the work.

2. Pavement and pavement base material, excavated rock in excess of the amount permitted to be and actually installed in trench backfill, junk and debris encountered in excavation work, and other similar waste materials shall be disposed of away from the site of the work.
 3. The disposal of waste and excess excavated materials, including hauling, handling, leveling and surfacing, shall be at the Contractor's expense.
- B. Excess backfill:
The Contractor shall dispose of excess excavated material above the surface of the ground or subgrade of pavement walks, etc., unless otherwise directed. If directed, he shall grade excess earth into adjacent low areas, fine grading and sloping to drain.
- C. Final grading:
1. Just prior to completion and acceptance of the project, the Contractor shall final grade over all pipe trenches and around structures, filling in any places that may have settled during the period between construction of each line and the completion of the entire Contract. Finished surface shall be bladed and aligned to a neat and uniform appearance.
2. Improved yards and lawns:
Fine grade, suitable for seeding or sodding. Hand rake earth off grass in established lawn areas, unless directed to leave excess earth as outlined above.
- D. Deficiency of backfill:
Wherever there is a deficiency of material required to backfill to the specified surface or subgrade, the Contractor shall furnish the necessary amount of suitable earth at his expense.
- E. Restoration of disturbed earth:
The Contractor shall restore all earth areas disturbed from the original condition by his operations. Restoration will be by seeding, fertilizing and mulching or by appropriate pavement and street repair.

3.11 RESPONSIBILITY OF CONTRACTOR FOR BACKFILL SETTLEMENT

- A. The Contractor shall be responsible financially and otherwise, for:
1. All settlement of trench and other backfill which may occur from time of original backfilling until the expiration of 1 year after the date of final payment for the entire contract under which the backfilling work was performed.
 2. The refilling and repair of all backfill settlement and the repair or replacement to the original or a better condition of all pavement, top surfacings, driveways, walks, surface structures, utilities, drainage facilities and sod which may have been damaged as a result of backfill settlement or which have been removed or destroyed in connection with backfill replacement operations.
 3. All damage claims or court actions against the Owner for any damage directly or indirectly caused by backfill settlement.
- B. The Contractor shall make all necessary backfill replacements and repairs, or replacements appurtenant thereto, within 30 days after notification by the Owner or Engineer. Upon the

Contractor's failure to do so, the Owner may do, or have done, the necessary work and charge the cost to the Contractor.

3.12 BARRICADES AND LIGHTS

- A. All streets, roads, highways and other public thoroughfares which are closed to traffic shall be protected by means of effective barricades on which shall be placed acceptable warning signs. Barricades shall be located at the nearest intersecting public highway or street on each side of the blocked section.
- B. All open trenches and other excavations shall be provided with suitable barriers, signs, and lights to the extent that adequate protection is provided to the public. Obstructions such as material piles and equipment, shall be provided with similar warning signs and lights.
- C. All barricades and obstructions shall be illuminated by means of warning lights at night. All lights used for this purpose shall be kept on from sunset to sunrise. Materials stored shall be so placed, and the work at all times shall be so conducted, as to cause the minimum obstruction and inconvenience to the public.
- D. All barricades, signs, lights and other protective devices shall be installed and maintained in conformity with applicable statutory requirements, and where within highway rights-of-way, as required by the authority having jurisdiction hereover.

3.13 MAINTENANCE OF TRAFFIC

- A. The Contractor shall conduct his work so as to interfere as little as possible with public travel, whether vehicular or pedestrian; whenever it is necessary to cross, obstruct, or close roads, driveways, and walks, whether public or private, the Contractor shall at his own expense provide and maintain suitable and safe bridges, detours, or other temporary expedients for the accommodation of public and private travel, and shall give reasonable notice to Owners of private drives before interfering with them; provided however, that such maintenance of traffic will not be required at any point where the Contractor has obtained permission from the Owner and tenant of private property, or from the authority having jurisdiction over the public property involved, to obstruct traffic at any designated point thereon and for the duration of whatever period of time as may be agreed upon.

3.14 CROSSING

- A. Highway crossings - main:
Crossings of pavements controlled by the State shall include all labor, tools, machines, and materials required for a complete installation to the satisfaction of the District Highway Engineer. This shall include all excavation, boring, steel casing, and compaction of backfill as required. Installation and safety policies required by the State shall be strictly adhered to.

- B. Street crossing - bored:
Crossings designated as Street Crossings on the Plans shall include all labor, tools, and materials necessary for a complete installation. This includes all excavation, boring, steel casing, compaction of the backfill and repair of pavement. Where street pavements are on State Highway right-of-way, requirements of the State shall be strictly adhered to.
- C. Street crossings - open cut:
Crossing shall include all materials, labor, and tools necessary for a complete crossing and repair of the street. This will include pavement removal, trenching, disposal of excess material, crushed rock backfill, replacement of pavement, casing pipe and all other necessary items.

END OF SECTION



PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Directional Boring under highways, roads, railroads and other obstruction.

1.02 RELATED SECTIONS

- A. Section 02010: Subsurface Conditions
- B. Section 02221: Trenching, Backfilling and Compaction

1.03 SUPERVISION AND QUALITY

- A. This work shall comply with all codes governing and all insurance requirements. Work shall be undertaken only when the construction superintendent is present and supervising the work.

1.04 REQUIREMENTS OF REGULATORY AGENCIES

- A. Crossings shall be completed in accordance with applicable federal, state and local regulations.

1.05 SUBMITTALS

- A. Work Plan:
Prior to beginning work, the Contractor must submit to the Engineer a general work plan outlining the procedure and schedule to be used to execute the project. Plan should document the thoughtful planning required to successfully complete the project.
- B. Equipment:
Contractor will submit specifications on directional boring equipment to be used to ensure that the equipment will be adequate to complete the project. Spares inventory shall be included.
- C. Material:
Specifications on material to be used shall be submitted to Engineer. Material shall include the pipe, fittings and any other item which is to be an installed component of the project.
- D. Personnel:
Documentation of training and relevant experience of personnel shall be submitted.

PART 2 - PRODUCTS

2.01 CARRIER PIPE

- A. Carrier pipe shall be as shown on the plans and called for on the Bid Form.

2.02 BORING SYSTEM

- A. Boring Rig:
The directional boring machine shall consist of a hydraulically powered system to rotate, push and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the crossing. The hydraulic power system shall be self-contained with sufficient pressure and volume to power boring operations. Hydraulic system shall be free of leaks. Rig shall have a system to monitor and record maximum pull-back pressure during pull-back operations. The rig shall be grounded during boring and pull-back operations. Sufficient spares shall be kept on hand for any break-downs which can be reasonably anticipated.
- B. Bore Head:
The bore head shall be steerable by changing its rotation and shall provide the necessary cutting surfaces and boring fluid jets.

2.03 GUIDANCE SYSTEM

- A. The Guidance System shall be of a proven type and shall be setup and operated by personnel trained and experienced with this system. The Operator shall be aware of any magnetic anomalies and shall consider such influences in the operation of the guidance system if using a magnetic system.

2.04 BORING FLUID (MUD) SYSTEM

- A. Mixing System:
A self-contained, closed, boring fluid mixing system shall be of sufficient size to mix and deliver boring fluid composed of bentonite clay, potable water and appropriate additives. Mixing system shall be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure thorough mixing. Mixing system shall continually agitate the boring fluid during boring operations.
- B. Boring Fluids:
Drilling fluid shall be composed of clean water and an appropriate additive. Water shall be from a clean source with a pH of 8.5 - 10. Water of a lower pH or with excessive calcium shall be treated with the appropriate amount of sodium carbonate or equal. The water and additives shall be mixed thoroughly and be absent of any clumps or clods. No hazardous additives may be used. Boring fluid shall be maintained at a viscosity sufficient to suspend cuttings and maintain the integrity of bore wall.

2.05 OTHER EQUIPMENT

- A. Pipe Rollers:
Pipe rollers, if required, shall be of sufficient size to fully support the weight of the pipe while being hydro-tested and during pull-back operations. Sufficient number of rollers shall be used to prevent excess sagging of pipe.
- B. Pipe Rammers/Pullers:
Hydraulic or pneumatic pipe rammers or pullers may only be used if necessary and with the authorization of Engineer.

PART 3 - EXECUTION

3.01 GENERAL

- A. The depths and locations of bore and receiving pits (working pits) shall be established by the Contractor in accordance with the horizontal alignment and grade as shown on the project construction plans.
- B. The working pits shall adhere to OSHA requirements. Barricades shall be furnished around working pits to safeguard traffics and pedestrians.
- C. All discharge from dewatering of the working pits shall be directed into approved receiving basins in accordance with all applicable regulatory requirements.
- D. The working pits shall be in locations that in no way interfere with the operation of highways, streets, driveways, railroads or other facilities. Working pits shall not weaken or damage any embankment, utility or structure.

3.02 CONSTRUCTION

- A. The directional bore machine shall be located at the low or downstream end, if possible.
- B. The directional bore machine shall be equipped with a spoil transportation equipment using drilling fluid. The drilling fluid shall be compatible for soil condition. The drilling fluid, such as bentonite, shall be used lubricating the casing during pull back operation.
- C. The drill bit head shall not be greater than the diameter of the pipe.
- D. The directional bore machine shall be equipped with an output signal that is located within the drill bit head. The output signal from the drill bit head shall allow the operator of the directional bore machine to track the location of the drill bit head.
- E. Spoil material and drilling fluid shall be removed from the working pits and disposed of properly.

- F. After completion of the pilot bore pipe installation and the backfill operation, the Contractor shall restore the profile of the right-of-way and/or surface to its original condition.

3.03 PERSONNEL REQUIREMENTS

- A. All personnel shall be fully trained in their respective duties as part of the directional boring crew and in safety. Training shall be provided specific to the project if any potential hazards may be encountered which has not already been included in personnel's training.

3.04 BORING PROCEDURE

- A. **Site Preparation:**
Prior to any alterations to work-site, contractor shall photograph or video tape entire work area, including entry and exit points. One copy of which shall be given to Engineer and one copy to remain with contractor for a period of one year following the completion of the project.
- B. **Bore Path Survey:**
Entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings. If contractor is using a magnetic guidance system, drill path will be surveyed for any surface geo-magnetic variations or anomalies.
- C. **Environmental Protection:**
Contractor shall place silt fence between all boring operations and any drainage, wetland, waterway or other area designated for such protection by contract documents, state, federal and local regulations. Additional environmental protection necessary to contain any hydraulic or boring fluid spills shall be put in place, including berms, liners, turbidity curtains and other measures. Contractor shall adhere to all applicable environmental regulations. Fuel or oil may not be stored in bulk containers within 200' of any water-body or wetland.
- D. **Utility Locates:**
Contractor shall notify all companies with underground utilities in the work area via the state or local "one-call" to obtain utility locates.

Once the utilities have been located Contractor shall physically identify the exact location of the utilities by vacuum or hand excavation, when possible, in order to determine the actual location and path of any underground utilities which might be within 20 feet of the bore path. Contractor shall not commence boring operations until the location of all underground utilities within the work area have been verified.

- E. **Safety:**
Contractor shall adhere to all applicable state, federal and local safety regulations and all operations shall be conducted in a safe manner. Safety meetings shall be conducted at least weekly with a written record of attendance and topic submitted to Engineer.

- F. Pipe:
Pipe shall be connected together in one length prior to pull-back operations, if space permits. Pipe will be placed on pipe rollers before pulling into bore hole with rollers spaced close enough to prevent excessive sagging of pipe.
- G. Pilot Hole:
Pilot hole shall be drilled on bore path with no deviations greater than 5% of depth over a length of 100'. In the event that pilot does deviate from bore path more than 5% of depth in 100', contractor will notify Engineer and Engineer may require contractor to pull-back and re-drill from the location along bore path before the deviation.
- In the event that an obstruction is encountered during the pilot bore, or the pilot hole pipe is misaligned, the pipe is to be removed from the borehole and the borehole shall be filled with pumpable, flowable fill at a sufficient pressure to and fill all voids. The cost of the pumpable, flowable fill, removal of pipe and re-bore/re-installing the pipe is incidental to the cost of the project.
- H. Reaming:
Upon successful completion of pilot hole, contractor will ream bore hole to a minimum of 25% greater than outside diameter of pipe using the appropriate tools. Contractor will not attempt to ream at one time more than the boring equipment and mud system are designed to safely handle.
- I. Pull-Back:
After successfully reaming bore hole to the required diameter, contractor will pull the pipe through the bore hole. In front of the pipe will be a swivel. Once pull-back operations have commenced, operations must continue without interruption until pipe is completely pulled into bore hole. During pull-back operations contractor will not apply more than the maximum safe pipe pull pressure at any time.
- In the event that pipe becomes stuck, contractor will cease pulling operations to allow any potential hydro-lock to subside and will commence pulling operations. If pipe remains stuck, contractor will notify Engineer. Engineer and contractor will discuss options and then work will proceed accordingly.

3.05 SITE RESTORATION

- A. Following boring operations, contractor will de-mobilize equipment and restore the work-site to original condition. All excavations will be backfilled and compacted to 95% of original density. Landscaping will be restored to original.

3.06 EXCAVATION

- A. The Contractor shall, during the entire period of construction, provide and maintain any necessary equipment as will, whenever practicable, keep his excavations reasonably free

from water pending construction. When necessary to use pumps the Contractor must dispose of the water without detriment to adjacent properties.

3.07 SHEETING AND SHORING

A. General:

Except where banks may be cut back on a stable slope, excavation for trenches shall be properly and substantially sheeted, braced and shored, as necessary, to prevent caving or sliding, to provide protection for the workmen and the work, and to provide protection for existing structures and facilities. Sheeting, bracing and shoring shall be designed and built to withstand all loads that might be caused by earth movement or pressure, and shall be rigid, maintaining its shape and position under all circumstances.

3.08 FINAL GRADING AND DISPOSAL OF EXCESS EXCAVATED MATERIALS

A. General:

1. Except as otherwise indicated, all excess excavated materials shall be disposed of by the Contractor away from the site of the work.
2. Excavated rock, junk and debris encountered in excavation work, and other similar waste materials shall be disposed of away from the site of the work.
3. The disposal of waste and excess excavated materials, including hauling, handling, leveling and surfacing, shall be at the Contractor's expense.

B. Restoration of disturbed earth:

The Contractor shall restore all earth areas disturbed from the original condition by his operations. Restoration will be by seeding, fertilizing and mulching to obtain an established cover or by appropriate pavement and street repair.

3.09 RESPONSIBILITY OF CONTRACTOR FOR BACKFILL SETTLEMENT

A. The Contractor shall be responsible financially and otherwise, for:

1. All settlement of trench and other backfill which may occur from time of original backfilling until the expiration of 1 year after the date of final payment for the entire contract under which the backfilling work was performed.
2. The refilling and repair of all backfill settlement and the repair or replacement to the original or a better condition of all pavement, top surfacings, driveways, walks, surface structures, utilities, drainage facilities and sod which may have been damaged as a result of backfill settlement or which have been removed or destroyed in connection with backfill replacement operations.
3. All damage claims or court actions against the Owner for any damage directly or indirectly caused by backfill settlement.

B. The Contractor shall make all necessary backfill replacements and repairs, or replacements appurtenant thereto, within 30 days after notification by the Owner or Engineer. Upon the Contractor's failure to do so, the Owner may do, or have done the necessary work and charge the cost to the Contractor.

3.10 MAINTENANCE OF TRAFFIC

- A. The Contractor shall conduct his work so as to interfere as little as possible with public travel, whether vehicular or pedestrian; whenever it is necessary to cross, obstruct, or close roads, driveways, and walks, whether public or private, the Contractor shall at his own expense provide and maintain suitable and safe bridges, detours, or other temporary expedients for the accommodation of public and private travel, and shall give reasonable notice to owners of private drives before interfering with them; provided however, that such maintenance of traffic will not be required at any point where the Contractor has obtained permission from the owner and tenant of private property, or from the authority having jurisdiction over the public property involved, to obstruct traffic at any designated point thereon and for the duration of whatever period of time as may be agreed upon.

END OF SECTION



PART 1 - GENERAL**1.01 SECTION INCLUDES**

- A. Boring under highways, roads and railroads.
- B. Casing pipe.

1.02 RELATED SECTIONS

- A. Section 02010: Subsurface Conditions
- B. Section 02221: Trenching, Backfilling and Compaction

1.03 SUPERVISION AND QUALITY

- A. This work shall comply with all codes governing and all insurance requirements. Work shall be undertaken only when the construction superintendent is present and supervising the work.

1.04 REQUIREMENTS OF REGULATORY AGENCIES

- A. Crossings shall be completed in accordance with applicable federal, state and local regulations. In the case of railroad crossings, the project shall comply with regulations established by the railroad company.

PART 2 - PRODUCTS**2.01 CASING PIPE**

- A. Smooth wall casing pipe shall be of welded steel construction and shall be new material with a minimum yield point of 35,000 psi. The pipe shall have a wall thickness as noted on the plans.
- B. Casing wall thickness shall be 1/4 inch thick for casing pipe 10 inch thru 16 inches, 3/8 inch thick for casing pipe 18 inch thru 24 inches, 1/2 inch thick for 30 inches.

2.02 CARRIER PIPE

- A. Carrier pipe shall be as noted on the Plans and specified within.

2.03 CASING SPACERS

- A. Spacers shall be RACI Type F from Public Works Marketing or approved equal. HDPE spacers shall be Type F or Type G for carrier pipe sizes 4-inch through 16-inch. Three spacers shall be used for each joint of pipe with a maximum spacing of 6 ft.

2.04 END SEALS

- A. End seals shall be synthetic rubber "wrap around" style with stainless steel bond as manufactured by Advance Products & Systems, Inc. or approved equal.

PART 3 - EXECUTION**3.01 GENERAL**

- A. Crossings under highways, roads and railroads shall be continuously encased under the through roadways, median, ramps and shoulder area to the limits called for or required by the federal, state and local regulations. Railroad crossings shall conform to the requirements of the regulations established by the railroad company.
- B. Work shall be performed in a safe and proper manner, with suitable precautions being taken against hazards of every kind. All crossings shall be bored, unless rock formations or other obstructions are encountered that prevents boring or pushing operations. If such conditions are encountered, excavation shall be performed by standard tunneling methods.
- C. Excavations shall provide adequate clearance for installation of and removal of equipment.
- D. Backfilling and construction of fills and embankments during freezing weather shall not be done except by permission of the Engineer. No backfill, fill or embankment materials shall be installed on frozen surfaces nor shall frozen materials, snow or ice be placed in any backfill, fill or embankments.
- E. When operating on pavements or walks all equipment shall be rubber tired, except for excavation equipment. Excavating equipment, in such cases, shall not have grousers, cleats or lugs on the tracks. The Contractor shall take all reasonable precautions to protect the existing pavements and walks.

- F. No classification of excavated materials shall be made. Boring excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition or condition thereof.
- G. Pipe lines and other existing underground installations and structures in the vicinity of the work to be done hereunder are not indicated on the plans. The Contractor shall make every effort to locate all underground pipe lines, conduits and structures by contacting owners of underground utilities and by prospecting in advance of excavation and boring. Damage to any existing underground installation caused by the Contractor's operation shall be repaired at the Contractor's expense.
- H. Any delays or extra cost to the Contractor caused by pipe lines or other underground structures or obstructions not shown by the plans, or found in locations different than those indicated, shall not constitute a claim for extra work, additional payment or damages.
- I. Erosion control of disturbed areas shall be required during the construction period through the use of check dams, siltation pools, mulching, etc.
- J. The Contractor shall meet the specific requirements of the Highway Department or Railroad. The Contractor shall obtain all necessary permits and insurance.
- K. Operation:
Use all means necessary to control dust or mud that may interfere with operation.
- L. Protection:
 - 1. Use all means necessary to protect material and preserve specification requirements.
 - 2. Replace all damaged material or material that has lost specification requirements.

3.02 EXCAVATION

- A. The Contractor shall, during the entire period of construction, provide and maintain any necessary equipment as will, whenever practicable, keep his excavations reasonably free from water pending construction. When necessary to use pumps the Contractor must dispose of the water without detriment to adjacent properties.

3.03 SHEETING AND SHORING

- A. General:
Except where banks may be cut back on a stable slope, excavation for trenches shall be properly and substantially sheeted, braced and shored, as necessary, to prevent caving or sliding, to provide protection for the workmen and the work, and to provide protection for existing structures and facilities. Sheet piling, bracing and shoring shall be designed and built to withstand all loads that might be caused by earth movement or pressure, and shall be

rigid, maintaining its shape and position under all circumstances.

3.04 CASING AND CARRIER PIPE INSTALLATION

- A. Casing pipe:
1. Before starting work on borings, complete details of the method of operation and casing to be used shall be submitted to the Engineer for review. All permits shall be obtained by the Contractor.
 2. Casing pipes shall have a clear inside diameter not smaller than the size indicated on the schedule.
 3. The casing pipe shall be installed by jacking into place. Earth displaced by the casing pipe shall be removed through the interior of the casing by hand, by auger, or by other acceptable means. Sections of the casing pipe shall be welded together to form a continuous casing capable of resisting all stresses, including jacking stresses. The casing pipe in its final position shall be straight and true in alignment and grade. There shall be no space between the earth and the outside of the casing.
- B. Carrier pipe:
Polyethylene casing insulators shall be strapped to each end of each piece of pipe. The pipe shall then be pushed into the casing pipe with care being taken to ensure the joints are not displaced. The joints in the installed pipe within the casing shall be tested for leakage before the backfill is installed.
- C. Casing closure:
Following the installation of the carrier pipe in the casing pipe, the ends of the casing pipe shall then be closed with wrap around or pull-on end seals as manufactured by Advance Products & Systems, Inc.

3.05 FINAL GRADING AND DISPOSAL OF EXCESS EXCAVATED MATERIALS

- A. General:
1. Except as otherwise indicated, all excess excavated materials shall be disposed of by the Contractor away from the site of the work.
 2. Excavated rock, junk and debris encountered in excavation work, and other similar waste materials shall be disposed of away from the site of the work.
 3. The disposal of waste and excess excavated materials, including hauling, handling, leveling and surfacing, shall be at the Contractor's expense.
- B. Restoration of disturbed earth:
The Contractor shall restore all earth areas disturbed from the original condition by his operations. Restoration will be by seeding, fertilizing and mulching to obtain an established cover or by appropriate pavement and street repair.

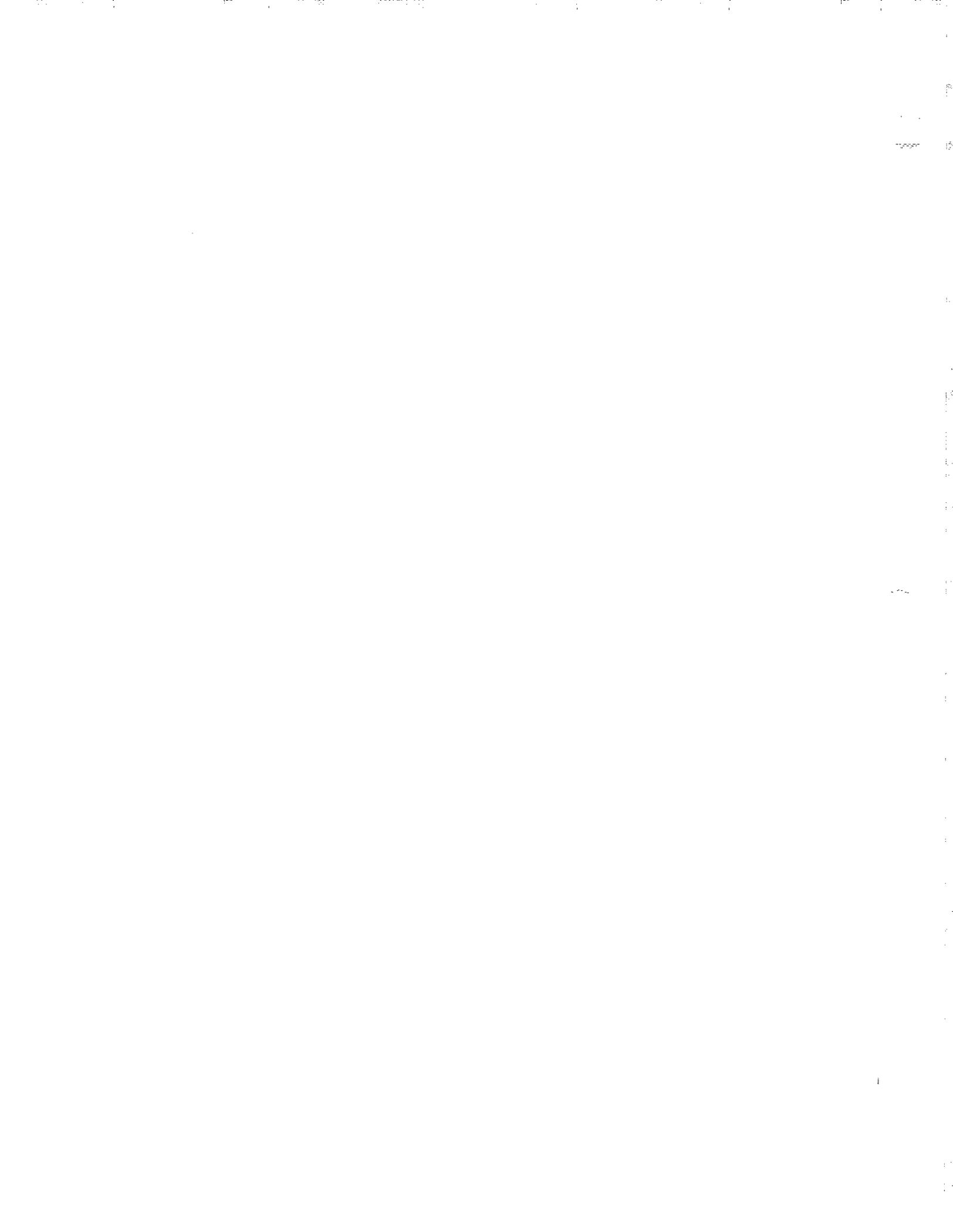
3.06 RESPONSIBILITY OF CONTRACTOR FOR BACKFILL SETTLEMENT

- A. The Contractor shall be responsible financially and otherwise, for:
1. All settlement of trench and other backfill which may occur from time of original backfilling until the expiration of 1 year after the date of final payment for the entire contract under which the backfilling work was performed.
 2. The refilling and repair of all backfill settlement and the repair or replacement to the original or a better condition of all pavement, top surfacings, driveways, walks, surface structures, utilities, drainage facilities and sod which may have been damaged as a result of backfill settlement or which have been removed or destroyed in connection with backfill replacement operations.
 3. All damage claims or court actions against the Owner for any damage directly or indirectly caused by backfill settlement.
- B. The Contractor shall make all necessary backfill replacements and repairs, or replacements appurtenant thereto, within 30 days after notification by the Owner or Engineer. Upon the Contractor's failure to do so, the Owner may do, or have done, the necessary work and charge the cost to the Contractor.

3.07 MAINTENANCE OF TRAFFIC

- A. The Contractor shall conduct his work so as to interfere as little as possible with public travel, whether vehicular or pedestrian; whenever it is necessary to cross, obstruct, or close roads, driveways, and walks, whether public or private, the Contractor shall at his own expense provide and maintain suitable and safe bridges, detours, or other temporary expedients for the accommodation of public and private travel, and shall give reasonable notice to owners of private drives before interfering with them; provided however, that such maintenance of traffic will not be required at any point where the Contractor has obtained permission from the owner and tenant of private property, or from the authority having jurisdiction over the public property involved, to obstruct traffic at any designated point thereon and for the duration of whatever period of time as may be agreed upon.

END OF SECTION



PART 1 - GENERAL**1.01 SECTION INCLUDES**

- A. Temporary sediment barrier.
- B. Temporary ditch checks

1.02 QUALITY ASSURANCE

- A. Regulatory Requirements
Erosion controls shall meet all requirements of the EPA.

1.03 SYSTEM DESCRIPTION

- A. Definitions
 - 1. Silt Fence
A temporary sediment barrier consisting of filter fabric buried at the bottom, stretched, and supported by posts.
 - 2. Ditch Checks
A barrier installed across, or at the toe of, a slope to intercept and detain sediment.
- B. Purpose
 - 1. Silt Fence
To retain sediment from small disturbed areas by reducing the velocity of sheet flows to allow sediment deposition.
 - 2. Ditch Checks
To intercept and detain small amounts of sediment from unprotected areas of less than 1/2 acre.
- C. Location
 - 1. Silt Fence
 - a. Below small disturbed areas.
 - b. Where runoff can be stored behind the sediment fence without damaging the fence or the submerged area behind the fence.
 - c. Do not install sediment fences across streams, ditches, or waterways.
 - 2. Ditch Checks
 - a. Where contributing area is approximately 1/2 acre, or less.
 - b. Where there is no concentration of water in a channel above the barrier.
 - c. Where erosion would normally occur in form of sheet erosion.
 - d. Where length of slope above the barrier is less than 100 feet.
 - e. Straw bales shall not be used on high sediment producing areas, above "high risk" areas, where water concentrates, or where there would be a possibility of a washout.

D. Planning

1. A sediment fence is a permeable barrier that shall be planned as a system to retain sediment on the construction site. The fence retains sediment primarily by retarding flow and promoting deposition. In operation, generally the fence becomes clogged with fine particles, which reduce flow rate. This causes a pond to develop more quickly behind the fence. Anticipate ponding and provide sufficient storage areas and overflow outlets to prevent flows from overtopping the fence. Since sediment fences are not designed to withstand high heads, locate them so that only shallow pools can form. Tie the ends of a sediment fence into the landscape to prevent flow around the end of the fence before the pool reaches design level. Provide stabilized outlets to protect the fence system and release storm flows that exceed the design storm.
2. Deposition occurs as the storage pool forms behind the fence. Plan deposition areas at accessible points to promote routine cleanout.

E. Design Criteria

1. Silt Fence
 - a. Ensure that the drainage area is no greater than 1/4 acre per 100 ft. of fence.
 - b. Make the fence stable for the 10-yr. peak storm runoff.
 - c. Ensure that the depth of impounded water does not exceed 1.5 ft. at any point along the fence.
 - d. Provide a riprap splash pad or other outlet protection device for any point where flow may overtop the sediment fence, such as natural depressions or swales. Ensure that the maximum height of the fence at a protected, reinforced outlet does not exceed 1 ft. and that support post spacing does not exceed 4 ft.
 - e. The design life of a synthetic sediment fence should be 6 months.

PART 2 - PRODUCTS**2.01 MATERIALS****A. Silt Fence**

1. Use a synthetic filter fabric or a pervious sheet of polypropylene, nylon, polyester, or polyethylene yard, which is certified by the manufacturer or supplier as conforming to the requirements shown in Table below.
2. Synthetic filter fabric should contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0 to 120° F.
3. Posts for sediment fences shall be either 4-inch diameter pine, 2-inch diameter oak, or 1.33 lb/linear ft. steel with a minimum length of 4 ft. Make sure that steel posts have projections to facilitate fastening the fabric.
4. For reinforcement of standard strength filter fabric, use wire fence with a minimum 14 gauge and a maximum mesh spacing of 6 inches.

5. SEDIMENT FENCE FABRIC SPECIFICATIONS

<u>Physical Property</u>	<u>Minimum Requirements</u>
Filtering Efficiency	85%
Tensile Strength at 20% (max.) Elongation	Standard Strength @ 30 psi Extra Strength @ 50 psi
Slurry Flow Rate	0.3 gal/sq ft/min

B. Straw Bales

1. Straw shall be locally baled material.
2. Anchors shall be #5 reinforcing bars or 2"x2" oak stakes.

PART 3 - EXECUTION**3.01 CONSTRUCTION**

A. Silt Fence

1. Construct the sediment barrier of standard strength or extra strength synthetic filter fabrics.
2. Ensure that the height of the sediment fence does not exceed 18 inches above the ground surface. (Higher fences may impound volumes of water sufficient to cause failure of the structure.)
3. Construct the filter fabric from a continuous roll cut to the length of the barrier to avoid joints. When joints are necessary, securely fasten the filter cloth only at a support post with overlap to the next post.
4. Support standard strength filter fabric by wire mesh fastened securely to the upslope side of the posts using heavy duty wire staples at least 1 inch long, or tie wires. Extend the wire mesh support to the bottom of the trench.
5. When a wire mesh support fence is used, space posts a maximum of 8 ft. apart. Support posts should be driven securely into the ground to a minimum of 18 inches.
6. Extra strength filter fabric with 6-ft. post spacing does not require wire mesh support fence. Staple or wire the filter fabric directly to the posts.
7. Excavate a trench approximately 4 inches wide and 8 inches deep along the proposed line of posts and upslope from the barrier.
8. Backfill the trench with compacted soil or gravel placed over the filter fabric.
9. Do not attach filter fabric to existing trees.

B. Ditch Checks

1. Bales will be placed in a single row, lengthwise, on the contour and embedded in the soil to a depth of 3 inches.

2. Bales must be securely anchored in place by stakes or re-bars driven through the bales or by other acceptable means to prevent displacement.
3. Inspection must be frequent and repair or replacement must be made promptly as needed.

3.02 MAINTENANCE

A. Silt Fence

1. Inspect sediment fences at least once a week and after each rainfall. Make any required repairs immediately.
2. Should the fabric of a sediment fence collapse, tear, decompose, or become ineffective, replace it promptly.
3. Remove sediment deposits as necessary to provide adequate storage volume for the next rain and to reduce pressure on the fence. Take care to avoid undermining the fence during cleanout.
4. Remove all fencing materials and unstable sediment deposits and bring the area to grade and stabilize it after the contributing drainage area has been properly stabilized.

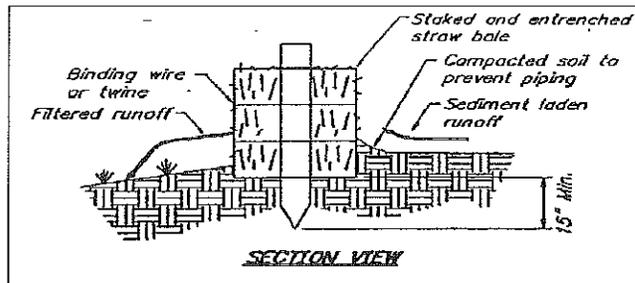
B. Ditch Checks

1. Inspect straw bale barriers at least once a week and after each rainfall. Make any required repairs immediately.
2. Should the barrier collapse, decompose or become ineffective, replace it promptly.
3. Remove sediment deposits as necessary to provide adequate storage volume for the next rain and to reduce pressure on the barrier.
4. Remove the barrier and unstable sediment deposits and bring the area to grade and stabilize it after the contributing drainage area has been properly stabilized.

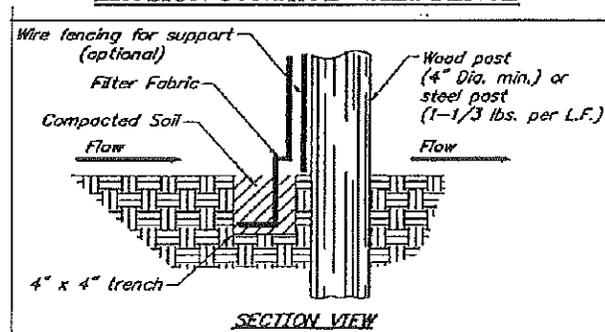
3.03 CLEANUP

A. General

1. Remove all silt and other debris from project site.
2. Remove all silt fence and ditch check materials from project site.
3. Grade area for uniform slope to blend with existing or finish contours.

EROSION CONTROL – DITCH CHECK**Notes:**

1. Straw bales shall not be used longer than a time period of three months. If construction continues beyond this time period, replace bales with new.
2. Excavate a trench along the areas that the straw bales will be used as erosion control to a depth of 4 inches and to the width of one straw bale. The straw bales then shall be placed in the trench. Place excavated material on upstream side of the trench.
3. Straw bales shall be anchored with a min. of 2 stakes or rebars driven into the underlying soil, making sure that the binding wire or twine is facing the sides and not touching the soil. The first stake into each bale shall be driven toward the previously laid bale to force them together.
4. Spacing between the bales shall be tightly chinked with loose straw.
5. After straw bales are in place the excavated soil shall be backfilled against the upslope side of the straw bales to a height of 4 inches after compacting.
6. Straw bales shall be inspected after each rainfall to determine if any repairs or replacements to the straw bales are needed. If it is determined that the straw bales need to be repaired or replaced, the work will occur immediately. Sediment accumulations must be removed when they reach 1/2 the barrier height.

EROSION CONTROL – SILT FENCE**Notes:**

1. The filter fabric shall have a minimum filtering efficiency of 75% a minimum tensile strength of 30 lbs. per linear inch and a flow rate of 0.3 gallons per square foot per minute. The filter fabric shall also have ultraviolet ray inhibitors to assure a life use expectancy of 6 months at 0 to 100 degrees fahrenheit.
2. The filter fabric shall be 36 inches or less in height. Joints shall occur only at posts with 6 inch minimum overlap. Posts shall be spaced 10 feet on center when wire mesh support is included or 6 feet on center without wire mesh support. A minimum of 8 inches of fabric will be buried in the 4" x 4" trench.
3. The silt fence shall be inspected after every rainfall to determine if any part of the fence needs to be repaired or replaced. If it is determined that the fence needs any repair or replacement, this work will occur immediately.
4. Sediment deposits shall be removed after each rainfall or before they accumulate to 1/3 of the fence height.

PART 1 - GENERAL

1.01 SELECTION INCLUDES

Removing and replacement of various pavement surface required for this project.

1.02 RELATED SECTION:

Section 02221: Trenching, Backfilling, and Compaction

1.03 JOB CONDITION:

A. Operation:

1. Use all means necessary to control dust or mud that may interfere with the neighborhood.
2. Traffic access shall be maintained.

B. Protection:

1. Use all means necessary to protect material and preserve specification requirements.
2. Replace all damaged material or material that has lost specification requirements.

PART 2 - PRODUCTS

Not Specifically Required

PART 3 - EXECUTION

3.01 STREET REPAIR AND DRIVEWAY REPAIR

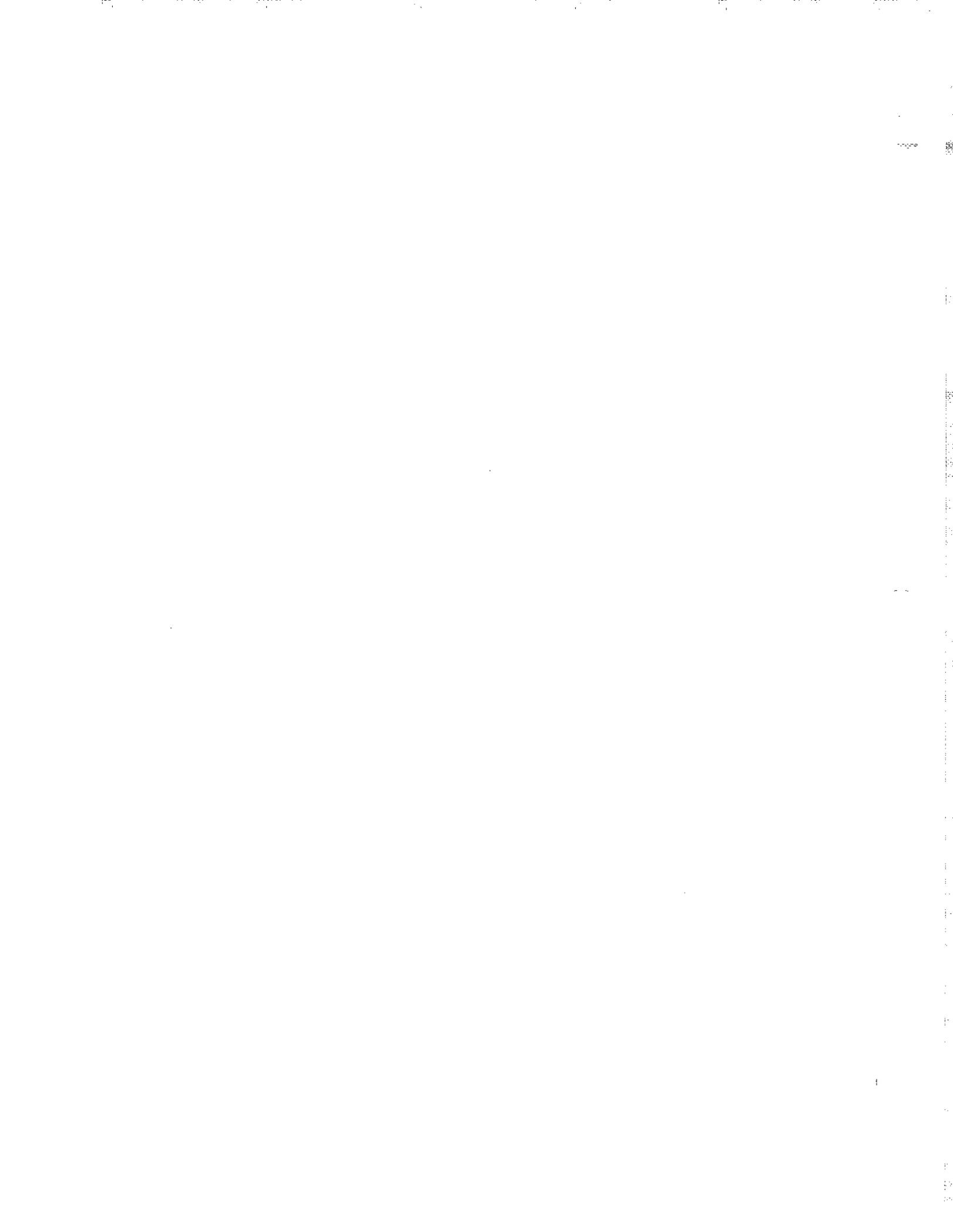
A. General:

These specifications provide a minimum standard for the removing of various pavement surfaces, open trenches, excavating, method of backfilling and replacement of various pavement surfaces. These specifications meet the requirements of the Owner as a standard to be followed in all cases where street or drive surfaces are disturbed in the process of any and all excavation work.

- B. Class A Street (Portland cement concrete pavement):
1. Prior to replacement of the concrete pavement, the concrete surface shall be scored with a saw on each side of the required excavation to a minimum depth of 2 inches. The size of the area cut shall be 1 foot greater in all directions than the size of the excavation. This is to provide a minimum 6 inch shoulder of undisturbed subgrade surrounding the excavation.
 2. All broken concrete shall be removed from the site and not used for backfill material.
 3. The walls of the excavation shall be vertical for the full length. Sufficient bracing or shoring shall be provided to hold the excavation walls in vertical plane and to prevent under-cutting of the undisturbed pavement. Sloping of trench walls in deep excavations may be permitted by the Owner or his authorized representative. Bracing or shoring may be omitted where, in the opinion of the Owner's authorized representative, depth of excavation and soil conditions warrant.
 4. All excavated materials shall be removed and disposed of after work within the excavated area is complete. The excavation shall be backfilled with clean 1/2 inch aggregate (3/8 inch minimum to 3/4 inch maximum) or type as specified in Section 109 and 109.1 and 109.2 of the Standard Specifications for State Road and Bridge Construction, State Highway Commission of Missouri, current edition, to the bottom of the concrete paving.
 5. The pavement removed shall be replaced with high early strength Class A concrete having a compressive strength of 3,750 pounds per square inch at 27 days. The new finish shall be flush with the present street surface.
- C. Class B Street (Hot mix asphaltic concrete or brick surface):
1. Conform to paragraphs (1) through (4) inclusive of the specifications for Class A Street (Portland cement concrete pavement).
 2. All removed paving shall be removed from the site and not used for backfill material. The minimum 6 inch shoulder shall be excavated to a point no less than 9 inches below the existing street surface. Across the backfilled excavation and resting on the 6 inch shoulders shall be poured a 6 inch slab of high early strength class A concrete having a compressive strength of 3,750 pounds per square inch at 27 days. After 48 hours, this slab shall be covered with 3 inches of hot mix asphalt and rolled. The new finish shall be flush with the present street surface.
- D. Class C Street (D.A.S.T., double asphalt surface treatment roads with base):
1. Conform to paragraphs (1) through (4) inclusive of the specifications for Class D Streets below, except final 6 inches of backfill shall be rolled stone base material. The crushed rock base shall be replaced by applying 2 lifts of 3 inch each of crushed rock to state highway specifications. Each lift shall be saturated with water and rolled. When compaction has been attained, and surface moisture evaporated, double asphalt surface treatment shall be applied. Penetration course shall be MC-0 at the rate of 0.20 gallon per square yard. Surface course shall be RC-3 at the rate of 0.35 per gallon per square yard and to be covered with clean 3/8 inch to 1/2 inch crushed aggregate at the rate of 20 pounds per square yard with a lap of 1 foot outside the disturbed area. Surface course shall be applied twice.

- E. Class D Street: (Surface asphalt treatment roads and earth base):
1. Initial cutting will be permitted by excavating machinery.
 2. Excavation wall shall be vertical and shall be braced and shored to prevent undercutting or crumbling. Sloping of trench walls in deep excavations may be permitted by the Owner's authorized representative, if depth of excavation and soil conditions warrant.
 3. Backfill shall consist of clean 1/2 inch aggregate or of rolled stone base material, to the level of the existing paving.
 4. Surface treatment shall conform to penetration and surface course for Class C Streets. Surface course shall be applied once.
- F. Crushed Stone Streets or Drives:
1. Six inches of compacted stone base meeting Missouri Highway Spec. 1007.1, Type 1 aggregate shall be placed over all disturbed areas.
 2. Preparation shall be as required by the applicable sub-articles of Section 203 of the Missouri Standard Specification for Highway Construction, 1977 Edition or latest revision.
 3. Crushed stone shall be placed and compacted in two lifts.
 4. All County and City gravel surface roads shall be backfilled entirely with approved crushed rock or river gravel. The disposal of unsuitable material excavated will be the responsibility of the Contractor.

END OF SECTION



PART 1 - GENERAL**1.01 SECTION INCLUDES**

Ductile iron pressure pipe.

1.02 RELATED SECTIONS

- A. Section 02221: Trenching, Backfilling, and Compaction
- B. Section 02640: Valves, Hydrants, and Accessories
- C. Section 02675: Disinfecting Water Mains

1.03 QUALITY ASSURANCE

- A. Supervision:
 - 1. Provide full time superintendent on the project who is qualified and experienced in the installation of ductile iron pipe.
 - 2. The superintendent shall direct all work in the execution of this portion of the work to insure proper and adequate installation.
- B. Codes and standards:

Installation shall comply with specifications, AWWA C600 and manufacturer's recommendations.

1.04 SUBMITTALS

- A. Shop drawings:

Submit shop drawings to the Engineer within 30 days after award of Contract in accordance with Section 01340, showing all the materials to be furnished and installed.
- B. As-built drawings:

During progress of the work, maintain an accurate record of all changes made in the plumbing installation from the layout and materials shown on the approved shop drawings.

PART 2 - PRODUCTS**2.01 MATERIALS**

- A. where designated on the Plans, piping and fittings shall be ductile iron pipe.
- B. Pipe shall have slip joints or mechanical joints. Only one of the two joint types shall be used on this project.
- C. All fittings shall be mechanical joints.
- D. Four inch diameter pipe shall be Class 51.
- E. All 6, 8, 10, and 12 inch diameter pipe shall be Class 50.
- F. All pipe and fittings shall have cement lining and bituminous coatings inside and outside.
- G. All materials shall comply with the following specifications or the latest revisions thereof.
- | | |
|--|--|
| ANSI (A21.4) (AWWA C-104) | Cement lining for cast iron pipe. |
| ANSI (A21.11) (AWWA C-111) | Mechanical joints for cast iron and ductile iron pressure pipe and fittings. |
| ANSI (A21.10) (AWWA C-110) | Short bodied fittings for water. |
| WW-P-421a Type II | Roll-on rubber gasket joint cast iron pipe. Pipe size 12 inch and smaller. |
| ANSI (A21.51) (AWWA C-151) | Ductile Iron pipe |
| ANSI (A21.50) (AWWA C-150) | |
| (AWWA C-100) | Cast iron pressure fittings. |

PART 3 - EXECUTION**3.01 HANDLING**

- A. Pipe, fittings, and accessories shall be handled in a manner that will ensure their installation in the work in sound, undamaged condition. Equipment, tools and methods used in unloading, reloading, hauling and laying pipe and fittings shall be such that they are not damaged. Hooks inserted in ends of pipe shall have broad, well padded contact surfaces.

- B. Pipe and fittings in which the cement lining has been broken or loosened shall be replaced by and at the expense of the Contractor. Where the damaged areas are small and readily accessible, the Contractor may be permitted to repair the lining, subject to the approval of the Engineer.
- C. All pipe coating which has been damaged shall be repaired by the Contractor before installing the pipe.

3.02 CUTTING PIPE

- A. Cutting of ductile iron pipe shall be in accordance with the recommendations of the manufacturer.

3.03 CLEANING

- A. The interior of all pipe and fittings shall be thoroughly cleaned of all foreign matter before being installed and shall be kept clean until the work has been accepted. All lumps, blisters, and excess coating shall be removed from exterior spigot and interior bell surfaces. Such surfaces shall be wire brushed and wiped clean, dry, and free from oil and grease before placing the spigot in the bell. All joint contact surfaces shall be kept clean until the jointing is completed.
- B. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being installed. No debris, tools, clothing, or other material shall be placed in the pipe.
- C. Whenever pipe laying is stopped, the open end of the line shall be sealed with a watertight plug. All water that may have entered the trench shall be removed prior to removing the plug. It is essential that no mud, trench water, or other foreign matter be permitted to enter the pipe line at any time.

3.04 INSPECTION

During installation, while suspended and hanging free, each pipe and fitting shall be inspected for defects and rung with a light hammer to detect cracks. All defective, damaged, or unsound pipe and fittings shall be rejected and removed from the site of the work.

3.05 ALIGNMENT OF BELL AND SPIGOT PIPE

- A. Pipe lines or runs intended to be straight shall be laid straight. Deflections from a straight line taken in joints shall not be greater than that recommended by the pipe manufacturer.

- B. Either shorter pipe sections, or special bends, shall be installed where the alignment or grade requires them.

3.06 LAYING PIPE

- A. Pipe shall be protected from lateral displacement by means of pipe embedment material installed as provided in the trench backfill specification.
- B. Under no circumstances shall pipe be laid in water and no pipe shall be laid under unsuitable weather or trench conditions.
- C. Pipe shall be laid with the bell ends facing the direction of laying except when making closures.

3.07 MECHANICAL JOINTS

Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned and reassembled. Overtightening bolts to compensate for poor installation practice will not be permitted.

3.08 BOLTLESS GASKETED JOINTS

All instructions and recommendations of the pipe manufacturer, relative to gasket installation and other jointing operations, shall be observed and followed by the Contractor. All joint surfaces shall be lubricated with heavy vegetable soap solution immediately before the joint is completed.

3.09 FLANGED JOINTS

When bolting flanged joints, care shall be taken to ensure that there is no restraint on the opposite end of the pipe or fitting which would prevent uniform gasket compression or which would cause unnecessary stress in the flanges. One flange shall be free to move in any direction while the flange bolts are being tightened. Bell and spigot joints shall not be packed or assembled until all flanged joints affected thereby have been tightened. Bolts shall be tightened gradually and at a uniform rate, in such a manner that gasket compression is uniform over the entire area of the gasket.

3.10 CONNECTIONS WITH EXISTING PIPE LINES

- A. Where connections are made between new work and existing piping, such connections shall be made using suitable and proper fittings to suit the conditions encountered. Each connection with an existing water pipe shall be made at a time and under conditions which will least interfere with water service to customers affected thereby, and as authorized by the Owner. Suitable facilities shall be provided for proper dewatering, drainage and disposal of all water removed from the dewatered lines and excavations, without damage to adjacent property.
- B. Great care shall be taken to prevent pipe line contamination when dewatering, cutting into, and making connections with, existing pipe lines used for the conveyance or distribution of water for domestic or public use. No trench water, mud, or other contaminating substance shall be permitted to get into the connected line or lines at any time during the progress of the work. The interiors of all pipe, fittings and valves, both new and re-used, installed in such connections, shall be thoroughly cleaned before installation.

3.11 REACTION ANCHORAGE AND BLOCKING

- A. All unlugged bell and spigot or all-bell tees, Y-branches and bends deflecting 11-1/4 degrees or more which are installed in piping subjected to internal hydrostatic heads in excess of 15 feet in exposed, or 30 feet in buried, piping shall be provided with suitable reaction blocking, struts, anchors, clamps, joint harness, or other adequate means for preventing any movement of the pipe caused by unbalanced internal liquid pressure.
- B. Trench installation:
Where in trench, the foregoing designated fittings shall be provided with concrete thrust blocking between the fitting and solid, undisturbed ground in each case, except where solid ground blocking support is not available. At the tops of slopes vertical angle bends shall be anchored by means of steel strap or rod anchors securely embedded in or attached to a mass of concrete of sufficient weight to resist the hydraulic thrust at the maximum pressures to which the pipe will be subjected. All concrete blocking and anchors shall be installed in such a manner that all joints between pipe and fittings are accessible for repair.
- C. The bearing area of concrete reaction blocking against the ground or trench bank shall be as shown by the plans or as directed by the Engineer in each case. In the event that adequate support against undisturbed ground cannot be obtained, metal harness anchorages consisting of steel rods or bolts across the joint and securely anchored to pipe and fitting or other adequate anchorage facilities approved by the Engineer shall be installed to provide the necessary support. Should the lack of a solid vertical excavation face be due to careless or otherwise improper trench excavation, the entire cost of furnishing and installing metal harness anchorages in excess of the contract value of the concrete blocking replaced by such anchorages shall be borne by the Contractor.

- D. For other locations:
Reaction blocking, struts, anchorages, or other supports for fittings installed in fills or other unstable ground, above grade, or exposed within structures, shall be provided as required by the plans or as directed by the Engineer.
- E. Protection of metal surfaces:
All steel clamps, rods, bolts and other metal accessories used in reaction anchorages or joint harness subject to submergence or contact with earth or other fill material and not encased in concrete shall be adequately protected from corrosion with not less than two coats of Koppers "Bitumastic No. 50", or approved equal, heavy coal tar coating material, applied to clean, dry metal surfaces. The first coat shall be dry and hard before the second coat is applied. Metal surfaces exposed above grade or within structures shall be painted with two coats (in addition to a primer coat) of a paint approved by the Engineer.

3.12 SEPARATION OF WATER MAINS, SANITARY SEWERS AND COMBINED SEWERS - MoDNR

- A. Parallel installation:
Water mains shall be laid at least ten feet horizontally from any existing or proposed sewer. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten-foot separation, the department may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer and on either case, at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer. In areas where the recommended separations cannot be obtained, either the waterline or the sewer line shall be constructed of mechanical joint pipe or cased in a continuous casing.
- B. Crossings:
Water mains crossing sewers shall be laid to provide a minimum vertical clear distance of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. At crossings, the full length of water pipe shall be located so both joints will be as far from the sewer as possible but in no case less than ten feet. Special structural support for the water and sewer pipes may be required. In areas where the recommended separations cannot be obtained either the waterline or the sewer line shall be constructed of mechanical joint pipe or cased in a continuous casing that extends no less than ten feet on both sides of the crossing.
- C. Exception:
Any variance from the specified separation distances in paragraphs A and B must be submitted to the engineer for approval.

- D. Force mains:
There shall be at least a ten-foot horizontal separation between water mains and sanitary sewer force mains and they shall be in separate trenches. In areas where these separations cannot be obtained, either the waterline or the sewer line shall be cased in a continuous casing.
- E. Sewer manholes:
No waterline shall be located closer than ten feet to any part of a sanitary or combined sewer manhole.
- F. Disposal facilities:
No waterline shall be located closer than 25 feet to any on-site wastewater disposal facility, agricultural waste disposal facility, or landfill.

END OF SECTION



PART 1 - GENERAL**1.01 SECTION INCLUDES**

- A. Polyethylene encasement.

1.02 RELATED SECTIONS

- A. Section 02615: Ductile Iron Pipe
- B. Section 02221: Trenching, Backfill, and Compaction

1.03 QUALITY CONTROL

- A. Supervision:
Provide full time supervisor trained and familiar with the work to be undertaken.
- B. Workmanship:
All workmen shall be skilled and experienced in the specified work.

1.04 SUBMITTALS

- A. Shop drawings:
Submit shop drawings to the Engineer within 30 days after award of Contract in accordance with Section 01340.

PART 2 - PRODUCTS**2.01 MATERIALS**

- A. Polyethylene encasement materials shall be manufactured of virgin polyethylene possessing the following characteristics:

Type, Class, Grade, In accordance with ASTM Specification
Other Characteristics D-1248-68 or latest revision thereof.

Type 1

WATER MAINS
POLYETHYLENE ENCASEMENT FOR
DUCTILE IRON PIPE AND FITTINGS

0313045

02616-2

Class C	Black where exposure to weather (including sunlight) may be more than 48 hours. Exposure to weather shall be kept to a minimum and in no case shall it exceed 10 days.
Grade	E-1
Flow Rate	0.4 maximum
Tensile Strength	1200 psi minimum
Elongation	300 percent minimum
Dielectric Strength	Volume resistivity, ohm-Cm ³ = 1015 800 volts per mil thickness

- B. Polyethylene tube material shall have a thickness of 0.008 inches (8 mils). The minus tolerance on thickness shall not exceed 10 percent of the nominal thickness.
- C. The minimum tube size for each pipe diameter shall be as listed in Table 1. For pipe sizes greater than 24 inches, tube size may be determined by multiplying the nominal pipe diameter by 2.25 to obtain minimum flat tube width.

TABLE 1

NOMINAL PIPE DIAMETER (INCHES)	POLYETHYLENE FLAT TUBE WIDTH (INCHES)
4	16
6	20
8	24
10	27
12	30
14	34
16	37
18	41
20	45
24	53

- D. Adhesive tape shall be a general purpose adhesive tape 1-inch wide and approximately 8 mils thick, such as Scotchtape No. 50, Pol. No. 900, Tapecoat CT or approved equal.

PART 3 - EXECUTION**3.01 INSTALLATION**

- A. General:
Polyethylene encasement shall be installed on ductile iron pipe and fittings. Although not intended to be a completely air- and water-tight enclosure, the polyethylene shall prevent contact between the pipe and the surrounding backfill.
- B. Pipe:
This standard includes two different methods for the installation of polyethylene encasement.
1. Method A:
 - a. Cut polyethylene tube to a length approximately 2 feet longer than the length of the pipe section. Slip the tube around the pipe, centering it to provide a 1 foot overlap on each adjacent pipe section, and bunching it accordion-fashion lengthwise until it clears the pipe ends.
 - b. Lower the pipe into the trench and make up the pipe joint with the preceding section of pipe. A shallow bell hole must be made at joints to facilitate installation of the polyethylene tube.
 - c. After assembling the pipe joint, make the overlap of the polyethylene tube. Pull the bunched polyethylene from the preceding length of pipe, slip it over the end of the new length of pipe, and secure in place with one circumferential turn of adhesive tape plus enough overlap to assure firm adhesion. Then slip the end of the polyethylene from the new pipe section over the end of the polyethylene from the new pipe section over the end of the first wrap until it overlaps the joint at the end of the preceding length of pipe. Tape it in place. Take up the slack width to make a snug, but not tight, fit along the barrel of the pipe, securing the fold at quarter points with adhesive tape.
 - d. Repair any rips, punctures, or other damage to the polyethylene with adhesive tape or with a short length of polyethylene tube cut open, wrapped around the pipe, and secured with adhesive tape. Proceed with installation of the next section of pipe in the same manner.
 2. Method B:
 - a. Cut polyethylene tube to a length approximately 1 foot shorter than the length of the pipe section. Slip the tube around the pipe, centering it to provide 6 inches of bare pipe at each end. Make polyethylene snug, but not tight. Tape down and secure ends as described in B,1.
 - b. Before making up a joint, slip a 3 foot length of polyethylene tube over the end of the preceding pipe section, bunching it accordion-fashion lengthwise. After completing the joint, pull the 3 foot length of polyethylene over the joint, overlapping the polyethylene previously installed on each adjacent section of pipe by at least 1 foot. Make snug,

- tape down, and secure each end as described in B,1.
- c. Repair any rips, punctures, or other damage to the polyethylene as described in B,1. Proceed with installation of the next section of pipe in the same manner.
- C. Pipe-shaped appurtenances:
Bends, reducers, offsets, and other pipe-shaped appurtenances shall be covered with polyethylene in the same manner as the pipe.
- D. Odd-shaped appurtenances:
Valves, tees, crosses, and other odd-shaped pieces which cannot practically be wrapped in a tube shall be wrapped with a flat sheet or split length of polyethylene tube. The sheet shall be passed under the appurtenance and brought up around the body. Seams shall be made by bringing the edges together, folding over twice, and taping down. Slack width and overlaps at joints shall be handled as described in B,1. Tape polyethylene securely in place at valve stem and other penetrations.
- E. Openings in encasement:
Openings for branches, service taps, blow-offs, air valves, and similar appurtenances shall be made by making an x-shaped cut in the polyethylene and temporarily folding the film back. After the appurtenance is installed, tape the slack securely to the appurtenance and repair the cut as well as any other damaged areas in the polyethylene with tape.
- F. Junctions between wrapped and unwrapped pipe:
Where polyethylene wrapped pipe joins a pipe which is not wrapped, extend the polyethylene tube to cover the unwrapped pipe a distance of at least 2 feet. Secure the end with circumferential turns of tape.

END OF SECTION

PART 1 - GENERAL**1.01 SECTION INCLUDES**

- A. Polyvinyl chloride pressure pipe required for project.

1.02 QUALITY ASSURANCE

- A. Supervision:
1. Provide full time superintendent on the project who is qualified and experienced in the installation of P.V.C. pipe.
 2. The superintendent shall direct all work in the execution of this portion of the work to insure proper and adequate installation.
- B. Codes and standards:
Installation shall comply with the applicable specifications of the AWWA and manufacturer.

1.04 SUBMITTALS

- A. Shop drawings:
Submit shop drawings to the Engineer within 30 days after award of Contract in accordance with Section 01340, showing all the plumbing system and plumbing materials to be furnished and installed.
- B. As-built drawings:
During progress of the work, maintain an accurate record of all changes made in the plumbing installation from the layout and materials shown on the approved shop drawings.

PART 2 - PRODUCTS**2.01 FITTINGS FOR DIP, CIP, OR C900 PVC THAT IS DUCTILE IRON O.D.**

- A. Ductile Iron Fittings shall be "mechanical joint" conforming to ANSI A21.53 (AWWA C153).
- B. Fittings on pipe thru 12 inch size shall be compact type conforming to AWWA C153. All other sizes shall be normal dimension.

2.02 PLASTIC PIPE - DUCTILE IRON O.D.

- A. The pipe shall be produced according to AWWA C900 specification for Class 200 psi. The pipe shall be produced by an extrusion process using resin complying with ASTM Specifications D1784. Unless designated otherwise on the plans, the pipe shall conform to all the requirements of Specifications AWWA C900-81 with a standard dimension ratio of DR of 14 for barrel, bell or coupling. All pipe shall bear the AWWA seal of approval and designation. Certificates of compliance with these specs shall be furnished upon request.
- B. Only elastomeric ring seals are to be used for joining pipes. Thrust blocks will be necessary at bends, tees, and reducers.
- C. The elastomeric gaskets for plastic pressure pipe shall conform with the requirements of ASTM F477. The joint shall have been tested and approved by the National Sanitation Foundation and certification of said approval shall be submitted.
- D. Prior to use, Engineer shall be given opportunity for examination and testing. Any pipe found to be injured, damaged or to have defects shall be removed. The pipe shall then be delivered along the line in which the pipe is to be laid. The pipe shall be handled in a manner as recommended by the manufacturer so that minimum damage results.

2.03 RESTRAINED JOINT PVC PIPE

- A. Where restrained joint PVC is indicated on plan sheets, pipe shall be North American Specially Products Certa-LOK Tapered Bell Restrained Joint PVC Pressure Piping System, Aquamine, or approved equal. Restrained joint pipe shall meet the ASTM D22-41 Standard Specifications for Poly Vinyl Chloride (PVC), Pressure Rated pipe (SDR Series)."
- B. Installation of pipe shall follow manufacturer's recommended procedure and is to be in accordance with Missouri Department of Natural Resources guidelines.
- C. Restrained Joint pipe shall have the following:
 - 1. DR 14, Class 305 psi pressure rating
 - 2. Designed for permanent use

PART 3 - EXECUTION**3.01 INSTALLATION**

- A. Maximum allowable bends in PVC pipe:

The following table gives the maximum distance from the center line of any length of PVC pipe to a chord line from the center of the joints at either end (mid-ordinate distance).

<u>Pipe Size</u>	<u>20 Ft. Length</u>	<u>40 Ft. Length</u>
1 in.	1.0 ft.	4.0 ft.
2 in.	0.5 ft.	2.0 ft.
3 in.	0.33 ft.	1.33 ft.
4 in.	0.25 ft.	1.0 ft.
6 in.	0.16 ft.	.67 ft.
8 in.	0.125 ft.	
10 in.	0.10 ft.	
12 in.	0.082 ft.	

Bends greater than the above require fittings. Use long radius elbow bends where possible.

- B. Plastic pipe shall be kept shaded and shall be covered with backfill immediately after installation. Pipe shall be installed in accordance with manufacturer's instructions.

No rock or debris shall be placed in trench within 6 inches of the pipe.

- C. The interior of all pipe and fittings shall be thoroughly cleaned of all foreign matter before being installed and shall be kept clean until the work has been accepted. All joint contact surfaces shall be kept clean until the jointing is completed.
- D. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being installed. No debris, tools, clothing, or other materials shall be placed in the pipe.
- E. Whenever pipe laying is stopped, the open end of the line shall be sealed with a watertight plug. All water that may have entered the trench shall be removed prior to removing the plug. It is essential that no mud, trench water, or other foreign matter be permitted to enter the pipe line at any time.
- F. Pipe lines or runs intended to be straight shall be laid straight. Deflections from a straight line taken in joints or in pipe shall not be greater than that recommended by the pipe manufacturer.
- G. Either shorter pipe sections, or special bends shall be installed where the alignment or grade requires them.
- H. Pipe shall be protected from lateral displacement by means of pipe embedment material installed as provided in the trench backfill specification.
- I. Under no circumstances shall pipe be laid in water and no pipe shall be laid under unsuitable weather or trench conditions.
- J. Pipe shall be laid with the bell ends facing the direction of laying except when

making closures.

- K. Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned and reassembled. Overtightening bolts to compensate for poor installation practice will not be permitted.
- L. Boltless gasketed joints shall be assembled following all instructions and recommendations of the pipe manufacturer, relative to gasket installation and other jointing operations, and shall be observed and followed by the Contractor. All joint surfaces shall be lubricated with heavy vegetable soap solution immediately before the joint is completed.

3.02 CONNECTIONS WITH EXISTING PIPE LINES

- A. Where connections are made between new work and existing piping, such connections shall be made using suitable and proper fittings to suit the conditions encountered. Each connection with an existing water pipe shall be made at a time and under conditions which will least interfere with water service to customers affected thereby, and as authorized by the Owner. Suitable facilities shall be provided for proper dewatering, drainage and disposal of all water removed from the dewatered lines and excavations, without damage to adjacent property.
- B. Great care shall be taken to prevent pipe line contamination when dewatering, cutting into, and making connections with, existing pipe lines used for the conveyance or distribution of water for domestic or public use. No trench water, mud, or other contaminating substance shall be permitted to get into the connected line or lines at any time during the progress of the work. The interiors of all pipe, fittings, and valves, both new and re-used, installed in such connections, shall be thoroughly cleaned before installation.

3.03 REACTION ANCHORAGE AND BLOCKING

- A. All unlugged bell and spigot or all-bell tees, Y-branches and bends deflecting 11-1/4 degrees or more which are installed in piping subjected to internal hydrostatic heads in excess of 15 feet in exposed, or 30 feet in buried, piping shall be provided with suitable reaction blocking, struts, anchors, clamps, joint harness, or other adequate means for preventing any movement of the pipe caused by unbalanced internal liquid pressure.

3.04 SEPARATION OF WATER MAINS, SANITARY SEWERS AND COMBINED SEWERS MoDNR

- A. Parallel installation:

Water mains shall be laid at least ten feet horizontally from any existing or proposed sewer. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten-foot separation, the department may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer and on either case, at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer. In areas where the recommended separations cannot be obtained, either the waterline or the sewer line shall be constructed of mechanical joint pipe or cased in a continuous casing.

- B. Crossings:
Water mains crossing sewers shall be laid to provide a minimum vertical clear distance of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. At crossings, the full length of water pipe shall be located so both joints will be as far from the sewer as possible but in no case less than ten feet. Special structural support for the water and sewer pipes may be required. In areas where the recommended separations cannot be obtained either the waterline or the sewer line shall be constructed of mechanical joint pipe or cased in a continuous casing that extends no less than ten feet on both sides of the crossing.
- C. Exception:
Any variance from the specified separation distances in paragraphs A and B must be submitted to the engineer for approval.
- D. Force mains:
There shall be at least a ten-foot horizontal separation between water mains and sanitary sewer force mains and they shall be in separate trenches. In areas where these separations cannot be obtained, either the waterline or the sewer line shall be cased in a continuous casing.
- E. Sewer manholes:
No waterline shall be located closer than ten feet to any part of a sanitary or combined sewer manhole.
- F. Disposal facilities:
No waterline shall be located closer than 25 feet to any on-site wastewater disposal facility, agricultural waste disposal facility, or landfill.

END OF SECTION

PART 1 - GENERAL**1.01 SECTION INCLUDES**

- A. Valves
- B. Fire Hydrants
- C. Valve Boxes
- D. Related Items

1.02 RELATED SECTIONS

- A. Section 02615: Water Mains - Ductile Iron Pressure Pipe
- B. Section 02620: Water Mains - Polyvinyl Chloride Pressure Pipe

1.03 QUALITY CONTROL

- A. Supervision:
Provide full time supervisor trained and familiar with the work to be undertaken.
- B. Workmanship:
All workmen shall be skilled and experienced in the specified work.

1.04 SUBMITTALS

Shop drawings:
Submit shop drawings to the Engineer within 30 days after award of Contract in accordance with Section 01340.

PART 2 - PRODUCTS**2.01 VALVES**

- A. Gate valves 12 inches and smaller:
 - 1. All gate valves shall comply with requirements of "Standard Specifications for Resilient Seated Gate Valves for Ordinary Water Works Service" AWWA C509 except as amended herein. All valves shall be resilient seated wedge type.

2. All gate valves unless noted otherwise on the plans shall have ends of standard mechanical joints conforming to ANSI/AWWA C111/A21.11. Flanged end valves shall conform to ANSI B16.1 Class 125.
3. All gate valves shall be mounted in the line in a vertical position unless noted otherwise on the plans.
4. All gate valves shall be provided with "O" rings for sealing of the valve stem.
5. All gate valves shall be equipped with 2 inch square operating nuts. Valves shall close on clockwise rotations.
6. All valves shall be designed for operation at a working pressure of not less than 200 psi.

2.02 FIRE HYDRANTS

- A. All fire hydrants shall comply with requirements of "AWWA Standard for Fire Hydrants for Ordinary Water Works Service" C502 except as amended herein.
- B. All hydrants shall have replaceable "breakable" sections. Hydrants shall be compression type closing with line pressure. Hydrants shall have inlet connection of 6 inch size with standard flange connection for direct bolting to auxiliary gate valve.
- C. All hydrants shall have two hose outlets with National Standard 2-1/2 inch hose threads, and on 4-1/2 inch steamer connection with National Standard threads. Operating nut shall conform to National Standard measurements.
- D. Valve opening shall be 5-1/4 inch.
- E. Hydrant valve shall open on counter-clockwise rotation of the operating nut.
- F. Hydrants shall be painted a finish coat of red above the ground line.
- G. Burial depths for hydrants will and may vary, but shall not be less than 4 feet. The steamer connection shall not be less than 12 inches nor greater than 24 inches above finish grade. The contractor shall furnish and install all spool pieces as may be necessary to adjust hydrants to the proper height.

2.03 VALVE BOXES

- A. Traffic areas:
Valve boxes shall be Clay & Bailey, or equal, three-piece, slip type 5-1/4 inch shaft for roadway service. Cover shall have the word "Water" cast on its top.

2.04 TAPPING SLEEVES

- A. Tapping sleeves shall be as manufactured by the Mueller Co. or M & H Valve & Fitting Co. or approved equal, for 150 psi working pressure. Sizes and number shall be as indicated on the plans. Joints shall be mechanical joint suitable for the pipe to be tapped. Outlet shall be flanged ASA B 16.1.
- B. Valves for tapping sleeves shall be as per 2.01 A in this section except that end connection shall be flanged and mechanical joint.

2.05 AIR RELEASE VALVES

- A. The air release valve shall operate (open) while pressurized, allowing entrained air to escape from the water pipeline, pump or reservoir tank, thru the air release orifice. After entrained air escapes thru the air release orifice, the valve orifice shall be closed by a needle mounted on the compound lever mechanism, energized by a CONCAVE FLOAT to prevent water from escaping. The air release valve will then stay closed until more air accumulates in it and the opening cycle will repeat automatically.
- B. The needle shall be Buna-N for tight shut-off and be resilient to prevent seepage due to pipeline or pump vibrations.
- C. The air release valve compound internal level mechanism shall be all Bronze. All other internals must be stainless steel. The stainless steel float must be CONCAVE and sufficiently bouyant to operate water and be SPURT FREE.
- D. The valve shall withstand 500 psi test pressure and have a 3/16 inch orifice for operating (opening) pressure up to 150 psi. The venting capacity @ 150 psi shall be 55 CFFAM.
- E. Valve to be APCO Model 1 inch - 200A Air Release Valve, as manufactured by Valve & Primer Corporation, Schaumburg, Illinois, U.S.A.

2.06 LOCATOR WIRE/ACCESS TESTING PORTS

Locator wire shall be 12 AWG solid copper insulated wire or 12 AWG copperclap steel wire as manufactured by Copperhead Industries, LLC, or approved equal. Install wire in the trench with the main. All wire connections shall be Copperhead Snake Bite Connectors, dry conn direct bury lug or snake bite wire nuts, or approved equal.

Install access ports at 1,000 feet max. intervals as detailed on plans. All valves, air release vaults, hydrants, flushing assemblies and blow-offs shall have access ports as well as every 1,000 feet. Access port shall be Copperhead, LP Test services or above ground posts shall be "Internal Terminal Style" with standard board with two terminals. Post shall be Rhino TriView Flex Tracing Station Model TVTI 72-BB2 or equal.

Contractor to field verify continuity of wire between access ports after installation. Payment for locator wire will be subject to successful continuity test and report.

When directional drilling or boring is required, only Copperhead® Extra High Strength (EHS), #1245B with 45 mil High Density Polyethylene (HDPE) jacket with minimum 1150# break load, will be used.

2.07 SERVICE CONNECTIONS

A. Service pipe:

The pipe from the main to the meter holding device shall be 1-inch rigid plastic pipe SDR 13.5 for 315 pounds working pressure and shall conform to the preceding specifications for plastic pipe or polyethylene service tubing (ASTM). If polyethylene tubing is used, Ford No. 82 stainless steel insert sleeves shall be used on each pack joint end. All service line installed in highway right-of-way shall be type K copper and subject to approval by the MHTD.

B. Meter holding device:

1. The meter holding device shall provide a complete mounting for the installation of and the holding of the water meter so that the line of flow through the meter shall be 18 inches above the lower edge of the meter box.
2. The copper meter yoke shall be provided with an inverted ground key angle valve or shut-off valve on the inlet side. On the customer side of the setter, a check valve is to be serviceable, spring loaded and one seat of resilient material. Check valve shall be guaranteed and tested to withstand a vacuum or external pressure test of 10.8 psia (22 in Hg) for 1 hour with no leakage. Each end of the yoke shall be provided with a combination tailpiece with inside I.P. thread. The yoke shall provide a copper, brass, or bronze passage entirely through the meter box with the exception of the meter. The construction shall be such that the meter may be removed without removing the meter holding device, and the footing or the discharge leg of the yoke shall extend at least 18 inches from the centerline of the meter box. Setter shall have a pack joint for PVC on each end. The meter holding device shall be an A.Y McDonald Mfg. Co. #22-218WW2233 coppersetter, or approved equal.

C. Service saddle:

Service saddle for main line shall be A.Y McDonald Mfg. Co. #3892. Corporation stop shall be 3/4 inch male IPS by 3/4 inch tube compression

D. Service meter:

1. Meters furnished under these specifications shall be product of a manufacturer with at least 5 years experience in meter manufacturing for the American Water Works market. Meter shall utilize positive displacement measuring chamber for cold water service, of split-case design with provision for frost protection with a nutating disc. The nutating disc shall make no more than 50 oscillations per gallon.
2. Meters shall comply with A.W.W.A. Standard C700-95 for accuracy, capacity,

- pressure loss and dimensions.
3. Meters may be either mechanically or magnetically driven with sealed registers. Meters with stuffing box, spindle and packing gland will not be acceptable.
 4. Meters shall be readily adaptable to remote readout capability designed and manufactured for Badger meters.
 5. Meters shall carry a minimum 5-year/750,000 gallons warranty against defective materials and workmanship and shall be Badger.
 6. The body cases shall be of high quality bronze with the manufacturer's serial number imprinted thereon and have raised markings to indicate the direction of flow.
 7. A hinged cover bearing the name of the manufacturer in raised letters shall be provided for the register glass. Thread protectors shall be supplied for the connection ends and the cases shall have provisions for wire sealing the meter body. Cases must be capable of withstanding working pressures of 150 psi.
 8. Registers shall be straight-reading in U.S. Gallons, sealed to prevent fogging and to prevent fluid contact with water being measured and with provision for test reading the flow to within 0.1 gallon. Register components shall be constructed of corrosion resistant material. The meter shall flow 15 gpm continuously and have a normal flow range of $\frac{1}{2}$ -25 gpm.
 9. Meter shall be 98.5%-101.5% accurate at $\frac{1}{4}$ gpm.
 10. Meter shall have maximum pressure drop of 5 psi.
 11. Meters shall have radio heads installed with them as manufactured by meter manufacturer and be compatible with existing radio read system.
 - a. General:
 - 1) The encoder register will incrementally encode meter reading information and provide a digital signal to collection equipment. The register shall be permanently sealed in a glass and metal housing and constructed without the use of gaskets, available for pit and remote installations.
 - b. Registration
 - 1) The register shall provide an active six-digit number wheel for visual registration.
 - 2) The register shall incrementally encode the seven most significant digits of the meter reading for digital transmission to the remotely located AMR device.
 - 3) Position based (absolute) encoders will not be allowed.
 - 4) The test circle must fill the entire face of the register and employ a full test sweep hand and have division gradients of $1/100^{\text{th}}$ of the units of registration.
 - 5) The units of measure shall be in U.S. Gallons, Cubic Feet, or Cubic Meters and appear in a conspicuous place on the face of the register.
 - 6) The register face shall prominently display the date code of manufacture, month and year, and indicate the model of water meter it is matched with.
 - 7) Every register shall utilize a low flow indicator for leak detection

and shall display it in appropriate colors: red for U.S. Gallons, blue for Cubic Feet, and black for Cubic Meters.

c. Electrical Construction

- 1) The register shall be driven by an accurate, solid-state data collection technology such as the piezoelectric switch. The use of reed switches and/or weigand sensors will not be allowed.
- 2) The register shall provide digitally formatted data to the AMR device represent accurate meter information.
- 3) The register shall offer compatibility to other levels of AMR: radio frequency, telephone, close-proximity meter reading, low earth orbit satellite technologies.

d. Mechanical Construction

- 1) Materials used in the construction of the register shall be environmentally safe with potable water systems. Absolutely no oil is allowed in the registration device.
- 2) The register shall be constructed of a domed glass top and a copper bottom for maximum durability. No plastic tops or bottoms allowed.
- 3) The register must be permanently sealed to provide superior moisture resistance flooded pit or remote settings. The permanent seal between the glass and copper bottom shall utilize an adhesive seal without the use of gaskets. This adhesive seal shall have a leak rate not to exceed 1×10^{-6} cc/sec when tested on a gas mass spectrometer. Absolutely no gasket seals will be allowed.
- 4) The register shall have a shroud assembly and lid that is factory installed. Disassembly of the shroud or lid from the register shall require special tools. Lids shall be constructed of plastic or bronze.
- 5) The register shall be attached to the water meter by bayonet connections. To ensure a high level of tamper resistance, a seal screw should be provided that effectively locks the register to the meter.
- 6) The register must be removable from the water meter without removing them from service.
- 7) The register must be factory prewired to pit and remote AMR devices requiring no wiring the field and available in a variety of wire lengths.
- 8) No connections between the register and AMR device will be allowed.

e. Warranty

- 1) The manufacturer must warrant the encoder register to be free from defects in materials and workmanship for a period of 10 years from date of shipment.

- E. Meter box:
The meter box to be used on this project shall be of PVC Plastic, 18 inch in diameter and not less than 36 inches in length. Boxes shall be A2000 meter well as manufactured by Midwest, Inc.
- F. Meter box cover:
1. The meter box covers shall be of cast iron construction of a good quality cast iron at least 50 percent of which shall be new pig. It shall be constructed to fit on the meter box with lugs extended into the box to prevent displacement of the cover. Cover shall be Clay & Bailey, D2210 with lifting lugs or approved equal.
 2. The lid shall be held to the body with lugs and shall lock therein with a bronze or bronze-bushed worm lock. The box cover shall be not less than 4 inches high.
- G. Cover:
The trench for service lines shall provide not less than 36 inches of cover and shall be not less than 6 inches in width.
- H. Meter box location:
Excavation for the meter boxes shall be made at the location indicated by the Engineer.
- I. Boring under street roadways for service connections:
Where it is necessary to go under streets and paved roadways with service connections, it will be accomplished by boring unless special permission for trenching is secured.

2.08 SERVICE RECONNECTIONS

- A. Service pipe:
The pipe from the main to the reconnection point on the existing service shall be 3/4-inch rigid plastic pipe SDR 13.5 for 315 pounds working pressure and shall conform to the preceding specifications for plastic pipe or polyethylene service tubing (ASTM). If polyethylene tubing is used, Ford No. 82 stainless steel insert sleeves shall be used on each pack joint end. All service line installed in highway right-of-way shall be type K copper and subject to approval by the MHTD. This reconnection shall be made after potable water becomes available from the new main.
- B. Service saddle:
Service saddle for main line shall be A.Y McDonald Mfg. Co. #3892. Corporation stop shall be 3/4 inch male IPS by 3/4 inch tube compression.
- C. Service tap:
Service tap shall be completed by use of a drilling machine of specified size of 3/4" or 1" drilling requirements.
- D. Cover:
The trench for service lines shall provide not less than 36 inches of cover and shall be not less than 6 inches in width.

- E. Boring under street roadways for service reconnections:
Where it is necessary to go under streets and paved roadways with service reconnections, it will be accomplished by boring unless special permission for trenching is secured.

2.09 CAP EXISTING SERVICE TAP

Materials:

Materials to be used to cap an existing service line connection on a main shall be a Smith-Blair 242 repair clamp with stainless steel bolt.

2.10 BLOW-OFF ASSEMBLIES

Blow-offs shall be non-freezing, self draining type with a 42" bury, blow-offs will be furnished with a 4" JM inlet, a non-turning operating rod and shall open to the left. All of the working parts shall be of bronze-to-bronze design, and be serviceable from above grade with no digging. Units shall operate with a standard 2" gate valve wrench. When open, valve shall be 100% unobstructed and drain hole shall be covered. The outlet shall be 4" FIP with plug and extend a minimum of 12" above the ground, as manufactured by Kupferle Foundry Co., St. Louis, Missouri Model No. 7500, or approved equal.

PART 3 - EXECUTION

3.01 VALVES AND VALVE BOXES

- A. Valves and valve boxes shall be set plumb. Each valve box shall be placed directly over the valve it serves, with the top of the box brought flush with the finished grade. After being placed in proper position, earth shall be filled in around each valve box and thoroughly tamped for a distance on each side of the box of 4 feet at the top of the pipe and 2 feet measured at the top of the trench.
- B. Each valve shall be inspected before installation to ensure that all foreign substances have been removed from within the valve body, and shall be opened and closed to see that all parts are in first-class working condition.

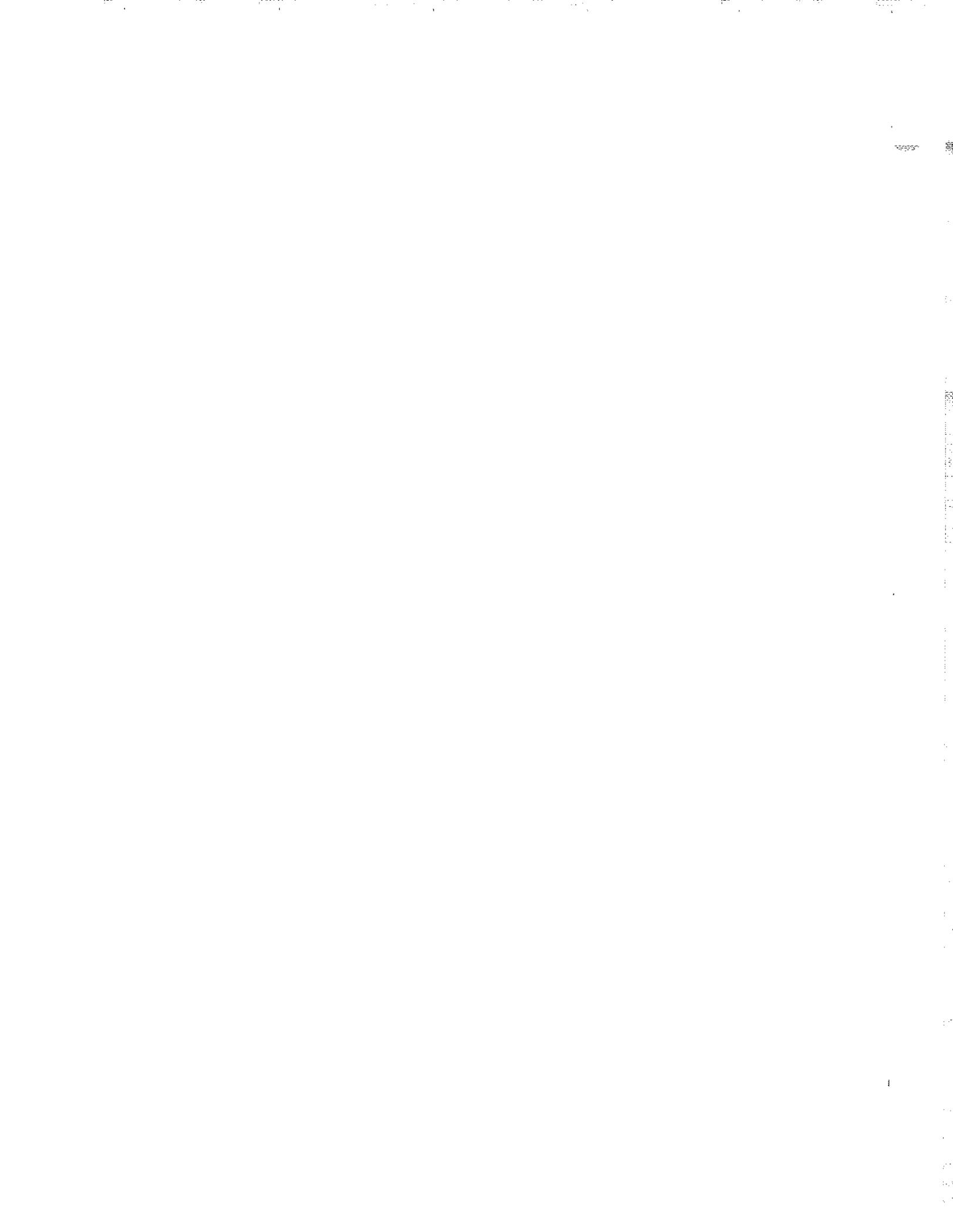
3.02 FIRE HYDRANTS

- A. Hydrants shall be set at such an elevation that the minimum pipe cover is provided throughout the length of the branch supply line and that the nozzles are at least 12 inches and not more than 24 inches above the ground.
- B. Each hydrant shall be set on a concrete foundation not less than 18 inches square and 6

inches thick. To prevent the hydrant from blowing off the supply connection, the bowl of each hydrant shall be blocked against the end of the trench with cast-in-place reaction blocking, or it shall be tied to the pipe with suitable rods or clamps.

- C. Hydrant drainage shall be provided by installing around the hydrant, and below the top of the hydrant supply pipe, not less than 7 cubic feet of a mixture of two parts gravel or crushed stone retained on a 3/4 inch screen to one part of coarse sand.
- D. All hydrants shall stand plumb. Hydrants with pumper nozzles shall have their hose nozzles parallel with, and the pumper nozzle perpendicular to, the curb line. Hydrants having hose nozzles 90 degree apart shall be set so that the line bisecting the angle between the nozzles is perpendicular to the curb line. Hydrants located behind curbs where the sidewalks extend close to, or abut against, the curb shall be set that no portion of the pumper or hose nozzle caps will be less than 6 inches nor more than 12 inches from the gutter face of the curb. Where set in a parking between the curb and sidewalk, or between the sidewalk and property line, no portion of the hydrant or nozzle cap shall be within 6 inches of the sidewalk.
- D. Immediately before installation of a hydrant, the following operations shall be performed: (a) the hydrant shall be carefully inspected; (b) the hydrant interior shall be thoroughly cleaned; (c) the hydrant shall be opened and closed as many times as may be necessary to determine if all parts are in proper working order, with valves seating properly and the drain valve operating freely; and (d) the packing gland checked to determine if the packing is in place and the gland nut properly tightened.

END OF SECTION



PART 1 - GENERAL**1.01 SECTION INCLUDES**

- A. Testing of water lines, fire hydrants, and valves.

1.02 RELATED SECTIONS

- A. Section 02221: Excavation, Trenching & Backfill
- B. Section 02615: Ductile Iron Pressure Pipe
- C. Section 02620: Polyvinyl Chloride Pressure Pipe
- D. Section 02640: Valves, Hydrants, and Accessories
- E. Section 02675: Disinfecting Water Mains

1.03 QUALITY CONTROL

- A. Supervision:
Provide full time superintendent on the project who is qualified and experienced in testing procedures. Superintendent shall direct all work in connection with the testing.
- B. Codes and standards:
Testing shall comply with AWWA C605-94 Section 7 - Hydrostatic Testing.

1.04 SUBMITTALS

- A. Test reports:
Submit certified copies of test reports on each section of pipe tested.

PART 2 - PRODUCTS

None

PART 3 - EXECUTION**3.01 GENERAL**

- A. The Contractor shall provide all necessary piping connections, pumping equipment, pressure gauges, flow meters, and other equipment as necessary for the required test.
- B. Pressure and leakage test may be coordinated with the disinfection of the pipeline, subject to conditions of Section 02675 - "Disinfecting Water Mains."
- C. The Owner will furnish at the nearest available source, all water required for filling the lines and making the required test. The pipe shall be filled with water at a velocity not to exceed 1 foot per second. Air shall be expelled from pipe line during filling.
- D. Where practical, pipelines shall be tested in lengths of not more than 1500 feet.
- E. All pipe, fittings and other materials found to be defective, shall be removed and replaced with new materials by the Contractor.
- F. All lines that fail to meet tests shall be repaired and retested as necessary until test requirements are complied with.
- G. Testing prior to backfilling in no way relieves the Contractor of the responsibility of repairing leaks which become evident after the main is put into service or during the one-year guarantee period.

3.02 TESTING AFTER BACKFILL

- A. If the Contractor chooses to test after backfilling, he shall comply with all requirements shown for testing before backfilling, except that the duration of the test shall be for 4 hours. All surface indications of leaks shall be immediately corrected even though the total leakage is less than allowed.
- B. In the event the leakage is more than permissible, the system shall be corrected as found necessary to bring it within the allowed limits. It shall be subject to as many 4 hour tests as necessary to obtain the desired result. If a section of pipe fails the 4 hour test, then a 24 hour test may be required by the Project Engineer.

3.03 TESTING BEFORE BACKFILL

- A. All backup blocks and anchors shall have been in place at least 48 hours prior to testing.

- B. The test pressure shall be maintained for 2 hours or longer as is necessary for time to inspect the pipe line for visible leaks and as is required to obtain a reasonable time for leakage measurement.

3.04 PRESSURE TEST

- A. Test pressure:
1. All newly installed piping shall be hydrostatic pressure tested at 80 percent of rated pressure for all PVC pipe and at 150 psi for all ductile iron pipe.
 2. Pressure shall not vary by more than plus or minus 5 psi.
 3. Pressurization:
 - a. Each valved section of pipe shall be filled with water slowly and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gage, shall be applied by means of a pump connected to the pipe. Test shall begin after pipe is filled with water and the air expelled.
- B. Air removal:
Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged, or left in place at the discretion of the Owner.
- C. Examination:
All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damage or defective pipe, fittings, valves, or hydrants that are discovered following the pressure test shall be repaired or replaced with sound material and the test shall be repeated until it is satisfactory to the Owner.

3.05 LEAKAGE TEST

- A. General:
A leakage test shall be conducted concurrently with the pressure test.
- B. Leakage defined:
Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.

C. Allowable leakage:

1. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{ND(0.08)P}{7400}$$

in which L is the allowable leakage, in gallons per hour; N is the number of joints in the length of pipeline tested; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test, in pounds per square inch gage.

2. The table below shows the allowable leakage in gallons per hour at 150 psi per 1000 feet in 18 foot nominal lengths. For 20 foot nominal lengths, multiply the leakage calculated from table by 0.9.

<u>Pipe Size</u>	<u>Allowable Leakage</u>
2	0.19
3	0.28
4	0.37
6	0.55
8	0.74
10	0.92
12	1.10
14	1.29
16	1.48
18	1.67
20	1.85
24	2.22

3. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gallons per hour per inch of nominal valve size shall be allowed.
4. When hydrants are in the test section, the test shall be made against the closed hydrant.
5. All visible leaks shall be repaired regardless of the amount of leakage.

D. Acceptance of installation:

Acceptance shall be determined on the basis of allowable leakage. If any test of pipe laid discloses leakage greater than that specified, the Contractor shall, at his own expense, locate and repair the defective material until the leakage is within the specified allowance.

END OF SECTION

PART 1 - GENERAL**1.01 SECTION INCLUDES**

- A. Disinfecting water lines and determining the bacteriologic quality by laboratory test after disinfection.

1.02 RELATED SECTIONS

- A. Section 02221: Water Mains - Excavation, Trenching, and Backfill
- B. Section 02615: Water Mains - Ductile Iron Pressure Pipe
- C. Section 02620: Water Mains - Polyvinyl Chloride Pressure Pipe
- D. Section 02640: Water Mains - Valves, Hydrants, and Accessories

1.03 QUALITY CONTROL

- A. Supervision:
Provide full time superintendent on the project who is qualified and experienced in disinfection procedures. Superintendent shall direct all work in connection with the disinfection.
- B. Codes and standards:
Testing shall comply with AWWA C651-92 or latest revision thereto.

1.04 SUBMITTALS

- A. Test reports:
Submit certified copies of test reports on each section of pipe tested.

PART 2 - PRODUCTS**2.01 CHLORINE**

- A. Calcium hypochlorite (70 percent available chlorine).

PART 3 - EXECUTION**3.01 FLUSHING**

- A. Water lines shall be flushed prior to disinfection at a velocity of not less than 2.5 feet per second.
- B. Discharge point shall have adequate drainage to prevent flooding of surrounding area. Discharge point to be approved by Owner.

3.02 CHLORINE APPLICATION

- A. Continuous feed method:
1. This method is suitable for general application.

TABLE 2

Chlorine Required to Produce 50 milligrams per liter Concentration in 100 feet of Pipe - by Diameter

Pipe Size <u>in.</u>	100 percent Chlorine <u>lb.</u>	1 percent Chlorine Solutions <u>gal.</u>
4	0.027	0.33
6	0.061	0.73
8	0.108	1.30
10	0.170	2.04
12	0.240	2.88
14	0.334	4.01
16	0.436	5.24
18	0.552	6.63
24	0.981	11.78
30	1.533	18.40

2. Water from the existing distribution system or other approved sources of supply shall be made to flow at a constant measured rate into the newly-laid pipeline. The water shall receive a dose of chlorine, also fed at a constant measured rate. The two rates shall be proportioned so that the chlorine concentration in the water in the pipe is maintained at a minimum of 50 milligrams per liter available chlorine. To assure that this concentration is maintained, the chlorine residual should be measured at regular intervals in accordance with the procedures described in the current edition of Standard Methods and AWWA M12 - Simplified Procedures for Water Examination.

3. In the absence of a meter, the rate may be determined either by placing a pitot gage at the discharge or by measuring the time to fill a container of known volume.
4. Table 2 gives the amount of chlorine residual required for each 100 feet of pipe of various diameters. Solutions of 1 percent chlorine may be prepared with sodium hypochlorite or calcium hypochlorite. The latter solution requires approximately 1 lb. of calcium hypochlorite in 8.5 gallons of water.
5. During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the line supplying the water. Chlorine application shall not cease until the entire main is filled with the chlorine solution. The chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24 hour period, the treated water shall contain no less than 25 milligrams per liter chlorine throughout the length of the main.

3.03 FINAL FLUSHING

- A. After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the system, or less than 1 milligrams per liter. Chlorine residual determination shall be made to ascertain that the heavily chlorinated water has been removed from the pipe line. Heavily chlorinated water shall be de-chlorinated with sodium thiosulfate prior to discharge to the water course or sanitary/storm sewers.

3.04 BACTERIOLOGIC TEST

- A. After final flushing, and before the water main is placed in service, a sample or samples shall be collected from the end of the line and tested for bacteriologic quality and shall show the absence of coliform organisms. If the number and frequency of samples is not prescribed by the public health authority having jurisdiction, at least one sample shall be collected from chlorinated supplies where a chlorine residual is maintained throughout the new main. From unchlorinated supplies at least two samples shall be collected at least 24 hours apart.
- B. In the case of extremely long mains, it is desirable that samples be collected the length of the line as well as at its end.
- C. Samples for bacteriologic analysis shall be collected in sterile bottles treated with sodium thiosulphate. No hose or fire hydrant shall be used in collection of samples. A suggested sampling tap consists of a standard corporation cock installed in the main with a copper tube gooseneck assembly. After samples have been collected the gooseneck assembly may be removed, and retained for future use.

3.05 REPETITION OF PROCEDURE

- A. If the initial disinfection fails to produce satisfactory samples, disinfection shall be repeated until satisfactory samples have been obtained. When the samples are satisfactory, the main may be placed in service.

END OF SECTION

PART 1 - GENERAL**1.01 SECTION INCLUDES**

- A. Fertilizer.
- B. Mulch.
- C. Seed.
- D. Preparation.
- E. Maintenance.

1.02 RELATED SECTIONS

- A. Section 02200: Excavation, Backfill, and Site Grading

1.03 ALTERNATE METHODS AND PRODUCTS

- A. Alternate methods from those specified will be considered for use, provided that in the Engineer's opinion the end product will be equal to or exceed that which would result from the specified methods and products.

1.04 DEFINITIONS

- A. Weeds:
Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wold Garlic, Perennial Sorrel, and Brome Grass.

1.05 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for fertilizer and herbicide composition.

1.06 QUALITY ASSURANCE

- A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

1.07 MAINTENANCE DATA

- A. Submit maintenance data for continuing Owner maintenance.
- B. Include maintenance instruction, cutting method, maximum grass height, types, application frequency, and recommended coverage of fertilizer.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.
- B. Deliver fertilizer in water proof bags showing weight, chemical analysis, and name of manufacturer.

PART 2 - PRODUCTS**2.01 AGRICULTURAL LIMESTONE**

- A. Shall be agricultural limestone with not less than 90 percent passing the No. 4 sieve and containing not less than 40 percent calcium carbonate equivalent. Lime shall be applied at the rate recommended by soil test.

2.02 FERTILIZER

- A. Shall be a standard commercial product which when applied at the proper rate will supply the equivalent quantity of total nitrogen, available phosphoric acid and soluble potash specified. Fertilizer shall be delivered to the site in bags or other suitable containers, each fully labeled, conforming to applicable state fertilizer laws, and bearing the name, trade name or trademark, and warranty of the producer.
- B. Requirements per acre:
 - 1. Six hundred pounds of 17-17-17 grade fertilizer or equivalent.

2.03 MULCH

- A. Shall be vegetive mulch consisting of cereal straw from stalks of oats, rye, wheat or barley. Straw shall be free of prohibited weed seeds as stated in State Seed Law and shall be relatively free of all other noxious and undesirable seeds. Straw shall be clean and bright, relatively free of foreign material and be dry enough to be spread properly.

2.04 SEED

- A. Seed shall be a mixture with the specified minimum purity and germination requirements, as follows:

<u>Seed Type</u>	<u>% Mix (By Wt.)</u>	<u>Purity %</u>	<u>Germination %</u>
Kentucky K-31 Fescue	52	97	85
Creeping Red Fescue	18	85	80
Rye Grass	8	98	85
Rye Grain	22	-	-

Variation in the above mix to suit local conditions or time of year may be required.

- B. Seed shall be labeled in accordance with USDA regulations. Care shall be taken during transportation to avoid segregation of seed mixtures.
- C. Seed shall be sown at a rate of 217 pounds of seed mix per acre for drill seeding. Seed mixture shall be thoroughly mixed prior to application.

PART 3 - EXECUTION**3.01 GENERAL**

- A. The application of fertilizer, seed, and mulch shall follow each other in successive sequence as closely as possible. Seeding shall be accomplished in the first of the following two periods after completion of earthwork.

February 15 to May 1st
September 1st to October 1st

- B. Seeding outside the specified seeding periods may be permitted at the Engineer's option, provided the Contractor is willing to make appropriate modifications to his seeding operations, and will guarantee the crop.

3.02 INSPECTION

- A. Contractor must request that Engineer inspect site grading, clean-up and surface preparation to determine if site is ready for the seeding, fertilizing and mulching operations.
- B. Upon Engineer's approval operations may begin.

3.03 SURFACE PREPARATION

- A. Immediately in advance of fertilizing, the surface to be seeded shall be repaired, if necessary, to eliminate all damage from erosion or construction operations. The surface shall then be loosened and thoroughly pulverized by discing, harrowing and raking or other approved methods, to such an extent that it is free from sod, stones, clods, or roots. All growth of vegetation that will seriously interfere with planting operations shall be removed and disposed of as directed. The final surface shall be smooth and uniform, and left in such a condition as to prevent formation of low places and pockets.

3.04 FERTILIZING

- A. Fertilizer and lime shall be dressed evenly over the areas to be seeded using approved mechanical type spreading equipment.
- B. Fertilizer and lime after spreading shall be immediately incorporated into the soil to a depth of approximately 2 inches, by chisel, spike tooth harrow, or other approved methods.

3.05 SEEDING METHODS

- A. General methods:
The Contractor shall employ a satisfactory method of sowing by use of either approved mechanical hand seeders or mechanical power-driven drills. When delays in operation carry the work beyond the specified planting seasons, or when conditions are such that by reason of drought, high winds, excessive moisture, or other factors, satisfactory results are not likely to be obtained, seeding shall stop. It will be resumed only where the desired results are probable or when approved alternate procedures have been adopted.
- B. Broadcast seeding:
When broadcast seeding is utilized, the seed shall be uniformly broadcast by mechanical hand seeder, in two directions at right-angles to each other and at 1/2 of the specified rate per acre in each direction. After the seed is broadcast it shall be covered by an approved method to a depth of 1/3 inch to 3/4 inch. Broadcast seeding shall not be done in windy weather.
- C. Drill seeding:
When drilling is utilized, it shall be done with approved equipment best suited to perform the work under prevailing conditions. The seed shall be uniformly drilled to a depth of one-third (1/3) inch to three-fourths (3/4) inch at the rate per acre specified. Drill seeding may be required in windy weather.
- D. Prior to start of seeding, the Contractor shall demonstrate that the application of seed is being made at the specified rate. A final check of the total quantity of seed used shall be made against the area seeded. If the check shows that the Contractor has not applied seed at the specified rate, he shall uniformly distribute seed at a rate calculated to meet the

shortage.

- E. The Contractor shall maintain the seeded areas until all fertilizing, seeding and mulching is complete and the work accepted by the Engineer. Areas damaged from the Contractor's own operations shall be repaired at his expense. After acceptance of the work the Contractor will not be held responsible for erosion due to weather, or conditions not due to the Contractor's own operations or negligence. The Contractor is not required to guarantee a crop, if seeding is done during the specified seeding periods.

3.06 MULCHING

- A. Immediately after seeding, the Contractor shall apply vegetative mulch at a rate between 1-1/2 and 2-1/2 tons per acre to all seeded areas. Quantity of mulch shall be adjusted within the above limits, as directed by the Engineer, to the particular area or slope being mulched. Total application of mulch for the project shall average approximately 2 tons per acre. Mulch shall be applied by mechanical mulch spreaders equipped to eject by means of a constant air stream controlled quantities of the vegetative mulch.
- B. Mulch shall be embedded by a disc type roller having flat serrated discs spaced not more than 10 inches apart, with cleaning scrapers for each disc.
- C. Where indicated, or in areas of the project where soil conditions are not suitable for satisfactory crimping, asphalt emulsion shall be applied with the mulching operation. The normal rate of application shall be 100 gallons per ton of straw; however, this rate may be varied as directed by the Engineer to suit the particular area or slope conditions.
- D. All mulch shall be distributed evenly over the areas to be mulched within 24 hours after the seeding operation. Following the mulching operation, suitable precautions shall be taken to prohibit traffic over mulched areas. Displaced mulch shall be replaced immediately, including repair of the underlying seed bed, if damaged as well.

3.07 MAINTENANCE

- A. The Contractor shall maintain all seeded areas until the grass is properly established (not less than 90 days) until satisfactory development. Maintenance shall be continued until final acceptance of the work.
- B. Maintenance of seeded areas shall include protecting, watering, mowing, fertilizing, and such other work as may be necessary to establish a permanent lawn. The Contractor shall reseed those seeded areas in which a satisfactory growth is not obtained, and shall refill any areas which become eroded prior to final acceptance of the work.
- C. Paved areas shall be kept clean while maintenance operations are in progress.

3.08 REPLACEMENT

- A. The Contractor shall replace all trees, shrubs, and flowers damaged by construction activities in the areas designated on the construction plans. The replacement trees and shrubs shall be equal in size to the damaged or removed specimen.

END OF SECTION

PART 1 - GENERAL**1.01 SECTION INCLUDES**

- A. Cast in place concrete.

1.02 QUALITY CONTROL

- A. Supervision:
1. Provide full time superintendent on the project who is qualified and experienced in concrete construction. Superintendent shall direct all work in connection with concrete construction.
 2. Finishers shall be journeymen concrete finishers experienced in concrete finish work.
- B. Codes and standards:
Work covered by this specification shall be as specified herein and as specified in "Building Code Requirements for Structural Concrete", ACI 318 (latest revision).

1.04 TESTING

- A. Laboratory and field testing shall be made on all concrete material including compression yield, air content, and slump test to the following ASTM Test and Specifications.
1. ASTM C31: Making and Curing Concrete Compressive and Flexural Strength Test Specimens in the Field.
 2. ASTM C33: Specification for Concrete Aggregate.
 3. ASTM C39: Test for Compressive Strength of Cylindrical Concrete Specimens.
 4. ASTM C87: Test for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar.
 5. ASTM C143: Test for Slump of Portland Cement Concrete.
 6. ASTM C15: Specification for Portland Cement.
 7. ASTM C172: Sample Fresh Concrete.
 8. ASTM C231: Test for Air Content of Freshly Mixed Concrete by Pressure Method.
 9. ASTM C260: Specification for Air Entraining Admixtures for Concrete.
 10. ACI 211-1-70: Recommended Practice for Selecting Proportions for Normal Weight Concrete.
 11. ACI 214-65: Recommended Practice for Evaluation of Compression Test Results of Field Practice.

- B. Concrete test cylinders shall be made at the job site by the Contractor. Concrete sample shall be taken from concrete being placed. Four cylinders shall be made for each pour over 5 cubic yards. Two cylinders shall be made for each pour for minor structural concrete as manholes, walks, etc.

Identify test cylinders to area concrete was placed. Cure cylinders same as job concrete.

Deliver three cylinders at 4 days. Test one at 7 days, moist cure other and test two at 28 days. Hold fourth cylinder for backup. Job cylinder tests are the basis for acceptance of concrete.

- C. Air content shall be measured at the job site by the pressure method ASTM C231. Each test shall be recorded and identified to area concrete was placed. Test results shall be submitted to the Engineer. Air tests shall be made for all pours over 5 cubic yards and as directed by Engineer.
- D. Slump test shall be made on all concrete pours. Each test shall be recorded and identified to area concrete was placed. Test results shall be submitted to the Engineer.

1.05 SUBMITTALS AND CERTIFICATES

- A. Contractor shall submit name and location of transit mix company for approval.
- B. Submit complete laboratory testing data on aggregate gradation, deleterious substances, and durability of mix additives and cement.
- C. Delivery tickets shall be required with each load indicating mix design and information listed under ASTM C94-16.

1.06 PRODUCT HANDLING

- A. Transit mix:
Concrete shall be handled and preserved in its "batched" proportion during transportation. Mixing time shall not exceed 45 minutes.
Concrete improperly cared for or mixed in the truck longer than 45 minutes shall be disposed of away from the project. Water shall not be added at anytime during transit or at the job site.
- B. Defective concrete:
Damaged or defective concrete shall be repaired or removed and replaced immediately as directed by the Engineer.
- C. Batch adjustment:
Cement, aggregate, or water, shall not be added to the truck after batching in an attempt to adjust slump or other batch characteristics.

PART 2 - PRODUCTS

2.01 STRUCTURAL CONCRETE

A. General:

1. All concrete used in the project shall be furnished by a reputable permanent concrete plant using transit mix trucks. The plant shall be located within a reasonable distance from the project so travel time is 30 minutes or less. Supplier shall have adequate bins that weigh material by approved scale system. The supplier shall have an adequate number of modern trucks to ensure delivery of concrete as required for placing schedule. Supplier shall be subject to approval of the Engineer.
2. The Contractor shall use whatever means necessary to ensure concrete delivered to the project is properly batched with approved kinds and quantities of materials.
3. All admixtures used in concrete mix shall contain no chlorides.

B. Cement:

All cement shall be Type I Portland cement conforming to ASTM C150.

C. Fine aggregate:

1. Fine aggregate shall consist of natural sand conforming to ASTM C33. Sand shall be well graded, washed, and shall conform to the following sieve analysis:

<u>Sieve Size</u>	<u>Percent Passing</u>
1/2 inch	100
3/8 inch	99-100
No. 4	95-100
No. 8	85-95
No. 16	60-85
No. 30	30-60

<u>Sieve Size</u>	<u>Percent Passing</u>
No. 50	10-30
No. 100	0-5

2. The sand shall not have more than 35 percent retained between any two consecutive sieve sizes. Fineness modules shall not be less than 2.5 nor more than 3.1.
3. The amount of deleterious substances in fine aggregate, each determined on independent samples complying with the grading requirements of Division 3, shall not exceed the following limits:

4. Table 1. - Limits for Deleterious Substances in Fine Aggregate for Concrete:

<u>Item</u>	<u>Maximum percent by Weight of Total Sample</u>
Clay Lumps	0.25
Material Finer than No. 200 Sieve	2.00
Coal & Lignite	0.06
Sticks, Leaves & Other Deleterious Material	0.25

5. Fine aggregate shall be free of injurious amounts of organic impurities. Except as herein provided, aggregates subjected to ASTM test No. C40-56T for organic impurities and producing a color darker than the standard shall be rejected.
6. Fine aggregate shall be free of material that could react harmfully with alkalis in the cement. If such materials are present in injurious amounts, the fine aggregate shall be rejected, or shall be used with cement containing less than 0.6 percent alkali calculated as sodium oxide or with the addition of a material that has been shown to inhibit undue expansion due to the alkali-aggregate reaction.
7. Except as provided above, fine aggregate subjected to five cycles of the soundness test (ASTM C88-59T), shall show a loss, weighted in accordance with the grading of a sample complying with the limitations set forth above, not greater than 10 percent when sodium sulfate is used or 15 percent when magnesium sulfate is used.

D. Coarse aggregate:

1. Coarse aggregate shall be crushed limestone having an established history of sound material conforming to ASTM C33 and shall be approved by the Engineer. Furnish soundness test results for approval of source. Coarse aggregate source shall not contain chert deposits.

Gradation

<u>Sieve Size</u>	<u>Percent Passing</u>
1½ inch	100
1 inch	95-100
1/2 inch	25-60
No. 4	0-10
No. 8	0-5

2. Satisfactory experience record shown for durability, otherwise pass soundness test ASTM C88-5 cycles using magnesium sulfate without splitting or losing more than 15 percent weight.
3. Contractor shall arrange and pay for testing if adequate history is not available.

- E. Water:
1. Water for mixing and curing concrete shall be clean, and free from injurious amounts of sewage, oil, acid, alkali, salt, or organic matter. Only potable water shall be used.
- F. Concrete mix:
1. All concrete for the project shall conform to the design mix listed in the table below. The concrete mix shall include water reducing agent and air entrainment of 6 percent air plus or minus 1.5 percent. Twenty-eight day design strength shall be 4500 psi. The total aggregate volume is based on 60 percent coarse aggregate and 40 percent fine aggregate by volume. In the event the percentage of fine aggregate is increased, the amount of cement shall be increased as directed to provide equivalent strength.

Maximum aggregate size	- 1 inch
Maximum water	- 250 lb/cy
W/C weight ratio (maximum)	- 0.410
Cement	- 6.49 sacks/cy
Fibrous concrete reinforcement	- 1.5 lbs./cy
 2. The supplier may submit complete data mix to accomplish the above design with which he has had a history of success for the Engineer's approval. The Contractor shall furnish laboratory design mix for the approved materials if a "history" mix is not available.
 3. Water reducing agent shall conform to ASTM C-494, Type A. Acceptable agents include Euclid "Eucon WR 91" or "Eucon MR"; Grace "WRDA with Hycol" or "Daracem 65"; Masterbuilders "Pozzolith" or "Polyheed 997"; or approved equal.
 4. Air entraining agent shall conform to ASTM C-260. Acceptable agents include Euclid "Air Mix 250"; W.R. Grace "Daravair 1000"; Masterbuilders "Microair" or "AE90", or approved equal. Proportions shall be as prescribed by the manufacturer and testing laboratory.
 5. All admixtures shall be the product of a single manufacturer.

2.02 CURING MEMBRANES AND JOINTS

- A. Curing membranes:
- Curing membranes shall be 6 mil clear sheet polyethylene, Vis-Queen or equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. Inspection:
Inspect all work of other trades to ensure installation is complete and ready for concrete placement. Verify all items are in place.
- B. Conflicts:
Consult Engineer in case of conflict between placing and other equipment or material.

3.02 PREPARATION

- A. General:
 1. Clean all forms and correct all fine grade damage.
 2. Wet down all subgrades.
 3. Verify all needed equipment for placing concrete is on hand: vibrators, crane or pump, tremies, flumes, finishing equipment.
 4. All keyways are to be in place.
 5. Dry up excavation if any water is present.
 6. Have cold weather equipment on hand if applicable.
 7. Notify Engineer at least 48 hours in advance of placing concrete.

3.03 PLACING OF CONCRETE

- A. General:
 1. Only those methods and arrangements of equipment shall be used which will reduce to a minimum any segregation of coarse aggregate from the concrete.
 2. Sufficient capacity of manpower and placing equipment shall be provided so that the work may be kept free from cold joints and other defects in the finished product.
 3. Concrete shall be deposited into the forms or on the grade as nearly as practicable in its final position, and in such manner that the concrete will completely fill the forms.
 4. Vibration shall not be used to move concrete in a horizontal direction after initial placement.
 5. Placement of concrete on a slope shall begin at the lower end of the slope and progress upward.
 6. Concrete that has partially hardened or has been contaminated by foreign material shall not be deposited in the work, but shall be discarded.
 7. Inclined chutes beyond the mixer chute shall not be permitted. Only concrete pumps or crane with concrete bucket will be approved method of placing concrete beyond chutes on mixers.
 8. No water shall be added to the concrete, for any reason, at the job site.

9. Care shall be taken to fill the forms and to finish the concrete so the top surface is true to line and grade.
 10. Concrete shall not be placed on muddy or frozen ground.
 11. Dry subgrade shall be wetted in advance of concrete placement.
 12. Care shall be taken to assure proper concrete coverage of reinforcing steel and mesh, as designed.
 13. Care shall be taken to maintain the proper location of all joint material, dowels, embedded items, etc., during concrete placement.
 14. No mud or other foreign materials shall be tracked into the concrete during placement operations, and all contaminated concrete shall be removed.
 15. Laitance or soft layers of mortar shall be removed from the top or face of previously hardened concrete prior to placing additional concrete in contact with the surfaces.
 16. Immediately before placing concrete walls. Concrete fill shall be placed on top of the previously placed concrete.
 17. Extreme care shall be taken to avoid damage to surfaces of forms for all exposed concrete work.
 18. Keyway shall be clean with no standing water.
- B. Footings:
1. Concrete shall not be placed on frozen, muddy or spongy base.
 2. All mud, free-standing water, loose dirt and debris shall be removed prior to placement of concrete.
 3. Placement operations shall be performed in such manner as to prevent loose earth falling into footing area during placement of concrete.
- C. Slabs:
1. Strike-off screeds shall be set to proper grades for all concrete slab construction, and the tolerance for screeds for smooth finish slabs shall not exceed 1/8 inch plus or minus in a distance of 7 feet.
 2. Strike-off shall be accomplished by use of a straight edge of adequate weight and length.
 3. Vibrating screeds, or other approved strike-off methods, shall be used when concrete slump is less than 3 inches and slab thickness is more than 4 inches.
- D. Vibrating:
1. Mechanical internal vibrators shall be used whenever possible in all formed concrete work.
 2. Vibrators shall be inserted at uniform spacing of 12 to 20 inches to assure thorough consolidation of all concrete.
 3. Vibrators shall be inserted and withdrawn vertically, to a depth which will assure penetration into the previous lift, with vibration periods of from 5 to 15 seconds.
 4. Form vibration and hand spading will be required at points inaccessible for thorough internal vibration.
 5. During placement of concrete, stand-by vibrators shall be immediately available in the event of mechanical failure in the vibrators being used.

- E. Maximum acceptable slump for all structural concrete shall be 3 inches (± 1 inch).
- F. Cold weather requirements:
1. Do not place concrete on ice or frozen subgrade.
 2. Concrete ingredients shall be heated when the air temperature is below 40 degrees F or forecast to drop below that temperature within 24 hours of the time concrete is to be placed.
 3. Heating shall be accomplished by heating either the aggregate or the mixing water, or both. Maximum temperature of the water or aggregates shall be 150 degrees F.
 4. Temperature of concrete at time of delivery shall be not less than 60 degrees F nor greater than 80 degrees F.
 5. During placing and finishing, concrete shall be maintained at a temperature of 50 degrees F or above, but not more than 80 degrees F.
 6. During placing and finishing, the concrete shall be protected from wind to prevent loss of heat and rapid drying.
 7. Heating of enclosures for flat slab finishing shall be done by vented heating methods. Open flame heating will not be permitted.
 8. Adequate facilities shall be provided prior to beginning concrete placement, for maintaining the ambient air temperature at the surface of the concrete or forms at 70 degrees F for 5 days.
 9. Protective measures shall be maintained for at least 4 days beyond the heating period, to prevent sudden cooling of the concrete. During this time, the concrete shall not be allowed to drop in excess of 20 degrees F in any 24 hour period with a minimum temperature of 40 degrees F.
 10. Newly finished flatwork shall be covered and protected for at least 14 days against exposure to rain, snow, sleet, and ice.
 11. During the entire protection period adequate means shall be provided to prevent loss of moisture from the concrete surface.
 12. All methods for protecting and heating concrete shall be subject to approval of the Engineer.
 13. See Part 3.05 for curing requirements.
- G. Hot weather requirements:
1. Concrete exposed to direct weather shall not be placed at temperatures above 100 degrees F.
 2. Temperature of concrete when placed shall not exceed 85 degrees F.
 3. In dry, hot or windy weather, sunshades and wind breakers shall be required during finishing operations.
 4. As soon as practicable without damage to the surface finish, all exposed concrete shall be covered and kept continuously wet. Maintain concrete below 100 F.
 5. See Part 3.05 for curing requirements.

3.04 FINISHING CONCRETE

- A. General:
1. All slabs, walks, and decks shall be sloped uniformly to drain to floor drains or to finish grade, and shall drain completely without ponding water.

2. Finish shall be of specified texture and uniform in color and appearance. Approval of each type of finish is required on 4 foot square test panels. Test panels shall be located in protected area away from actual project. Test panels shall be made and approved prior to first concrete placement.
 3. All voids in slabs and horizontal surfaces are to be filled during finishing operation. Voids in formed surfaces are to be repaired immediately at the time forms are removed.
 4. Avoid over finishing, late finishing, rewatering, and other techniques that may cause "crazing."
 5. Provide adequate manpower and equipment for finishing prior to placing concrete.
 6. Initiate curing process as soon as surface strength will permit.
- B. Slabs and footing surfaces:
Finish shall be a broom finish. Finish preparation shall be the same as the basin floor slabs. Finish with a steel trowel to produce dense surface then texture with a hair broom to produce non-skid surface. Texturing shall be uniform, single stroke, perpendicular to walls, or parallel to slope direction.

3.05 CURING

- A. General:
1. All concrete shall be continuously moist cured a minimum of 5 days after placing and finishing or 5 days after repairing.
 2. Protect all concrete surfaces from damage during and after curing period.
- B. Horizontal surfaces:
1. Cover with 6 mil polyethylene sheet. Lap edges 6 inches and seal. Hold in place with 2 by 4's at 4 foot centers or similar method. Placement shall not let air circulate under sheets.
 2. Place polyethylene sheets as soon as finish can be walked on without damage. Sheets must be in place within 6 hours after finish.
 3. Leave polyethylene sheets in place 5 days.
- C. Formed surfaces:
1. Forms are adequate if left in place 5 days.
 2. Cover top as described in B above.
 3. If forms are removed to "stone" finish or repair concrete, moisten surface and completely cover with 6 mil polyethylene sheets. Anchor in place.

3.06 DEFECTIVE WORK

- A. General:
1. Defective concrete work shall be removed and replaced immediately.
 2. Work built outside tolerances listed in Section 03100 shall be considered defective.

3. Concrete of inadequate strength or having surface conditions indicating poor durability such as crazing, severe "map cracking," crumbling, or other evidence shall be considered defective.
 4. Engineer shall be notified immediately when such conditions become apparent.
- B. Repairing:
1. Repairing of minor faults such as small "honeycomb" areas and voids may be patched. Repairs shall be made as described in 3.04D above.
 2. Cure patched areas 5 days.

3.07 SPECIAL CONSTRUCTION

- A. Pipe supports:
1. Provide concrete pipe supports for all piping located 3 feet or less above floor. Form supports for neat appearance.
 2. Provide inserts in concrete for pipe hangers.
- B. Equipment bases:
- Construct concrete bases for all equipment unless otherwise called for on the plan. Grout for solid bearing with non-shrinking grout. Grout shall be thoroughly mixed with the minimum water needed to produce flowable grout. Concrete base shall be saturated with water for at least 24 hours prior to grouting. Fill all void space. Minimum grout thickness shall be 1 inch. Finish edge of base plate grout vertically unless special requirements exist. Keep damp and covered for 5 days.
- C. Anchor bolts:
- The Contractor shall place anchor bolts, sleeve inserts, etc. required for all items of construction and equipment on the project prior to concrete placement. Care shall be exercised to set all anchors accurately.

END OF SECTION

CONSTRUCTION STANDARDS

GENERAL NOTES:

1. The Contractor shall verify the location and depth of all utilities prior to construction.
2. On Missouri projects, Contractor is to call 1-800-DIG-RITE to request utility locations to be marked at site(s) of proposed excavation.
3. Prior to commencement of work, the Contractor shall notify all those companies which have facilities in the vicinity 72 hours prior to the construction to be performed.
4. Contractor is to coordinate with Owner prior to connection to existing waterlines. Where interruption of facilities are necessary the Contractor is to plan his work in cooperation with Owner personnel for the least possible disruption of service. Night or weekend work may be necessary. If system operation must be suspended because of the Contractor's work, he shall have all necessary materials and equipment on hand, and have ample force available prior to beginning the work.
5. All work on Road/Street right-of-way shall be coordinated and in compliance with the applicable controlling authority. This includes traffic control as required.
6. Contractor is to coordinate w/property owners prior to any temporary closing of drives and/or parking areas.
7. Waterline shall be installed a minimum of 42" (inches) below surface of ground.
8. All Street and Private property monuments shall be protected.
9. All structures, fences, pavement, driveways and other improvements disturbed by construction activities shall be restored by the Contractor to condition equal or better than pre-construction condition.
10. When waterline crosses over or under other utilities, Contractor is to supply and fill 18" void between waterline and other utilities with crushed rock.
11. Waterline is to be installed with a minimum of 10' horizontal clearance from any force main or sewer line.
12. Locations of waterlines, and utilities shown are approximate only, and should be verified by Contractor prior to construction.
13. Backfill all driveway crossings with $\frac{3}{4}$ " type I rock. Resurface drives with material to match existing type and thickness. Culvert shall be replaced and ditches graded to drain.
14. Contractor to review and adhere to all provisions on easements, if any, provided to Contractor by Owner.



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0313045

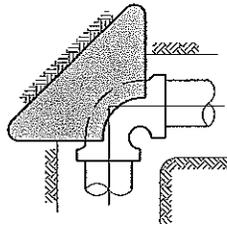
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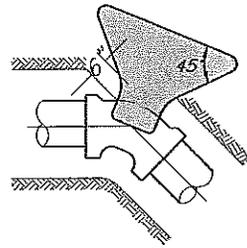
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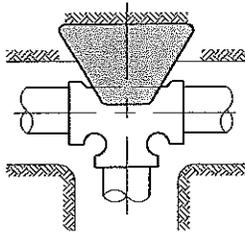
Note:
Construct thrust block at all fittings and hydrants.



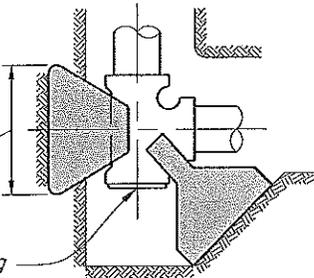
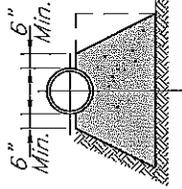
90° BEND



45° BEND
OR LESS



TEE TYPICAL SECTION



PLUGGED TEE

Note:
Bend #7 rods over to be symmetrical about plane pipe & lap weld for formed by ϕ 's of intersecting pipe alignments.

2 - #7 Bars each side
#4 @ 12" E.W.
Tie down block See table
1'-0" Min.

CONCRETE TIE DOWN BLOCK

Each block shall have same area of bearing surface as called for in table for tee

REQUIRED THRUST BLOCK AREA OF BEARING IN SQUARE FEET BETWEEN CONCRETE AND UNDISTURBED TRENCH WALL

PIPE SIZE	24"	20"	18"	16"	14"	12"	10"	8"	6"	2"-4"
90° BEND	64	44	36	28	22	16	11	7	4	2
45° BEND	35	24	19	15	12	9	6	4	2	1
22 1/2° BEND	18	12	10	8	6	4	3	2	1	1
11 1/4° BEND	9	6	5	4	3	2	1 1/2	1	1	1
TEE	45	31	25	20	15	11	8	5	3	1 1/2

Note:
Calculations based on working pressure of 150 psi and soil bearing capacity of 1500 psf.

REQUIRED CUBIC FEET OF CONCRETE FOR TIE DOWN BLOCKS

BEND	PIPE SIZE									
	24"	20"	18"	16"	14"	12"	10"	8"	6"	2"-4"
90°	680	470	380	300	230	170	120	75	42	16
45°	480	330	270	210	160	120	85	53	30	11
22 1/2°	260	180	145	115	90	65	45	29	16	6
11 1/4°	130	90	75	60	45	35	23	15	8	3

Note:
Calculations based on working pressure of 150 psi, unit weight of concrete of 150 psf and a safety factor of 1.5.

THRUST BLOCK DETAILS

Scale: Not to scale



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Notes:

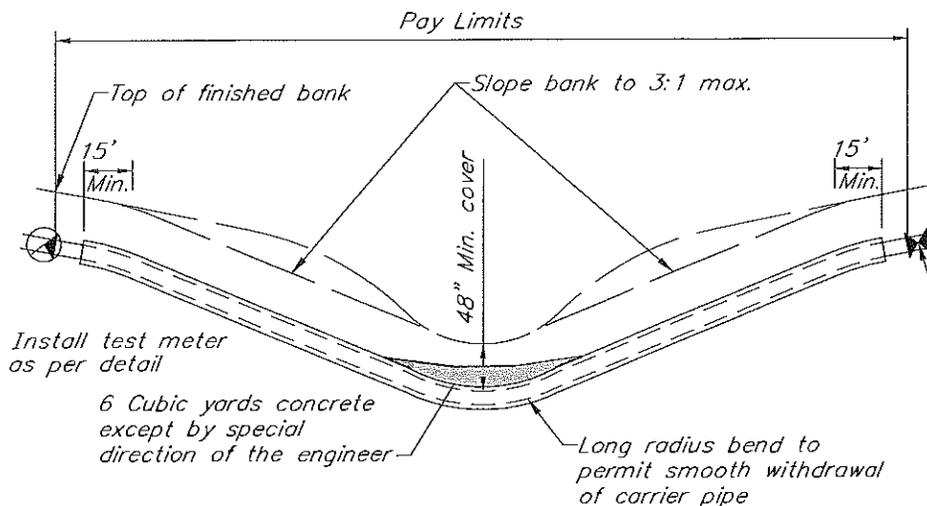
A. *Flowing streams.*

A minimum cover of four feet shall be provided over the pipe. When crossing water courses are greater than 15 feet in width, the following shall be provided.

1. The pipe shall be of special construction, having flexible watertight joints. Steel or ductile iron ball-joint river pipe shall be used for open cut crossings. Restrained joint pipe may be used for open cut crossings, provided it is encased in a welded steel casing. Restrained joint or fusion weld pipe shall be used for bored crossings.
2. The stream crossing pipe or casing shall extend at least 15 feet beyond the upper edge of the stream channel on each side of the stream.

B. *Intermittent flowing streams*

1. Restrained joint pipe shall be used for all stream crossings.
2. The pipe shall extend at least 15 feet beyond the upper edge of the stream channel on each side of the stream.



MISSOURI DESIGNATED STREAM CROSSING

Scale: Not to scale



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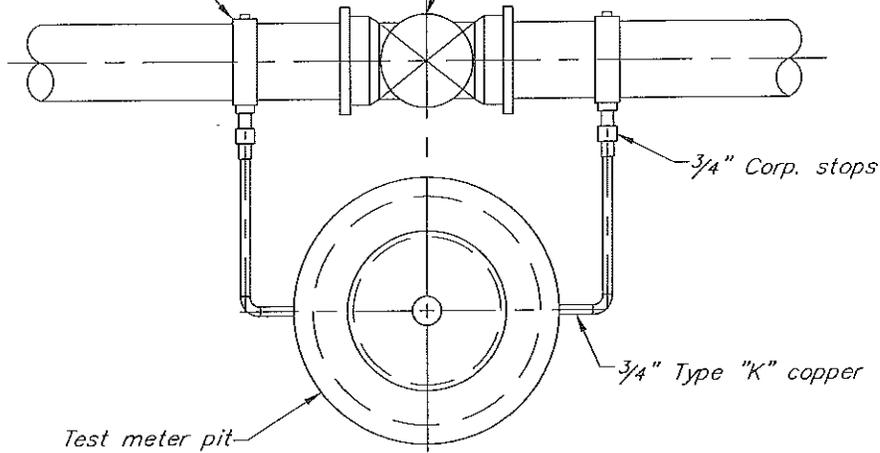
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Ford style S71 service
saddles (2 req'd)

Main line valve and box, not
considered as part of test meter

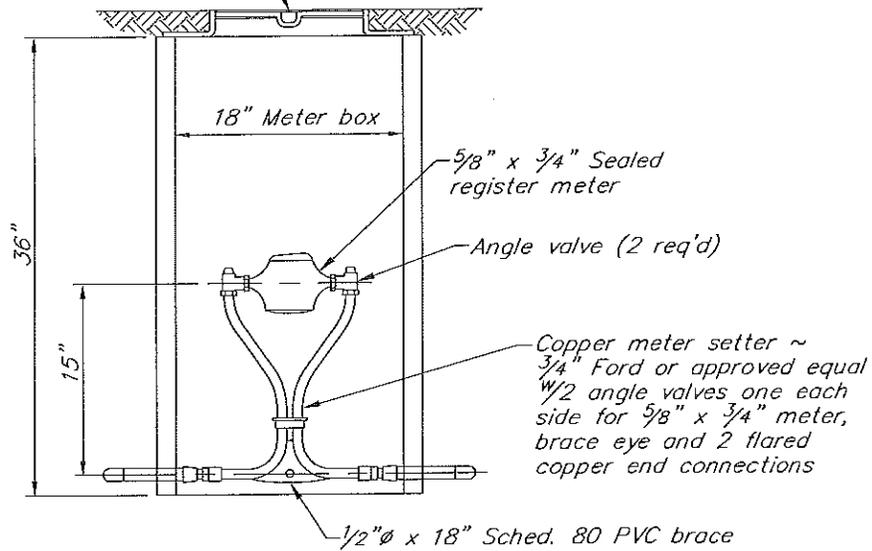


PLAN

NOTE:

Meter shall be installed
after the lines have been
disinfected and flushed.

Clay & Bailey
D2210 cover



SECTION

TEST METER INSTALLATION

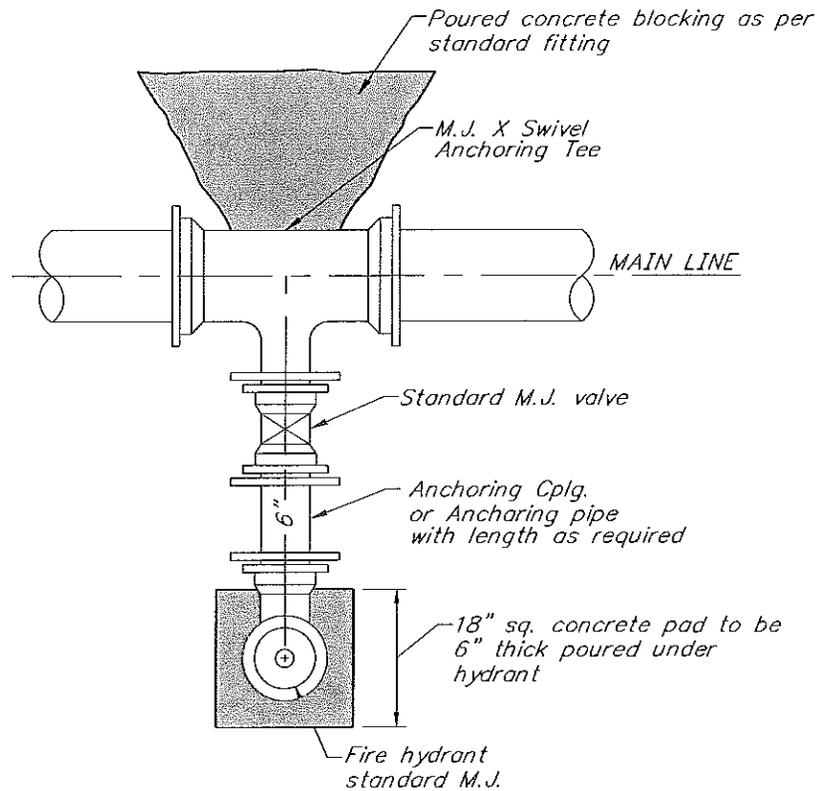
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STANDARD FIRE HYDRANT DETAIL

Scale: Not to scale

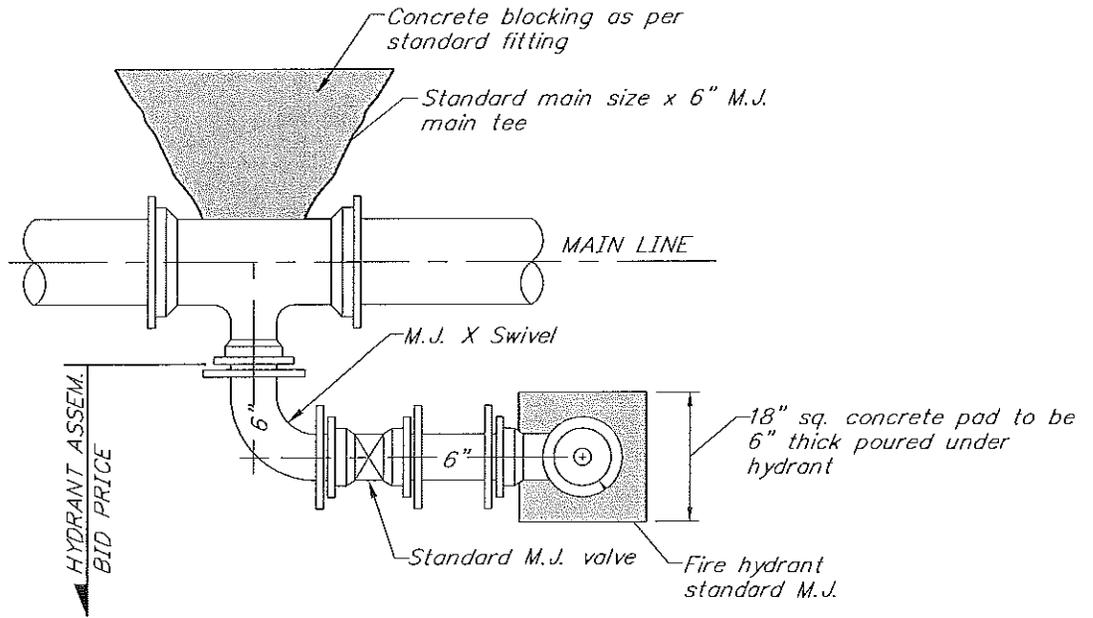


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STANDARD HYDRANT INSTALLATION WITH 90° BEND

Scale: Not to scale

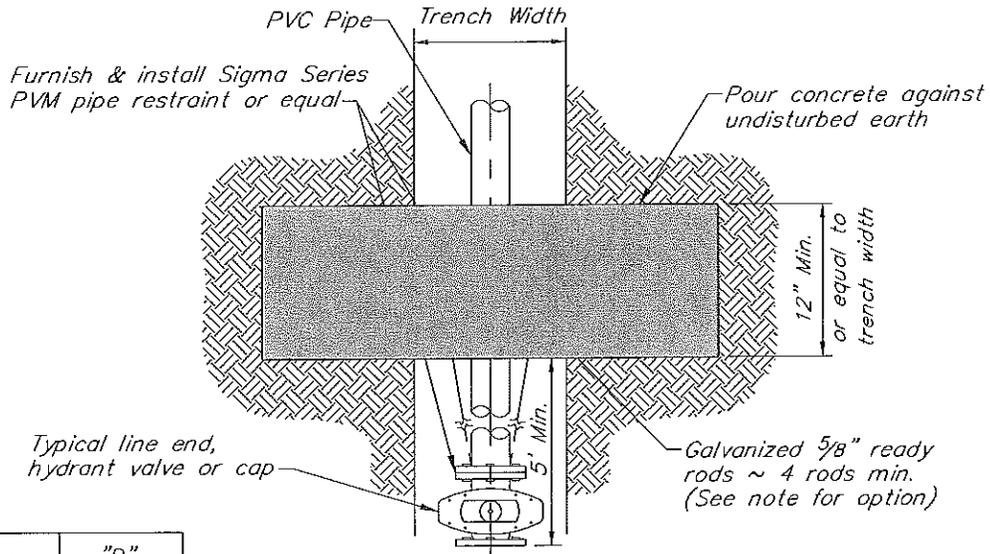


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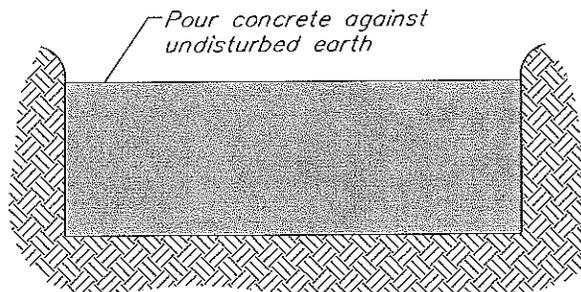


PLAN

NOTE:

In lieu of ready rods as shown, contractor can use Sigma PV- LOK or equal with PVC - to MJ fitting to tie valve to main.

Pipe Size	"D" Min.
4-6"	4"
8"	7"
10"	11"
12"	15"
16"	24"



ELEVATION

STRADDLE BLOCK

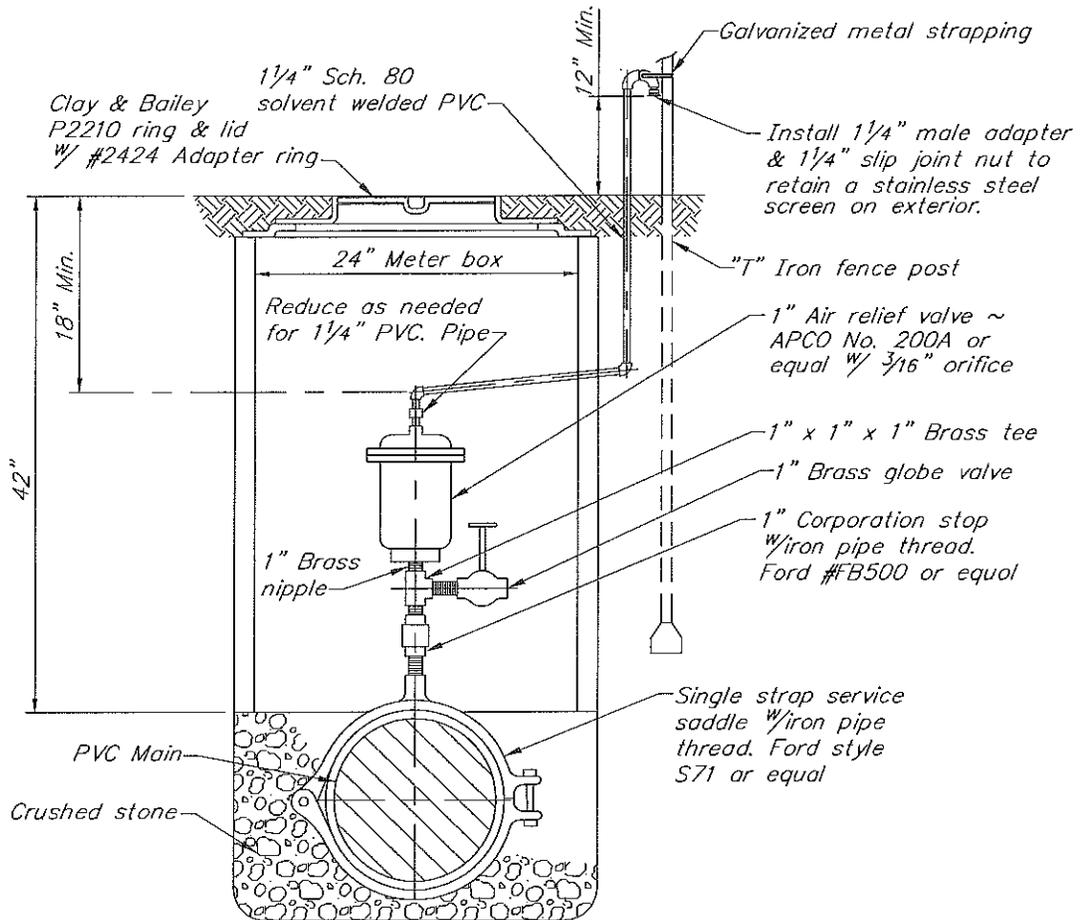
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AIR RELEASE VALVE DETAIL

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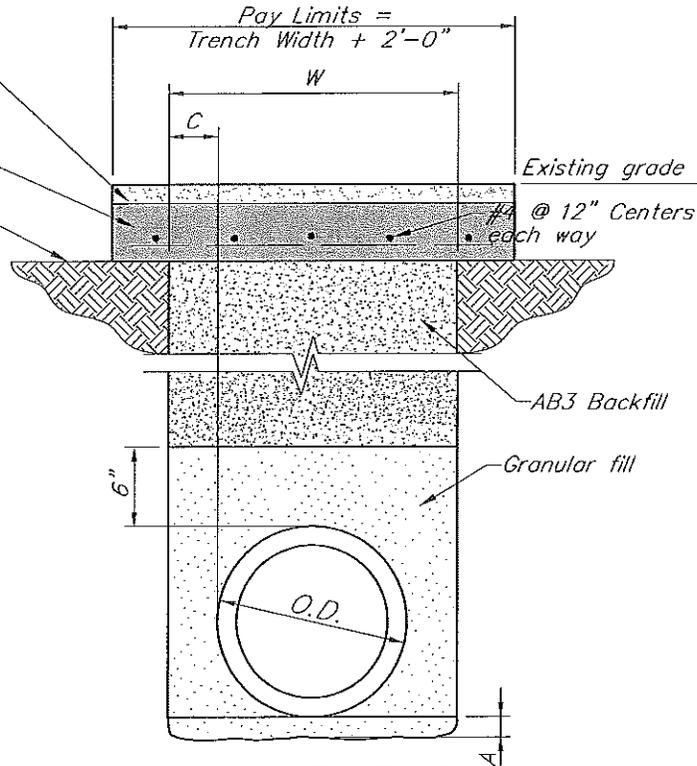
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2" Hot mix asphalt match existing pavement (For asphalt pavements only)

6" thick minimum concrete, (greater thickness if required to match existing pavement)

Existing grade



PAVEMENT RESTORATION DETAIL

Scale: Not to scale



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CASING SCHEDULE FOR CROSSINGS

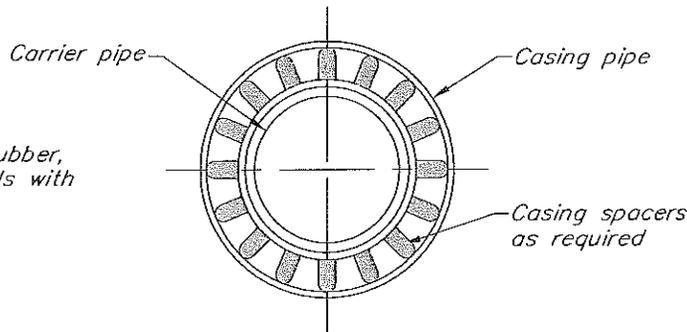
CROSSING TYPE	PVC OR DIP CARRIER PIPE DIAMETER							
	2"	3"	4"	6"	8"	10"	12"	18"
	*MINIMUM CASING DIAMETER							
STATE HIGHWAY (MO. HWY. SPECS.)	6" STEEL	6" STEEL	8" STEEL	10" STEEL	12" STEEL	20" STEEL	20" STEEL	30" STEEL
STREAM	4" PVC	6" PVC	8" PVC	10" PVC	12" PVC	16" STEEL	20" STEEL	30" STEEL
COUNTY AND STREET (BITUMINOUS SURFACE)	4" PVC	6" PVC	8" PVC	10" PVC	12" PVC	16" STEEL	20" STEEL	30" STEEL
RAILROAD (RAILROAD SPECS.)	6" STEEL	8" STEEL	8" STEEL	12" STEEL	16" STEEL	20" STEEL	20" STEEL	30" STEEL

Casing up thru 14" for State Highways shall have a minimum wall thickness of 0.188

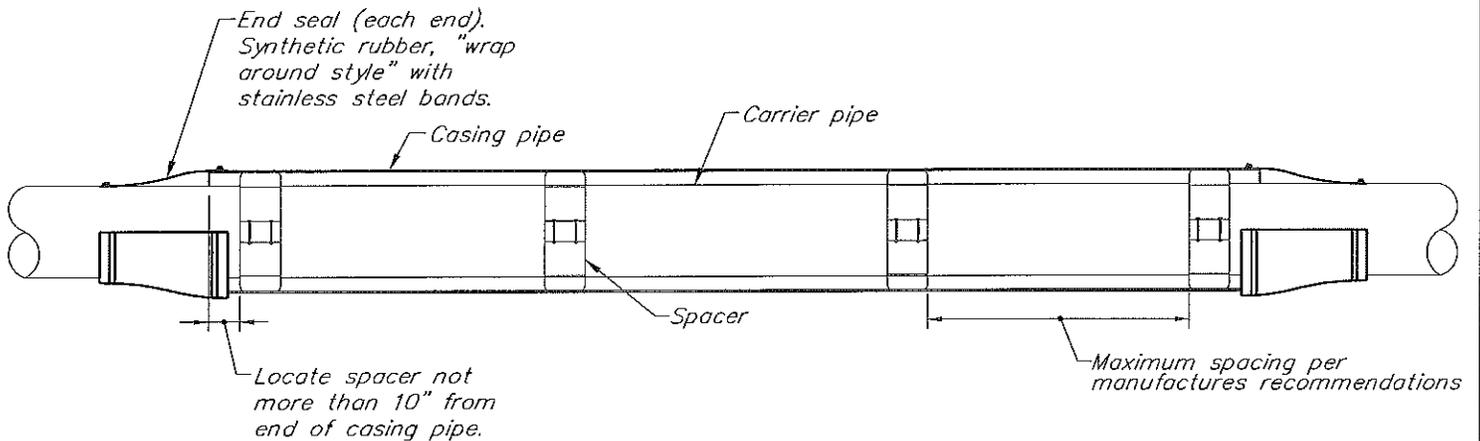
Casing 16" & 20" with 0.219" and 0.281" wall thickness respectively for state highways, streams, county roads & streets.

NOTE:

Each end of casing to be sealed with Synthetic rubber, "wrap around style" end seals with stainless steel bands.



CASING DETAIL
(FOR ALL BORED CROSSINGS)



END SEAL DETAIL

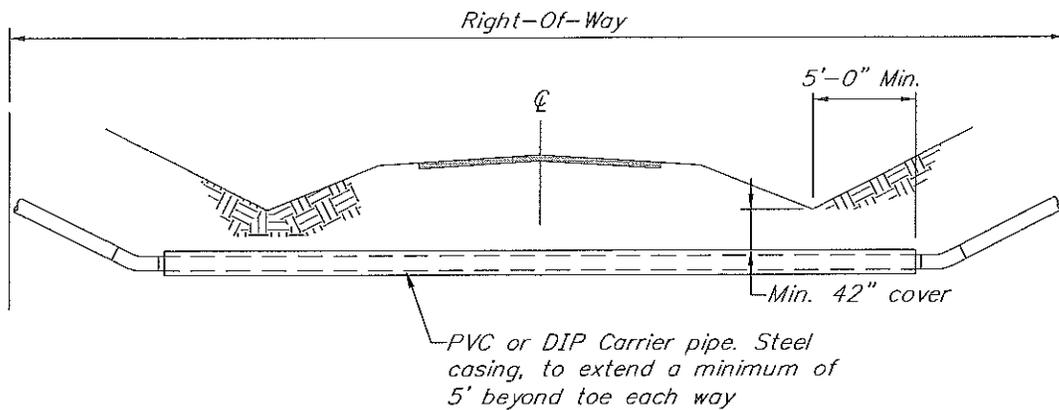
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STATE HIGHWAY CROSSING

Scale: Not to scale



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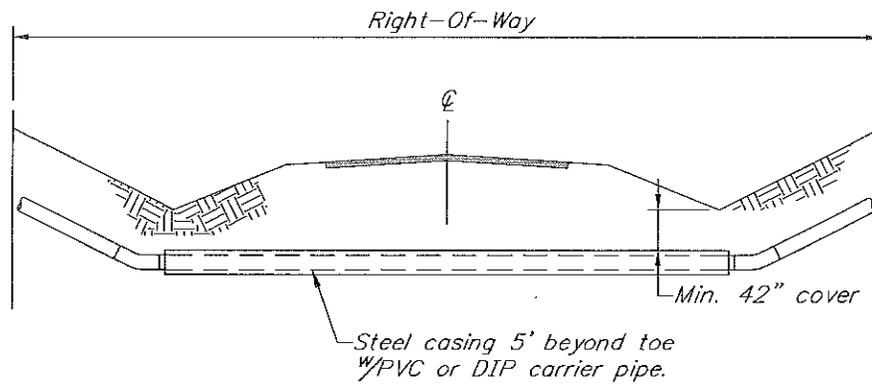
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NOTE:

1. Bituminous surfaced roads shall be bored.



DESIGNATED CITY & COUNTY ROAD CROSSING
Scale: Not to scale



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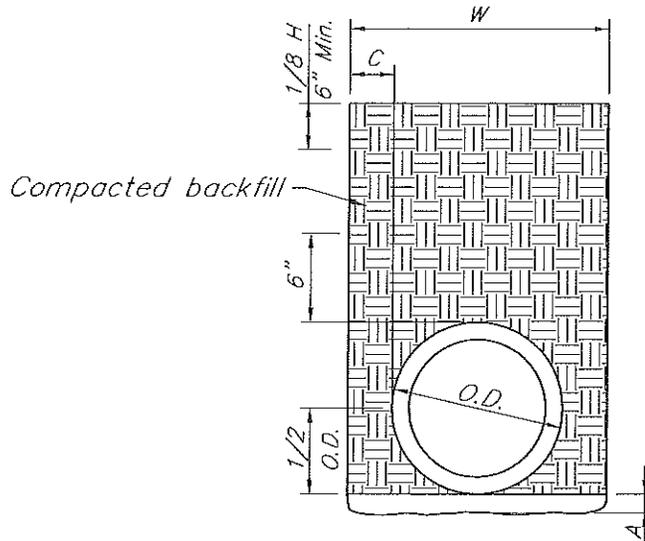
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date
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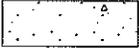


COMPACTED BACKFILL

Scale: Not to scale

NOTES:

1. A & C = Absolute min. Clearance from pipe wall to any projection of trench bottom or wall.
 A (earth excav.) 2", class b.
 A (rock excav.) 6", class b.
 C = 6"
2. W = Trench width at a level 6" above top of pipe.
 W = Min. Of 12" plus (O.D., O.S. or S).
 W = Max. Of 24" plus (O.D., O.S. or S).
3. H = Trench height, top of pipe to finished grade.

4.  = granular fill.
5.  = precast concrete.
6.  = cast-in-place concrete.
7.  = compacted trench backfill.
8.  = undisturbed earth.
9. All bedding class B.
10. See specifications for trench bottom stabilization, if required.

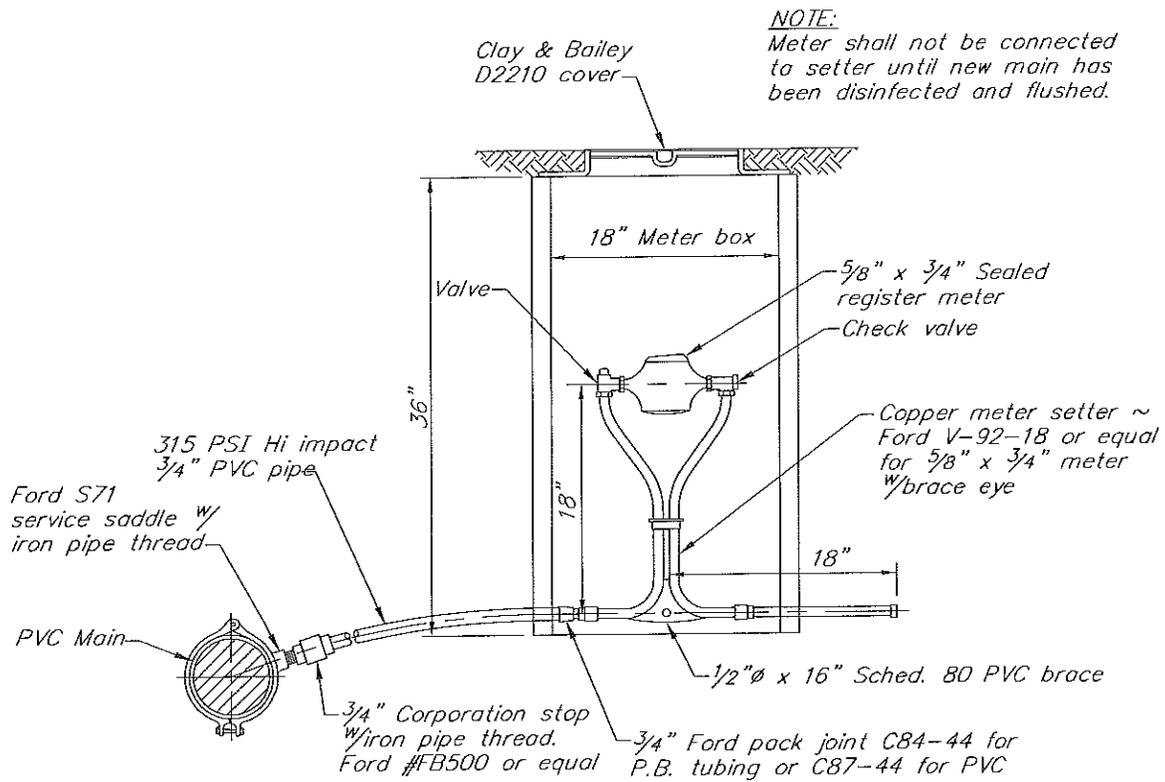


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3/4" TYPICAL SERVICE CONNECTION DETAIL



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