

Inman-Campobello Water District

Standard Specifications

Inman-Campobello Water District

Inman, SC

SECTION 1

GENERAL REQUIREMENTS

1.01 Scope: This Section covers the general requirements for work to be performed, and special provisions pertaining to that work.

1.02 Drawings: The Drawings entitled _____
 _____ WATER MAIN EXTENSIONS FOR THE
 INMAN-CAMPOBELLO WATER DISTRICT form a part of the Construction Agreement.

1.03 Specifications: The Specifications form a part of the Construction Agreement, and include this Section and Sections 2 through 4F as identified below:

<u>Section Number</u>	<u>Title of Section</u>
1	General Requirements
2	Sitework & Installing Pipe & Appurtenances
2A	Clearing and Grubbing
2B	Existing Utilities and Structures
2C	Removing and Replacing Pavement
2D	Trench Excavation
2E	Assembling and Jointing Pipe and Fittings
2F	Bedding of Pipe and Backfilling of Trenches
2G	Testing, Disinfection, Clean-Up & Placing in Service
2H	Rock Excavation
2I	Blasting
2J	Thrust Restraint
2K	Installing Fire Hydrants
2L	Installing Valves
2M	Boring
2N	Bridge Attachment

2O	(Reserved)
2P	Erosion Control
2Q	Grassing
3	Material Specifications
3A	Pipe Materials
3B	Fittings
3C	Tapping Saddles and Sleeves
3D	Valves and Valve Boxes
3E	Fire Hydrants
4	PVC Piping Materials and Installation
4A	PVC Pipe Materials
4B	Trench Excavation for PVC Pipe
4C	PVC Pipe Joint Assembly
4D	Bedding of PVC Pipe and Backfilling of Trenches
4F	Tracer Wire and Warning Tape Installation

1.04 Work to be Done: Work to be done consists of furnishing all materials, equipment and labor necessary for constructing work as specified and/or shown on drawing(s) entitled:

_____ WATER MAIN EXTENSIONS
FOR THE INMAN-CAMPOBELLO WATER DISTRICT

1.05 Shop Drawings: Shop drawings are required for all products. The Contractor shall submit six (6) copies to the Engineer for approval.

The Contractor is responsible to determine and verify field measurements, field construction criteria, catalog numbers, and conformance with specifications prior to sending the shop drawings to the Engineer. All submittals shall bear the Contractor's stamp and signature ensuring the Owner he has reviewed and verified the product, measurements, and compliance with specifications. The Contractor shall not begin fabrication or work which requires submittals until return of approved submittals by the Engineer.

The submittal shall show the name of the Contractor, supplier and manufacturer. It shall clearly identify field dimensions and any deviation from the specification.

Distribution of the submittals will be:

1. Inman-Campobello Water District Job File - One Copy
2. Inman-Campobello Water District Construction - Two Copies
3. Contractor - Three Copies

The Engineer shall review the submittals and return within two weeks from the date received.

1.06 Contractor's Work Limits: The Contractor is to perform his work in compliance with all State and Federal safety requirements within the specified public right-of-way or right-of-way as procured by the Inman-Campobello Water District (ICWD). The Contractor may make his own arrangements for increased construction right-of-way at no additional cost to the Owner. Any damage caused by the Contractor inside or outside of the specified work limits will be the responsibility of the Contractor.

1.07 Record Drawings: To enable the ICWD to prepare record drawings, the Contractor shall keep a complete set with accurate records of changes and/or deviations from the contract documents and shop drawings. It shall show the project as it was actually installed. The Contractor's record set of marked-up drawings, shop drawings and specifications shall be kept at the job site during construction and be available for inspection by the Owner. These marked-up drawings and specifications shall be included in the package of final documentation submittals before final payment is requested.

1.08 Trench Bracing: The Contractor is required by State and Federal law to have on site a competent person to respond to the requirements for the safety of the job site to include trench bracing. Inman-Campobello Water District personnel will not enter any trench that does not meet with the regulations and, therefore, will not approve that portion of construction until the site in question meets with requirements. The Contractor is responsible to provide the necessary labor, equipment and material to comply with the regulations and work within the right-of-way provided by the Inman-Campobello Water District at no additional cost to the Owner.

1.09 Order and Sequence of Work: The prosecution, or sequence of the work shall be as provided herein or as approved by the Engineer, which approval, however, shall in no way affect the responsibility of the Contractor.

All taps and line draining (if necessary) for connecting lines will be coordinated with the ICWD Engineering Department and may not be constructed until approved.

The Contractor shall schedule with the ICWD any construction work which requires interference with the waterworks operations.

1.10 Source of Supply and Quality of Materials: The source of supply of all materials and equipment shall be submitted to the ICWD Engineering Department for review before orders are placed. Suppliers of reinforcing steel, fabricated metal work, and metal castings may be required to submit guarantees of conformity with the Drawings and Specifications. If required, representative preliminary samples of the character and quality prescribed shall be submitted by the Contractor or producer for examination and tested in accordance with the methods specified below. Only materials conforming to the requirements of the specifications shall be used in the work. Any materials proposed to be used may be inspected or tested during their preparation and use. If, after inspecting and testing and/or trial, it is found that initial sources of supply do not furnish an acceptable product in conformity with the Specifications, the Contractor shall be required to furnish materials that comply with the specifications. No materials, which after approval have become unfit for use, shall be used in the work or remain on the jobsite.

1.11 Samples and the Testing of Materials: Testing and certification of materials may be required by the Engineer if the quality of such materials are in question. In the event the materials do not meet specifications, the Contractor shall pay for the testing and provide materials which meet the specifications. If the materials meet specifications, ICWD will pay for the testing. Unless otherwise specified, materials tests shall be made in accordance with the standards of the American Society for Testing and Materials (ASTM), and by a commercial testing laboratory approved by the Engineer. Reports of tests shall promptly be furnished to the Engineer. Test shall be arranged by the Contractor as directed by the Engineer. The cost of all specified inspection and testing of materials shall be paid by the Contractor.

1.12 Handling of Materials: Proper and suitable tools and equipment for the safe and convenient handling of pipe and appurtenances are to be used. Special care shall be taken to prevent damage to all pipe, appurtenances and surrounding property while unloading, storing and stringing the pipe.

1.13 Stringing of Pipe: Stringing of pipe along the route of work will be allowed to the extent of work which can be completed during a single work day. Unloading and stringing pipe along the entire route is prohibited.

SECTION 2

SITE WORK & INSTALLING PIPE AND APPURTENANCES

2.01 Scope: This Section consists of subsections for installing pipe and appurtenances. The subsections are listed as follows:

<u>Subsection</u>	<u>Title</u>
Section 2A	Clearing and Grubbing
Section 2B	Existing Utilities and Structures
Section 2C	Removing and Replacing Pavement
Section 2D	Trench Excavation
Section 2E	Assembling & Jointing Pipe & Fittings
Section 2F	Bedding of Pipe & Backfilling of Trenches
Section 2G	Testing, Disinfection, Clean-Up and Placing in Service
Section 2H	Rock Excavation
Section 2I	Blasting
Section 2J	Thrust Restraint
Section 2K	Installing Fire Hydrants
Section 2L	Installing Valves
Section 2M	Boring
Section 2N	Bridge Attachment
Section 2O	(Reserved)
Section 2P	Erosion Control
Section 2Q	Grassing

SECTION 2A

CLEARING AND GRUBBING

2A-01. SCOPE: Work consists of all necessary clearing and grubbing as shown on the plans and specified herein.

2A-02. CLEARING AND GRUBBING:

A. General: Contractor shall consult with the Inman-Campobello Water District prior to beginning clearing, and a full understanding is to be reached as to procedure. Contractor shall then conduct clearing and grubbing operations in strict accordance with their agreement.

(1) All operations shall be conducted with full consideration of all proper and legal rights of the Owner, adjacent property owners and the public, and with the least possible amount of inconvenience to them. Care shall be taken to protect adjacent property.

(2) Contractor shall perform all clearing and grubbing work required for the installation of the complete work. Clearing shall consist of the removal and disposal of all pavement, stumps, trees, brush, debris, or other such materials in the path of the work.

(3) No burying of cleared debris on the right-of-way will be allowed.

(4) Any vehicular access to the right-of-way which crosses private property shall be by written permission of the property owner with copy of same provided to the Inspector.

(5) Erosion control measures as shown on the plans, and/or as required by Section 2P, EROSION CONTROL, shall be put in place during clearing and grubbing and before trench excavation.

B. Clearing Along Right Of Way: Where trees, brush, stumps or exposed roots exist within rights-of-way, the full width of the right-of-way shall be completely cleared and grubbed. Stumps shall be removed and roots shall be grubbed at least two (2) feet below the ground surface.

C. Burning Of Cleared Material shall be in strict accordance with all applicable local, state and federal regulations pertaining to open burning and smoke abatement. Prior to burning, approval and where applicable written permits, must be obtained from all applicable agencies.

D. Minor Structures may exist on the right-of-way. The disposition of the structures shall be so noted as shown on the plans by either; (1) left in place in a condition equal to or better than prior to construction; (2) removed and disposed of by the Contractor;

(3) removed for construction and replaced in a condition equal to or better than prior to construction; (4) relocated as shown on the plans. If the Contractor notes structures on the right-of-way that are not shown on the plans or the disposition is not noted on the plans, he shall contact the ICWD as to which of the above methods shall be followed.

E. Removal and Replacement of Fences: Fences removed for construction shall be promptly replaced to a condition equal to or better than prior to construction.

F. Trees or Shrubbery along the highways, roadways, and streets shall not be disturbed unless absolutely necessary. Approval must be obtained from the ICWD prior to any such removal. Any such trees or shrubbery which may be necessary to be removed shall be heeled in and replanted. Heeling in and replanting shall be done under the direction of an experienced nurseryman. Trees or shrubbery that die within six (6) months of replacement shall be replaced by the Contractor at no expense to the Inman-Campobello Water District.

G. Construction Operations: All work along highways, streets and roadways shall be in accordance with the following sequence of construction operations, so as to least interfere with traffic.

(1) Stripping: Where the pipeline is to be installed along road shoulders, all sod, topsoil and other material suitable for shoulder restoration shall be stripped and stockpiled at a location approved by the Engineer for replacement.

(2) Trenching, Laying and Backfilling: It is the intent of these specifications that there shall be minimum interruption to traffic and all traffic control shall be in accordance with the regulations and requirements of the South Carolina Department of Transportation, Spartanburg County and/or the local jurisdiction. By entering into the construction agreement, the Contractor agrees to hold the Inman-Campobello Water District harmless from and against any and all liabilities and claims of any nature whatsoever relating to or arising from traffic control. The trench shall not be opened any further ahead of pipe laying operations than is necessary for proper laying operations, and trenches shall be progressively backfilled and consolidated, and excess material removed immediately behind laying operations so as not to interfere with traffic.

(3) Shaping: Immediately after backfilling operations are complete, any damaged cut and fill slopes, side ditches and ditch lines, shall be reshaped and returned to original level and condition. Topsoil, sod and any other materials removed from shoulders shall be replaced in accordance with the requirements of, and to the full and complete satisfaction of the South Carolina Department of Transportation, Spartanburg County, the local jurisdiction, and the Inman-Campobello Water District.

(4) Grassing: Within 14 days after a trench is opened, the entire disturbed area shall be grassed in accordance with Section 2Q, GRASSING.

(5) Capability: When installing pipelines and appurtenances, sufficient personnel and equipment will be provided so as to simultaneously carry out all of the above operations.

SECTION 2B

EXISTING UTILITIES AND STRUCTURES

2B-01. SCOPE: This Section pertains to the coordination with other utilities at the construction site and instructions to prevent damage to other utilities.

2B-02. GENERAL: It is the intent of these specifications that care shall be taken to prevent damage to other utilities and structures. Any repairs shall be made at Contractor's expense and in accordance with the particular utilities' requirements.

A. Existing Utilities: Utilities have been located based on information provided to the Engineer by the utility companies. The Inman-Campobello Water District cannot guarantee the accuracy of this information. At least 72 hours prior to installation, Contractor shall contact Palmetto Utility Protection Service (PUPS) in Columbia, SC (1-800-922-0983) and any other utility that may be in the area.

(1) When interruptions of existing utilities occur, temporary service shall be provided as approved by the Engineer and owner of the utility.

(2) Underground Utilities and Other Structures: Necessary excavations to determine the location and elevation of existing underground utilities and other structures shall be made prior to the opening of trenches. Contractor shall contact the utility and a representative of the utility shall be present when excavating to locate utilities. When a conflicting utility has been located in the field by the utility's personnel, or when there is direct knowledge of the presence of one of these utilities in an area which will conflict with the construction efforts, then the exact location of the conflicting utility shall be verified by hand digging before any additional construction takes place. If the utility's line is not uncovered in the staked position, then additional hand digging shall be performed until either the utility's line is uncovered or until it can safely be determined that it does not interfere with the proposed construction and is not subject to damage during construction. Only after it is confirmed that the conflicting utility will not be damaged shall the pipeline construction efforts proceed.

(3) The Separation of Water Mains and Sanitary Sewers: The separation of water mains and sanitary sewers shall be in accordance with Section R61-58.4 of the State Primary Drinking Water Regulations as outlined herein.

(a) Parallel Installation: Water mains shall be laid at least ten (10) 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 (10) foot separation, the water main may be laid closer to the 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 at such

an elevation that the bottom of the water main is at least eighteen (18) inches above the top of the sewer.

(b) Crossings: Water mains crossing sewers shall be laid to provide a minimum vertical separation of eighteen (18) inches between the outside of the water main and the outside of the sewer. This shall be the case whether the water main is either above or below the sewer line. Whenever possible, the water main shall be located above the sewer line. Where a new water main crosses a new sewer line, a full length of pipe shall be used for both the water main and the sewer line and the crossing shall be arranged so that the joints of each line will be as far as possible from the point of crossing and each other. Where a new water main crosses an existing sewer line, one full length of water pipe shall be located so both joints will be as far from the sewer line as possible. Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer line to prevent damage to the water main. If it is determined by the ICWD Inspector that special structural support is required for either the water main, the sewer or both, such support will be installed by the Contractor.

(c) Special Conditions: When it is impossible to obtain the distances specified in (a) and (b) above, the Contractor shall contact the ICWD Engineer. Any alternative design must first be approved by the ICWD Engineer and the South Carolina Department of Health and Environmental Control. Any alternative design shall:

- (i) maximize the distances between the water main and the sewer line and the joints of each;
- (ii) use approved water main piping materials for the sewer line; and,
- (iii) allow enough distance to make repairs to one of the lines without damaging the other.

B. Structures: Adequate temporary support and adequate protection and maintenance of all underground and surface structures, drains, sewers, curbs, and other obstructions encountered in the progress of the work shall be provided. The structures which have been disturbed by the construction operations shall be restored to the satisfaction of the utility involved upon completion of the work. ANY DAMAGES to existing underground utilities shall immediately be reported to the Engineer and to the appropriate utility.

- (1) Chambers, pits or manholes containing valves, blow-offs, meters, air relief valves, or other such appurtenances to a distribution system, shall not be connected directly to any storm drain or sanitary sewer.

SECTION 2C

REMOVING AND REPLACING PAVEMENT

2C-01. GENERAL: Pavement shall be removed as necessary for installing the new pipelines and appurtenances and for making connections to existing pipelines. Pavement shall be removed and replaced in accordance with this section.

2C-02. REMOVING PAVEMENT:

A. Marking: Before removing any pavement, the pavement shall be marked for cuts neatly paralleling pipelines. Asphalt pavement shall be broken along the marked cuts by use of jackhammer or other suitable tool. Concrete pavement and asphalt pavement on concrete base shall be scored to a depth of one and one-half inches below the surface of the concrete along the marked cuts. Scoring shall be done by use of suitable concrete rotary saw cutting equipment, after which the pavement may be broken below the scoring by use of jackhammer or other suitable tool. No pavement shall be machined pulled or removed until completely broken and separated along the marked cuts. The pavement adjacent to pipeline trenches shall not be disturbed or damaged. Any such damaged pavement shall be removed and replaced in straight lines parallel to the ditch for the full length of the cut to the satisfaction of the Inman-Campobello Water District, the South Carolina Department of Transportation, Spartanburg County, and/or local jurisdiction at no cost to the Inman-Campobello Water District.

2C-03. REPLACING PAVEMENT: It is the intent of these specifications that pavement shall be equal to or better than the existing pavement. Pavement replacement shall be in accordance with the plans and these specifications. If encroachment permits are issued, replacement shall be in accordance with encroachment permits. Contractor shall obtain permits from the Engineer. If encroachment permits are not issued, then pavement shall be replaced according to the following specifications. It shall be the responsibility of the Contractor to familiarize himself with all requirements of the South Carolina Department of Transportation, Spartanburg County, and/or local jurisdiction having jurisdiction thereof.

A. Base for pavement shall be crusher run stone for all secondary highways and non-highway streets, and concrete for all South Carolina Department of Highways and Public Transportation highways and roads.

(1) Crusher run stone shall be graded one and one-half inches and smaller with fines being added if necessary and meeting the requirements of the South Carolina Department of Highways and Public Transportation. Stone shall be well mixed and compacted by tamping and rolling so as to prevent settlement. Crusher run base material shall be placed at the same time that the trench is backfilled. Backfilling to the top of the trench, to be cut out and replaced with base material at a later date, will not be allowed.

(2) Base for secondary and non-highway streets and adjacent drives shall be eight (8") inches of crusher run stone, as per Section 306 of the SCDOT "Standard Specifications."

(3) Concrete base shall consist of ten (10") inches of concrete. Concrete shall be designed to produce a compressive strength of 3000 psi at 28 days. In the event concrete cannot be poured the same day as backfilling, then the top twelve (12") inches of trench shall be backfilled with crusher run stone and replaced when necessary to maintain the top elevation of the trench equal to the top level of the pavement.

B. Bituminous Pavement shall be Bituminous Hot Plant Mix Pavement, as specified below and shall be placed where shown on the plans or where existing pavement is removed. This shall be placed to a depth of not less than two (2") inches unless otherwise shown on the plans. Bituminous Hot Plant Mix Pavement shall conform to the requirements of applicable South Carolina Department of Transportation specifications.

C. Backfilling up to the road base shall be in accordance with Section 2F, BEDDING OF PIPE AND BACKFILLING OF TRENCHES. Application shall be in accordance with the South Carolina Department of Transportation specifications.

D. Pavement shall be repaired with temporary patching within the same week that is cut and removed. If inclement weather delays pavement replacement, Contractor shall not cut additional pavement until he has notified the Engineer and received specific permission and instructions.

E. For bituminous pavement or surfacing, the entire area to be resurfaced (including edges of existing pavement) shall be primed with an asphalt prime coat, according to SCDOT standard specifications, just prior to placing the new hot mix asphalt pavement.

F. In the event weather conditions do not permit the permanent replacement of pavement immediately subsequent to the completion of the water main construction, the Contractor will be required to maintain temporary surfacing until such time as the weather is suitable for paving operations.

G. Replacing Curb and Gutter: Before cutting, the curb and gutter shall be scored two (2") inches deep with a concrete saw before being broken. The curb and gutter shall be replaced to original line and grade with 3000 psi concrete with a finish matching original finish and shape. Same type of curb and gutter shall be used.

H. Replacing Sidewalks: It is the intent that replaced sidewalks be equal to the original sidewalk. After backfilling, the sidewalk shall be repoured to the original thickness with concrete to original line, grade, and width. Construction joints shall be every five (5') feet maximum, or to correspond with distances on existing sidewalks with one-half inch molded bituminous expansion joint every 30 feet, with finish matching original finish. Concrete shall be 3,000 psi as specified elsewhere in these specifications.

I. Replacing Asphalt Driveways: Asphalt shall be cut according to Section 2C-02 of these specifications and replaced with six (6") inches of compacted crusher run stone base and two (2") inches of asphalt.

J. Replacing Concrete Driveways: Concrete driveways shall be saw cut and replaced with six (6") inches of crusher run stone and six (6") inches of Class "A" (3,000 psi) concrete and "brushed" finished to match existing concrete.

SECTION 2D

TRENCH EXCAVATION

2D.01. SCOPE: Work consists of all necessary site grading, trench excavation and backfill, and related work as shown on the plans and as specified herein.

2D.02. GENERAL: All excavation and grading shall be confined to the right-of-way or easement area as shown on the plans, and shall be done in an approved manner with proper equipment. Excavation, filling and grading work shall be suspended during rain and inclement weather, or when unsatisfactory field conditions are encountered, unless otherwise directed by the Inman-Campobello Water District. At all times during construction, Contractor shall maintain proper drainage in the construction area, and shall take all measures necessary for erosion and sediment control.

A. Classification of Earthwork: Excavation shall be classified as either "common excavation" or "rock excavation." "Rock excavation" shall be such materials which cannot be removed by means other than by blasting or with air hammer. "Common excavation" shall include all types of materials that do not fall into the category of "rock excavation" as defined above. Classification of excavation shall be determined by the Engineer. It shall be the Contractor's responsibility to notify the Engineer when rock excavation is encountered. The Contractor will not be credited for any rock quantities excavated before such notice is given.

B. Excavation and Preparation: Trenches shall be excavated true to line and grade so that the pipe can be installed to the alignment and depth required. The trench shall not be opened any further ahead of pipe laying operations than is necessary for proper laying and backfilling operations and as approved by the Inman-Campobello Water District. Trenches shall be progressively backfilled within 100 feet of the pipe laying and installation operations unless otherwise approved by the Inspector. No trenches may be left open overnight without the approval of the Inman-Campobello Water District. When approved, proper traffic protection, lighting and signs in accordance with requirements of South Carolina Department of Transportation shall be provided by Contractor.

C. Width: The width of the trench shall be ample to permit the pipe to be laid and jointed properly. Allowable widths of trenches are as follows:

<u>PIPE SIZE</u>	<u>TRENCH WIDTH (min/max)</u>
3" or Under	6"/12"
4"	18"/24"
6"	24"/30"
8"	24"/30"
10"	24"/36"
12"	24"/36"
16"	30"/40"
20"	40"/44"
24"	44"/48"
30"	50"/54"
36"	56"/60"
42"	62"/66"
48"	68"/72"

Trenches shall be of such extra width, when required, to permit the placing of timber supports, sheeting and bracing.

D. Depth of Cover: All pipe shall have a minimum cover of 36 inches. If 36 inches of cover cannot be obtained (i. e. bridge crossings) ductile iron pipe shall be required and adequate insulation shall be provided to prevent freezing.

E. Excavation to Grade: The trench shall be excavated to the depth required so as to provide a UNIFORM AND CONTINUOUS ditch bottom between the bell holes. Any part of the bottom of the trench excavated below the specified grade shall be corrected by adding approved material and compacted to not less than 95% of the maximum dry density as determined by a Standard Proctor Test (ASTM D698). The finished subgrade shall be prepared accurately by means of hand tools.

F. Bell Holes: Bell holes shall be provided at each pipe joint to permit the jointing to be properly made. Bell holes shall be excavated to sufficient depth and width, approximately one (1") inch, to allow the pipe to rest uniformly on the bedding

material and to allow the joint to be properly made. The pipe bell shall not be used to support the pipe.

G. Excavation in Soil: Where the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders, refuse, vegetable, or other organic material which, in the opinion of the Inspector should be removed, then the material shall be removed to the width and depth required. Before the pipe is laid, the subgrade shall be prepared by backfilling with an approved material in three (3") inch uncompacted layers. Each layer shall then be thoroughly compacted, as specified in Section 2F, BEDDING OF PIPE AND BACKFILLING OF TRENCHES, of these specifications in order to provide a uniform and continuous firm bearing and support for the pipe at every point between bell holes.

H. Crushed Stone Stabilization: Wherever, in the opinion of the Inspector, the subgrade is by nature too soft or mucky for the proper installation of the pipe, the trench shall be excavated as directed by the Engineer, and backfilled with No. 67 Stone (3/4" and down) and brought to the grade required and compacted.

I. Excavated Material: All surface materials which are suitable for reuse in restoring the surface shall be kept separate from the general excavated materials.

(1) Storage of Excavated Material: All excavated material shall be stored in a manner that will not endanger the work and which will avoid obstructing sidewalks, driveways, or traffic. Fire hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes or other utility controls shall be left unobstructed and accessible until the work is completed. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural water courses shall not be obstructed. Rural mail boxes shall be left unobstructed and accessible when possible.

J. Trench Bracing: The Contractor is responsible for the safety of the site. This is to include complying with all safety regulations concerning trench bracing to State and Federal requirements.

K. Dewatering: An adequate dewatering system shall be provided, if required by the Inspector. If a well-point system is used, the Contractor shall submit plans to the Inman-Campobello Water District for approval. The system shall be capable of removing any water that accumulates in the excavation and maintaining the excavation in a dry condition while construction is in progress. Dirt placed on the surface of the ground shall be sloped away from the excavation. If necessary, piping shall be provided to prevent surface water from entering the excavation. Disposal of water from the dewatering operation shall be done in a manner that does not interfere with normal drainage, and does not cause damage to any portion of the work or adjacent property. All drains, culverts, storm sewers and inlets subject to the dewatering operation shall be kept clean and open for normal surface drainage. The dewatering system shall be maintained until backfilling is complete or as otherwise directed by the Engineer. All damage resulting from the dewatering operation shall

be repaired by the Contractor to the satisfaction of the Engineer and at no cost to the Inman-Campobello Water District.

L. Underground Utilities: The Contractor is responsible for locating and protecting all existing underground utilities as required in Section 2B, EXISTING UTILITIES AND STRUCTURES.

SECTION 2E

ASSEMBLING AND JOINTING PIPE AND FITTINGS

2E-01. GENERAL: All pipe and fittings shall be assembled and joined in accordance with the instructions in this Section and shall accurately conform to the lines and grades established by the plans.

A. Handling: Proper and suitable tools and equipment for the safe and convenient handling and laying of pipe shall be used. Care shall be taken to prevent the pipe or fittings coating from being damaged, particularly the cement lining on the interior of the iron pipe. All pipe and fittings shall be carefully examined for cracks, broken lining or other defects. No pipe or fitting shall be laid which is known to be defective. If any pipe or fitting is discovered to be cracked, broken or defective, after being laid, it shall be removed and replaced with acceptable new pipe or fittings at no additional cost. All pipe and fittings shall be thoroughly cleaned before being laid and shall be kept clean until accepted in the completed work.

B. Cleaning Pipe and Fittings: All lumps, blisters and excess tar coating shall be removed from the bell and spigot, and the inside of the bells shall be wire brushed and wiped clean and dry and free from oil and grease or other foreign material before the pipe is laid. If the interior of the pipe is not clean, the entire length of pipe shall be SWABBED clean by the use of a circular cloth swab having a diameter equal to the inside diameter of the pipe.

C. Placing in Ditch: Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. If the pipe laying crew cannot place the pipe into the trench and in place without getting earth into it, a heavy tightly woven canvas bag of suitable size shall be placed over each end before lowering the pipe into the trench and left in place until the connection is to be made. During laying operations, no debris, tools, clothing or other material shall be placed in the pipe. When pipe laying is not in progress, open ends of installed pipe shall be plugged with ICWD approved plugs to prevent the entrance of trench water, dirt, or other foreign matter. Any dirt or foreign matter which is found in the pipe shall be removed before jointing occurs.

D. Permissible Deflection: Whenever it is necessary to deflect the pipe from a straight line, either in the horizontal or vertical plane the maximum amount of deflection allowed shall not exceed that listed in the table below. Joints shall be pushed home straight before deflecting. For mechanical joint pipe, the bolts shall be partially tightened before the length of pipe is deflected.

MAXIMUM PIPE DEFLECTION AND TORQUE

<u>Size</u>		<u>Push-on Joint*</u>		<u>Mechanical Joint*</u>		<u>Torque</u>	
nominal		degree s	inches		degrees	inches	ft-lbs
3 inch		4.0	15.0		4.5	17.0	60
4 inch		4.0	15.0		4.5	17.0	90
6 inch		4.0	15.0		4.5	17.0	90
8 inch		4.0	15.0		4.5	17.0	90
10 inch		4.0	15.0		4.5	17.0	90
12 inch		4.0	15.0		4.5	17.0	90
14 inch		2.0	7.5		3.0	11.0	90
16 inch		2.0	7.5		3.0	11.0	90
20 inch		2.0	7.5		2.0	7.5	90
24 inch		2.0	7.5		2.0	7.5	90
30 inch		1.5	5.5		2.0	7.5	120
36 inch		1.5	5.5		2.0	7.5	120
42 inch		1.5	5.5		1.5	5.5	150
48 inch		1.5	5.5		1.5	5.5	150

*18-foot joints

E. Cutting Pipe:

(1) The cutting of pipe for installing valves, fittings or nipple pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining and so as to leave a smooth end at right angles to the axis of the pipe. Prior to cutting, the exact location of the cut shall be carefully marked by chalk or some other means around the entire circumference of the pipe. The cut shall be made following this mark. The edge of the cut spigot shall be bevelled a minimum of 1/4-inch when "push-on" joints are involved.

(2) A pipe saw shall be used for cutting all pipe. Any other method must be approved by the Inman-Campobello Water District prior to construction.

(3) The flame cutting of any pipe by any means will not be allowed.

(4) The minimum nipple length allowed without approval from the ICWD Engineer is 2'-0".

F. Sequence of Work: Excavation, cleaning, laying, jointing, and backfilling shall be kept up as closely as is possible so as to progress in a uniform, workmanlike manner. In no case shall pipe be left in the trench overnight, without completing the joint. The completed pipeline shall not be left exposed in the trench unnecessarily. The trench shall be backfilled and compacted as soon as possible after laying and jointing is completed. If necessary, exposed ends of pipe shall be properly plugged during laying to prevent dirt and other materials entering the line. Each day at the close of work, and at all times when laying is not in progress the exposed end of the pipeline in the trench shall be closed by the use of an approved temporary water tight plug. If, at any time, it becomes necessary to cover the ends of the uncompleted line with backfill, the end of such pipeline shall be plugged with a water tight plug.

G. Push-On Joints ("Super Bellite", "Tyton", Fastite"): Jointing of compression ("Push-on") joint pipe shall be made by experienced workers. Sockets, spigots, and gaskets shall be thoroughly cleaned in accordance with AWWA C111 before the gasket is inserted into the socket recess. At a minimum, the sockets and spigots shall be cleaned with a wire brush. The gaskets and spigots require additional cleaning and lubrication and this shall be provided via a NSF approved soapy water solution or an approved lubricant. However the lubricant cannot be vegetable shortening nor can it support microbiological growth. Any lubrication shall be in accordance with manufacturer's recommendation. The gasket shall be carefully placed into the socket recess by hand, and evenly seated. A thin film of lubricant supplied by the pipe supplier shall be applied to the inside of the gasket and outside of the spigot end of the pipe to permit easy entry of the pipe into the socket. The spigot ends of cut pipe shall be dressed and tapered with a coarse file or approved bevelling device in a manner that will protect the gasket from damage, permit the proper centering of pipe in the bell, provide uniform compression of the gasket, and easy entry of spigot into socket. The spigot end of the pipe shall be pushed "HOME" by the use of a large bar ratchet type assembly tool, or jack, or other approved methods. Care must be taken in the use and storage of the joint lubricant provided. Lubricant contaminated by dirt or other material shall be discarded. During assembly of the next joint of pipe in the ditch, the joint being installed must be kept straight and in line with the previous joint installed. Pipe may be deflected if necessary but only after the assembly is completed.

H. Mechanical Joints: Joints for mechanical joint pipe shall be made by experienced workers. Gaskets, sockets and spigots shall be cleaned and lubricated as stated in paragraph "G" above. The spigot shall be pushed into position and seated evenly in the socket. The gland shall be pushed into position for compressing the gasket. All bolts and nuts shall be tightened to a uniform permanent tightness to the required torque as shown in Table 2E-1. Bolts shall be tightened beginning with the bottom bolt, then the bolt directly opposite and proceeding around the joint using this alternating procedure to provide uniform tightness around the pipe. Care shall be taken to keep the gland square with the socket. The glands and bolts shall be kept clean and sockets, spigots, and gaskets shall be kept clean until such joint has been completed. Any joint which leaks shall be reassembled.

I. Restrained Joint Pipe: Where restrained joint pipe is called for on the plans, or is otherwise required and approved by the Engineer, it shall be assembled and installed in accordance with the manufacturers published instructions and recommendations.

J. Threaded Jointing: The threads of the coupling and pipe shall be inspected for defects and, if satisfactory, all threads shall be thoroughly cleaned with a wire brush before the joint is made. If the coupling is furnished "hand-tight", it shall be removed and all threads cleaned with a wire brush before being reassembled and properly tightened. The threaded end of the next joint to be assembled shall be squared with the coupling and hand-tightened. Final uniform tightening of the pipe length and coupling shall be accomplished by competent workers using the proper wrenches which shall not damage the pipe coating. Teflon tape and Teflon pipe dope shall be used as lubricant for all threaded joints.

K. Water Crossings: For all surface water crossings (above the water level) the pipe shall be adequately supported and anchored as shown on the construction drawings in order to protect the pipe from damage and freezing as well as to make the pipe accessible for repair or replacement. For all underwater crossings, a minimum of two (2) feet of cover shall be provided. For water crossings of 15 feet wide or greater, the pipe and fittings shall be of the material specified indicated on the construction drawings. At a minimum, valves shall be located on each side of the crossing and located so as to not be subject to flooding and easily accessible. Also, a blow-off shall be provided on the side opposite the supply service.

L. Separations of Water Mains and Sewers:

(a) Parallel installation - Water mains shall be laid at least 10 feet horizontally from any existing or proposed sewer. The distance shall be measured edge to edge. The water main may be allowed to be installed 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 at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer. However, any deviations to the 10 feet horizontal distance must be approved by the Engineer and DHEC.

(b) Crossings - Water mains crossing sewers shall be laid to provide a minimum vertical distance of 18 inches between the invert of the water main and the top of the sewer. Where a water line crosses under a sewer line, both the water and sewer line must be ductile iron. At crossing, one full length of water pipe shall be located so both joints will be as far from the sewer as possible. Special structural support for the water and sewer pipes may be required.

(c) Force mains - There shall be at least a 10 foot horizontal separation between water mains and sanitary sewer force mains. There shall be an 18 inch vertical separation at crossing as required in Part (a) and (b) above.

(d) Sewer manholes - No water pipe shall pass through or come in contact with any part of a sewer manhole.

(e) No water line shall be installed within 25 feet horizontally from any portion of a wastewater tile/spray field. Also no water line shall be installed within a contaminated area.

2E-02. ANCHORING OR BRACING: All anchoring and bracing shall be as required in Section 2J, THRUST RESTRAINT.

SECTION 2F

BEDDING OF PIPE AND BACKFILLING OF TRENCHES

2F-01. SCOPE: This Section shall include specifications for bedding of pipe and backfilling of trenches.

2F-02. PIPE BEDDING:

A. Pipe Bedding: All ductile iron pipe 3-inch through 20-inch diameter shall be bedded on a flat trench bottom or on select material as described in B.(1) below. All ductile iron pipe 24-inch through 42-inch diameter shall be bedded on a 4-inch thick bed of angular material as described in B.(2) below. All pipe bedding shall be continuous and uniform, have adequate support, and no stones within six (6) inches of the pipe.

B. Bedding Materials: Materials for pipe bedding shall be as indicated on the typical trench section detail, or as specified herein.

(1) Select material shall be used from the angular material to the top of trench. It shall be suitable material from the excavation free of large stones, hard lumps of debris and other objectionable materials. If select material is not available from the excavation, it shall be hauled to the site.

(2) Angular material shall be crushed stone conforming to ASTM C33, Size No. 67 with a size not larger than 3/4-inch.

C. Trench Earth Dams: Where pipe bedding is angular material, earth dams, consisting of a minimum ten (10) foot trench length of select compacted backfill to replace angular bedding, shall be installed every 200 feet of pipe to prevent groundwater movement in angular bedding material. Compacted backfill 95% proctor shall replace angular bedding.

2F-03. BACKFILLING TRENCHES:

A. All trenches shall be backfilled immediately after pipes are laid in the trench, unless otherwise directed by the Inspector. All opened trench shall be properly backfilled before the end of the working day unless the Inman-Campobello Water District specifically approves leaving the trench open.

B. Backfilling: The backfilling of pipe trenches shall be as stated below according to the pipe diameter.

(1) Ductile iron pipe 3-inch to 12-inch diameter: The trench shall have a lightly consolidated backfill (80% Standard Proctor) placed around the barrel of the pipe, with fine material, free of large stones, hard lumps of debris and other objectionable material, up to the top of pipe. Backfilling shall be carried up

evenly on both sides of the pipe. The remaining backfill may be placed in layers of up to 12-inches for mechanical tamps, (18-inches if a mobile tamp is used) and each layer shall be compacted to 95% standard proctor by using one of the approved tamping devices listed in paragraph C below. The tamping equipment shall make no less than four (4) passes. One compaction run up the trench and back down the trench is considered one pass.

(2) Ductile iron pipe 14-inch to 42-inch diameter: The trench shall be backfilled to the top of the pipe with select material compacted to 95% standard proctor by a narrow footed air tamp or narrow footed mechanical tamp. Remaining backfill may be placed in layers of up to 12 inches. From the top of the pipe to the top of ditch the backfill shall be compacted by using one of the approved tamping devices listed in paragraph C below. All backfill shall be compacted to 95% maximum Standard Proctor (ASTM D698). The tamping equipment shall make no less than four (4) passes; more if necessary to obtain the required compaction. One compaction run up the trench and back down the trench is considered one pass. Compaction shall be such as to prevent future settlement. The entire cross-section of the trench (from side to side of trench and entire length) shall be compacted. No space in the trench shall be left uncompacted.

C. Tamping Equipment: Mechanical tamps (gasoline driven), pneumatic tamps (air tamp), and sheepsfoot trench rollers are acceptable. "Mobile tamps" and/or "sheepsfoot trench rollers" such as "Rammax P-24EC" or approved equal, are permitted.

D. Compaction Test: All backfill for water lines shall be subject to a compaction test by Inman-Campobello Water District personnel or an independent laboratory approved by the Inman-Campobello Water District.

2F-04. TEMPORARY SURFACING:

A. Temporary Surfacing of Trenches: Where trenches are in streets or across roadways or driveways open to vehicular traffic, the remaining 6 inches of backfill up to the traveled surface shall be made with compacted crushed stone, ASTM C33 Gradation 67 with sufficient fines for compaction. Such surface maintenance of trenches shall continue until permanent replacement of street paving is completed.

B. Under Pavement, the top of the trench shall be filled with base for pavement as specified in Section 2C, REMOVING AND REPLACING PAVEMENT. In unpaved roads and shoulders, the top 6 inches of the trench shall be filled with compacted topsoil.

C. Contractor shall be responsible for final subsidence of all trenches, and shall leave trenches flush with the original ground after all settlement has taken place. Any settlement of backfill below finish grade shall be promptly corrected. Trenches shall be protected against scour due to surface drainage.

2F-05. CONCRETE ENCASEMENT OF PIPE:

Where shown, and where otherwise directed, pipe shall be completely encased with Class "B" concrete. The trench shall first be excavated not less than six inches (6") below the bell of the pipe and the pipe laid to line and grade on concrete blocking. Concrete shall then be placed to the full width of the trench, but in no case less than six inches (6") from the pipe bell on either side of the trench, and to a height of not less than six inches (6") above the top of the pipe bell. No backfill material shall be placed in the trench for a period of at least twenty four (24) hours after the concrete encasement has been placed. The water main shall be tested before encasing in concrete.

SECTION 2G

TESTING, DISINFECTION, CLEAN-UP AND PLACING IN SERVICE

2G-01. HYDROSTATIC PRESSURE AND LEAKAGE TESTING: The hydrostatic pressure test shall be performed in conjunction with the leakage test and shall be in accordance with the requirements of the Inman-Campobello Water District, and AWWA C600, and the South Carolina Department of Health and Environmental Control. All equipment, procedures, and sequences for each test shall be as required by the Inman-Campobello Water District. Water for testing shall be provided by the Inman-Campobello Water District at no cost to the Contractor.

A. Taps: If taps are not available at high points in the pipeline, taps for air release shall be installed. The Contractor shall excavate tap holes, make the taps, and backfill when testing is complete. After the tests have been completed, plugs shall be installed on the taps by the Contractor at his expense. Post hydrants are not allowed.

B. Testing shall be conducted in the following steps:

(1) The ICWD Inspector with the assistance of the Contractor shall fill each of the sections of pipe slowly with water and expel all air through air valves or taps. Inspectors shall operate all valves in the existing water system. Contractor to operate all blow-offs.

(2) Before testing, the newly constructed water main shall be thoroughly flushed to remove all dirt and foreign matter. Water shall be flowed in a manner which will create a scouring velocity of not less than 2.5 feet per second in the main being flushed for all ductile iron pipe installations. For all PVC pipe installations, the scouring velocity shall not be less than 3.0 feet per second. Flushing of all lines shall be done at the direction of the ICWD after the trench has been backfilled. Flushing will be coordinated by the Engineer based upon system operating conditions at the time. Extreme care shall be taken during the flushing operation to ensure that damage from the discharged water is not caused to adjacent property and that the operation is performed in the safest manner possible. Care shall be exercised to prevent the water from entering the trench and/or wetting the backfill material. The Contractor shall be responsible for any damage caused by flushing.

(3) The Contractor shall provide an approved test pump and an approved method of measuring water pumped into the pipeline.

(4) The test pressure shall be 1.5 times the working pressure of the line or 150 psi, whichever is greater, as measured at the lowest point in the section of the line being tested, and no less than 1.25 times the working pressure as measured at the highest point in the section.

(5) The pressure in the line shall be pumped up to the test pressure and be constantly maintained for 120 minutes and recorded on pressure recorders furnished by the Inman-Campobello Water District . During testing, the pressure must be maintained to within ± 5 psi of the test pressure.

(6) Leakage is the quantity of water that must be supplied to the newly laid pipe or any closed valved section to maintain the pressure within the limits stated in paragraph 4 above.

(7) The allowable leakage is defined by the following AWWA formulas:

Ductile Iron Pipe

$$L = \frac{SD(P)^{(1/2)}}{133,200}$$

where

L = Allowable leakage in gallons per hour

S = Length of pipe in feet

D = Diameter of the pipe in inches

P = Average test pressure in psi

PVC Pipe

$$L = \frac{ND(P)^{(1/2)}}{7,400}$$

where

L = Allowable leakage (gallons per hour)

N = # of joints in the length of pipe being tested

D = Nominal diameter of pipe (inches)

P = Average test pressure during the leakage test (psi)

(8) If the amount of leakage exceeds the allowable limit, the Contractor shall locate and repair the leaks and shall retest the line using the same test procedures. All visible leaks shall be repaired regardless of the amount of leakage.

(9) Examination: All exposed pipe, valves, fittings, fire hydrants, etc., shall be carefully examined during the tests. When any visible leakage is detected, joints that are found to be leaking shall immediately be properly adjusted to stop the leakage. Any pipe, valves, fittings, fire hydrants, or other items discovered to be defective during the tests shall be removed and replaced and tests repeated until the results are satisfactory to the Inman-Campobello Water District.

(10) Upon successful completion of the pressure and leakage tests, each section of the new main will be isolated by closing appropriate valves and

each segment will be checked for evidence of excessive leakage. This inspection shall consist of connecting a pressure gauge to a blow off or other appropriate point, closing the next main line valve and watching for a rapid drop in pressure in the segment being tested. A full pressure test shall be required on questionable segments.

2G-02. DISINFECTION: All water for disinfection shall be furnished at no cost by the Inman-Campobello Water District . Chemical hoses, pumps and all equipment shall be supplied by the Contractor. Disinfection shall be in accordance with AWWA C651 (including Section 4.8). In order to schedule laboratory testing, disinfection must be done on Monday through Thursday and must be scheduled so that the samples collected by personnel of the Inman-Campobello Water District can be collected before 3:00 P.M. on Friday. All chemicals or products added to the public water supply must be third party certified as meeting the specifications of ANSI/NSF Standard 60.

A. Equipment: All disinfection equipment shall be suitable and approved by the Engineer.

B. Disinfection Procedure: Before being placed in service, all new mains and repaired portions of, (or repaired existing mains) must be thoroughly flushed and then chlorinated with not less than fifty (50) ppm of available chlorine throughout the length of the water main being disinfected. Water from the existing distribution system should be controlled so as to flow slowly into the newly constructed pipeline during the application of chlorine. The solution shall remain in the main for a minimum period of twenty-four (24) hours. The pressure of the injected chlorination solution in the main must not exceed a pressure of 5 psi less than the static pressure of the supply main. At the end of this 24-hour period, the treated water in all portions of the main must have a residual of not less than ten (10) ppm free chlorine.

C. Flushing After: Immediately after the requirements of the above paragraph have been met, the water main shall then be thoroughly flushed with potable water using the same taps and materials as utilized in the previous flushing procedures. No flushing device or drain shall be directly connected to any type of sewer. Chambers for valves, blow-offs, meters, air release valves are not allowed to be connected directly to storm drains or sewer systems. No cross connections between water lines and any pipes, pumps, hydrants, or tanks will be allowed. No cross connections between the distribution system and unsafe water or contaminations are allowed.

D. Sampling: Riser pipes for sampling shall be the same size as the tap and shall be made with a minimum of one foot of metal piping material at the end and supplied by and installed by the Contractor. Hydrants shall not be used for sampling. After water mains have been tested, disinfected, and flushed, the Engineer shall then notify the Inman-Campobello Water District that the main is ready for bacteriological sampling. Contractor shall give the Engineer sufficient notice to allow twenty-four (24) hours notice to the Inman-Campobello Water District. The number of sampling sites depends on the amount of new construction but must include all dead-end lines and be representative of the water in the newly constructed mains. At each site, a **minimum of two (2) satisfactory bacteriological** samples taken at least 24 hours

apart shall be obtained. Also, at each site, **chlorine residual at time of sampling must be measured and reported.** If the membrane filter method of coliform analysis is used, non-coliform growth must also be reported. All samples shall be analyzed by a State approved laboratory with results being submitted with the registered professional engineer's letter of certification. If the bacteriological tests are satisfactory, the laboratory will so inform the Inman-Campobello Water District that the sampled water main may then be put into operation. However, if the samples indicate that contamination is still present, the water main shall then be disinfected according to the above procedure until the sample tests meet the Inman-Campobello Water District and the South Carolina Department of Health and Environmental Control's minimum Bacteriological Standards.

E. Disinfection Requirements: If the non-coliform growth is greater than eighty (80) colonies per one hundred (100) milliliters, the sample result is invalid and must be repeated.

2G-03. PLACING IN SERVICE: Placing the new water main in service is conditional upon the following:

A. Installation: The completed installation fully complying with all of the Inman-Campobello Water District's current requirements, standards and criteria.

B. Hydrostatic Leakage Test: The successful completion of the required Hydrostatic Leakage Test.

C. Disinfection: The meeting of the Inman-Campobello Water District's standard water quality and bacteriological tests.

D. Discharge of Chlorinated Water: All chlorinated water which is to be discharged, shall be discharged in a manner which protects fish, wildlife, and vegetation from damage. All State, Federal, and local requirements governing the discharge of chlorine into the environment shall be adhered to.

E. Valve Operation: Verification by the Inspector (with assistance from the Contractor) that all valves within the project are in the "open" position unless specific instructions to leave a valve "closed" are shown on the plans or ordered by the Inman-Campobello Water District.

F. Pavement Patches: All pavement patches shall be made in full accordance with approved standard details or as directed by the Inman-Campobello Water District, if special conditions are made a portion of any permit.

G. Receive Final Construction Permit from SCDHEC.

SECTION 2H

ROCK EXCAVATION

2H-01. SCOPE: Where excavation is classified, Contractor shall be paid for rock as defined in this Section.

2H-02. ROCK:

A. "Rock Excavation" shall be the excavation of such material which cannot be removed by means other than by blasting or with a jack hammer or other means approved by the Engineer. "Unclassified" excavation shall include the excavation of all types of materials that do not fall into the category of "rock excavation" as defined above. The classification of excavation shall be determined by the Engineer. It shall be the Contractor's responsibility to notify the Engineer when he believes that rock excavation is encountered. THE CONTRACTOR WILL NOT BE CREDITED FOR ANY ROCK QUANTITIES EXCAVATED BEFORE SUCH NOTICE IS GIVEN.

B. Clearance: Ledge rock, boulders and larger stone shall be removed to provide a clearance of at least 6 inches below and on each side of all pipe, valves, and appurtenances. This specified minimum clearance is the minimum clear distance which will be permitted between any part, projection or point of such rock, boulder, or stone and any part of the water main.

C. Subgrade: Where excavation is made in rock or boulder, the subgrade shall be prepared by backfilling with an approved selected material in 6-inch compacted layers and each layer shall then be thoroughly compacted to not less than 95% of the maximum dry density as determined by a Standard Proctor Test (ASTM D698) so as to provide a uniform and CONTINUOUS BEARING and support for the pipe along the entire pipe length between bell holes. The minimum depth of the compacted backfill material shall be 6 inches.

SECTION 2I

BLASTING

2I-01. GENERAL: All blasting, where required, shall be done under the personal supervision of a person duly licensed in the State of South Carolina to engage in the use or storage of explosive materials. All necessary measures to protect life and property shall be taken. Where in close proximity to buildings, structures, transmission lines, utility lines or other facilities, timber mats or other means of preventing damage from flying debris shall be used. Ample and suitable signals shall be given in proximity to the work before each blast, and flagmen shall be placed on all roads beyond the danger zone in every direction to warn traffic. Contractor shall be responsible for all damage resulting from blasting.

A. Procedure: Blasting for excavation will be permitted only after securing the approval of the Engineer, only after a South Carolina State Blasting Permit has been obtained and a copy given to the Engineer, and only when proper precautions are taken for the protection of persons and property. The hours of blasting will be fixed by the Contractor and approved by the Engineer. Blasting operations and storage of explosives shall be conducted in strict accordance with existing ordinances, regulations, and laws of local, State, and Federal agencies.

B. Damage Liability: All blasting shall be done with the utmost care so as not to endanger life or property. Whenever directed, the number and size of the charges shall be reduced. All damages or injuries resulting from blasting operations shall be reported immediately to the Engineer. Contractor shall be responsible for all damage resulting from blasting and shall supply liability insurance to cover any damage. Certificates of insurance shall be filed with the Inman-Campobello Water District prior to commencing blasting work. The policy shall cover blasting over the duration of the project.

C. Limits: Where new water lines are being constructed or connections being made to existing mains, blasting operations shall not be conducted within fifty (50) feet of the end of such mains. The use of explosives shall be limited to a minimum distance of twenty-five (25) feet from any and all utilities or structures or as specified by the Inman-Campobello Water District.

D. Operations: Blasting operations shall be conducted in strict accordance with the S.C. Explosives Control Act, all applicable Inman-Campobello Water District, city, county, state and federal ordinances and regulations. All exposed structures shall be carefully protected from the effects of blast and all blast areas shall be covered with heavy timbers, mats or other suitable protection. The blasting shall be done only by blasting personnel licensed in the State of South Carolina. Very light charges must be used to prevent damages to adjacent structures. In no case shall caps or other explosives be kept at the place where dynamite or any other explosive is stored.

E. Traffic Controls: Ample and suitable signals shall be given in proximity to the work before each blast, and flagmen and appropriate signs shall be placed on all roads beyond the danger zone in every direction to warn traffic.

SECTION 2J

THRUST RESTRAINT

2J-01. All plugs, caps, tees, bends and other items as may be indicated on the plans shall be restrained or braced as shown on the detail drawings for lines 2-inches in diameter and larger. This includes fire hydrants on lines 6 inches in diameter and larger.

A. Concrete Blocking and Rodding:

- (1) Concrete used for blocking, collars and "Deadman" type thrust blocks shall have a compressive strength of 3,000 psi at 28 days. High early strength concrete shall be used.
- (2) Concrete blocks shall be poured to the dimensions shown on the plans and formed when directed by the Inspector at no additional cost. The large side (backs) of the blocking shall bear against undisturbed, hard, solid earth. Blocking shall be poured to bear against the pipe or fitting and allow sufficient area for repair and the easy removal of nuts and bolts.
- (3) Backfilling on poured concrete will not be permitted on concrete for 24 hours after pouring, and no water will be permitted in mains for at least 24 hours after concrete blocking is poured.
- (4) Metal Straps and rods shall be made of steel having a tensile strength of 95,000 psi. If required by the Engineer, the Contractor shall supply acceptable certification of tensile strength. All steel components, including rods, straps, nuts, bolts, couplings and clamps shall be coated with 17.5 mils of Thick and Quick Mastic, or equal. Contractor shall supply coating and coat all the tie rods, clamps and miscellaneous steel used for anchoring purposes.
- (5) Concrete Collars poured on the last joint of pipe in a dead end run, shall be poured around a welded-on steel or ductile iron thrust collar. This collar shall be shop welded on the pipe midway between the MJ bell and the spigot by the pipe manufacturer. The weld shall be a continuous weld around the entire circumference of the pipe. If only one side of the collar is to be welded to the pipe, it shall be the side facing the MJ bell. Pipe manufacturer's shop drawings must be submitted for each size to be used indicating that the collar is designed to, at a minimum, restrain the force created by a 250 psi line pressure as listed in the table below. Field welding thrust collars will not be allowed. A wall pipe flange will not be accepted as a thrust collar.

<u>PIPE SIZE</u>	<u>THRUST</u>
3	2,650 lbs
4	4,500 lbs
6	9,300 lbs
8	16,000 lbs
12	34,000 lbs
16	59,000 lbs

B. Restrained Joint Pipe:

(1) Restrained joint piping materials shall meet the requirements stated in Section 3A, PIPE MATERIALS, and Section 3B, FITTINGS, and shall be as those shown on the shop drawings submitted by the Contractor and approved by the Engineer.

(2) Installation of restrained joint piping shall be as specified in Section 2E, ASSEMBLING AND JOINTING PIPE AND FITTINGS, and as recommended by the manufacturer.

C. Megalugs:

Megalug thrust restraint devices manufactured by EBAA Iron, Inc. shall be installed where shown on the plans. Installation shall be as recommended by the manufacturer.

SECTION 2K

INSTALLING FIRE HYDRANTS

2K-01. GENERAL: Hydrants shall be installed plumb and jointed as specified for pipe and fittings. The installation of hydrants shall include the installation of concrete blocking, rodding and washed crushed stone backfill as shown on the Drawings and/or as specified herein.

A. Fire hydrants shall be located as shown on the plans and shall be field located by the Engineer in a manner to provide complete accessibility, and in such a manner that the possibility of damage from vehicles or injury to pedestrians will be minimized.

B. Generally, when placed behind a curb, the face of the fire hydrant barrel shall be 12 INCHES FROM THE BACK OF THE CURB. The distance shall be approved by the Engineer.

C. No hydrants shall be located closer than ten (10) feet to the beginning point of curvature of the curb or road at street intersection. Where there are not curbs, then the hydrant location shall be as shown on the plans.

D. All fire hydrants shall be plumbed and shall have the pumper nozzle perpendicular to the curb. Fire hydrants shall be set with the "Bury Line" marker set to the established grade or as directed by the Inspector.

E. Each fire hydrant shall be connected to the main with a minimum 18-inch branch connection of ductile iron material. Gate valves shall be used on all fire hydrant branches.

F. The proper length of hydrant extension shall be used, when necessary, to raise the bury line of the hydrant to grade. The use of multiple short extensions when one of longer length is needed will not be permitted. A maximum of two extensions per hydrant will be allowed.

G. Clean, washed gravel, no larger than #57 stone, shall be placed around the shoe of the fire hydrant, 6" above and for a radius of 18-inches around the weep holes. Hydrants shall be set with stone free of dirt and set to drain freely. Three (3") inches of additional stone (18-inch radius around the weep holes) shall be added for each 6-inch of hydrant extension. Hydrant drains shall not be connected to or located within ten (10) feet of sewer systems.

H. The shoe of each fire hydrant shall be well braced against UNDISTURBED earth and secured with mega-lugs, as directed by the Engineer and shown on the plans.

SECTION 2-L

INSTALLING VALVES

2L-01. GENERAL: Gate valves, in general, shall be installed and jointed as specified in Section 2E, ASSEMBLING AND JOINTING PIPE AND FITTINGS. The installation of valves where shown on the drawings shall include the installation of valve boxes and concrete "doughnuts". Valve markers shall be supplied and installed by Contractor and shall be located as directed by the Inman-Campobello Water District. All valves shall be installed in accordance with the applicable AWWA standard.

A. Non-geared Valves: A cast iron P-107 valve box shall be provided for each vertical valve which has no gearing mechanism. The appropriate length of 6" PVC riser shall be installed as shown on Plan 5. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut of the valve with the box cover flush with the surface of the finished grade.

B. Geared Valves: A valve vault shall be provided for each valve which has a geared operating mechanism for all valves 16-inch and larger. The operating nut shall be easily accessible for operation through the opening in the manhole, which shall be set flush with the surface of the finished pavement or such other level as may be directed by the Engineer. Valve vaults shall be constructed as to permit minor valve repairs and afford protection to the valves and pipe from impact where they pass through the vault walls.

C. Valves shall be installed so the operating stem is vertical and plumb. Horizontal valves shall be installed so that the operating nut is vertical and plumb.

D. Pre-cast concrete "doughnuts" shall be installed around the tops of all valve boxes which are not otherwise installed in pavement.

2L-02. AIR RELIEF AND VACUUM VALVES: Where called for on the construction drawings air relief and vacuum valves shall be installed in 5-foot diameter manholes as shown on the plan detail. Air relief valves shall be provided at high points in water main. Open end of valve shall be extended to the top of the pit with a screened downward facing elbow.

Chambers, pits or manholes containing valves, blow-offs, meters, air release valves or other such appurtenances shall not be directly connected to any storm drain or sanitary sewer.

2L-03. DOUBLE CHECK VALVE ASSEMBLIES: Where called for on the construction drawings a double check valve assembly shall be installed as shown on the plan detail. A minimum of a double detector check valve assembly must be used on dedicated fire lines. No steam condensate, cooling water, or heat exchange water can be returned to the potable water supply.

SECTION 2M

BORING

2M-01: SCOPE: Where shown, pipe shall be installed under highways and railroads by boring. Contractor shall furnish all labor and materials necessary to complete bore, install steel casing, if required, to complete bore and install carrier pipe.

1. All bores under railroads shall include steel casing.
2. Bores under highways and streets shall be D.I. pipe only with encasement unless otherwise noted on the plans.
3. If steel casing is required, unless otherwise noted on plans, encasement up to and including 48-inches in diameter shall be installed by boring and jacking. Larger encasement shall be by tunneling.

2M-02: GENERAL REQUIREMENTS:

A. Authorities: All aspects of crossing construction shall conform to the requirements of the South Carolina Department of Transportation and/or railroads.

B. Insurance: It shall be the responsibility of the Contractor and/or his subcontractor to comply with all insurance requirements of the highway or railroad work within their right-of-way if the limits are higher than the limits of the insurance requirements of this contract.

C. Inspection: Crossing construction operations shall be subject to inspection by the Owner's representative and by the highway or railroad representative, who shall have full authority to stop work if, in his opinion, it would cause damage to the roadway or railway section, endanger traffic or endanger life.

D. Additional Requirements:

(1) Contractor shall comply with all requirements of the highway or railroad relating to temporary work, inspection, watchmen, flagmen, traffic barriers, protection of personnel and property, work restrictions, work scheduling, insurance and such other requirements. The Contractor shall pay for all costs associated with meeting these requirements, except as otherwise specified.

(2) Where steel casing is required, it shall be within the limits of the highway or railway right-of-way and shall be installed to the proper line and grade; no open excavation will be allowed within the limits of the steel casing without the Engineer's approval. The steel casing shall be furnished and installed in accordance with additional requirements specified herein.

(3) All work shall be completed to the full satisfaction of the highway or railroad engineer, or his authorized representative.

(4) For all work on railroad right-of-way, the Contractor shall notify the railroad division superintendent at least 72 hours prior to entering railroad right-of-way to begin construction.

2M-03: INSTALLATION BY THE BORING METHOD: Installation of the water main and, the steel pipe casing, where required, shall be by the dry boring method at locations shown on the Drawings. Installation shall include all related work and services such as mobilization, construction and maintenance of work pits, R/W maintenance and restoration, traffic maintenance, excavation, dewatering, sheeting, shoring, bracing, bulkhead, clean up, and move out. Installation of steel casing shall be in accordance with the applicable regulations of the South Carolina Department of Highways and Public Transportation and/or Railroad; the Detail Drawings and these Specifications. All excavation for pit and bore shall be unclassified.

A. Boring Pit: The boring pit shall be solid sheeted, braced and shored as necessary to provide a safe operation, keep the limits of the bore pit contained on public right-of-way, and provide protection to other utilities and roadways. The Contractor shall take all precautions, and shall comply with all requirements as may be necessary to protect private or public property.

B. Line and Grade: The Contractor shall set the boring rig so that, after the water main and, the casing pipe, if required on the project, is (are) installed the elevations of the water main shall conform accurately to the grades and alignment fixed or given by the Engineer.

C. Boring:

(1) Where encasement is required, the water main diameter and steel casing diameter shall be as noted on the plans. The hole shall be bored and encased through the soil by a cutting head on a continuous auger mounted inside the steel casing. The boring of the hole and installation of the steel casing shall be simultaneous. Lengths of casing shall be fully welded to the preceding section in accordance with American Welding Society recommended procedures. The Contractor shall bear the cost of any corrective action required to meet line and grade requirements shown on the plans. The distance to which excavation is carried ahead of the casing shall be not more than is absolutely necessary for installation purposes, and will be subject to approval of the Engineer. The work shall be performed so that no voids occur in the earth surrounding the casing and so that ground settlement adjacent to and within the limits of the pipeline crossing is eliminated. If voids occur or are encountered outside the pipe, grout holes shall be drilled at 10-foot centers in the top of the steel casing and the voids filled with a 1:3 Portland cement grout at sufficient pressure to fill voids and prevent embankment settlement. If it becomes necessary to abandon an incomplete or unacceptable bore, the abandoned encasement shall be capped and filled

completely with 1:3 Portland cement grout. Abandonment procedures shall be completed prior to moving to another boring location. All costs in connection with an abandoned bore, including the construction cost and capping and filling costs, shall be at the Contractor's expense.

(2) Steel casing installed by boring and jacking shall be welded steel pipe conforming to ASTM A139, Grade B, and shall be of the sizes shown on the plans. Pipe shall be bituminous coated on the outside. Minimum wall thickness shall be as follows:

Diameter (In.)	Thickness (In.)	Diameter (In.)	Thickness
Under 14	0.188 (3/16)	28 - 30	0.406
14 - 18	0.250 (1/4)	32	0.438
20	0.281	34 - 36	0.469
22	0.312	38 - 48	0.500
24	0.344	54 - 60	0.750
26	0.375		

When steel casing is installed without protective coating or cathodic protection, the wall thickness shall be increased a minimum of 0.063 inch greater than the thickness shown above.

(3) Pipe inside inches shall be specified for water mains.

(4) Boring without encasement shall be bored through the soil and the pipe pushed through the bore hole. The diameter of the bore shall be no larger or more than 4-inches greater than the diameter of the bell of the pipe.

D. Casing Spacers: All carrier pipe installed inside encasement shall be supported by spacers as called for on the plans. Spacers shall be fabricated from quality material approved by Inman-Campobello Water District. The flanges for the two-piece spacer supports shall be formed with half bands. The legs shall be welded to the bands and the skids welded to the legs. After fabrication, the spacers shall be coated with bituminous dip. Grade 5 bolts with nylon locking nuts shall be used to secure the spacer supports to the carrier pipe. Spacers shall be manufactured by Spider Manufacturing, Inc., Cascade, Inc., or other approved supplier.

SECTION 2N

BRIDGE ATTACHMENT

2N-01. GENERAL: All pipe, fittings and appurtenances shall be assembled and joined in accordance with the instructions in this Section and manufacturer's recommendations and shall accurately conform to the dimensions established. Pipe hanger assemblies shall be the type and size indicated on the plans and shall meet the requirements stated on the plans and stated herein. The pipe hanger shall be either a yoke pipe roll or a clevis. All pipe fittings and appurtenances shall be adequately supported and anchored, protected from damage and freezing, and accessible for repair and replacement.

A. Steel Yoke Pipe Roll Hanger: If the hanger is to be a yoke pipe roll type, it shall be a Grinnell "adjustable steel yoke pipe roll," or approved equal. The yoke, roll rod and hex nuts shall be manufactured from carbon steel and the roll shall be cast iron. Each hanger shall have a maximum recommended load of not less than 1200 lbs.

B. Pipe Hanger Clevis: If the pipe hanger is to be a clevis type, it shall be a Grinnell "adjustable clevis for cast iron pipe," or approved equal. The clevis shall be manufactured from carbon steel and shall have a maximum recommended load of not less than 1940 lbs.

C. Rods: Rods shall be the diameter and length shown on the plans. Rods shall be carbon steel with a minimum yield strength of 60,000 psi. Rods shall be threaded to match the hanger hardware.

2N-02. EXISTING BRIDGE: Where a pipeline is to be installed on an existing bridge, it shall be supported by hangers attached to the bridge by anchors drilled and embedded in the bottom of the bridge deck as shown on the construction plans.

A. Concrete Anchors: Shall be the Hilti HVA Adhesive Anchor System or approved equal with 7/8-inch diameter and a minimum embedded depth of 6 5/8 inches. Tensile bond strength shall be 28,720 lbs minimum.

B. Installation: During assembly, the vertical position of the hanger on the rod shall be adjusted to provide consistent clearance between the pipe and the bridge deck. The hanger rod nuts shall be tightened securely. Each completed hanger assembly shall be coated with 17.5 mils of Koppers Bitumastic 300-M, or equal.

2N-03. NEW BRIDGE: Where a pipeline is to be installed on a bridge which is being newly constructed, arrangements will be made by the Inman-Campobello Water District to have concrete inserts cast in place in the bottom of the bridge deck when it is being formed. The pipeline will be supported by hangers attached to these inserts as shown on the construction plans.

A. Concrete Inserts: Concrete inserts shall be the Grinnell "wedge type concrete

insert," or approved equal. The inserts shall be manufactured from carbon steel and have a galvanized finish. The nut shall be iron. Maximum recommended load shall be not less than 1,200 lbs. Inserts shall be installed in place by nailing each insert to the wooden form at the locations shown on the plans before the concrete is poured into the form. Two one foot lengths of 3/8-inch rebar shall be installed in the slots of each insert as shown on the plans and shall be cast in place with the inserts. After the bridge is poured, set and the forms removed, the knockout plate in each insert shall be removed with a screwdriver.

B. Installation: The wedge nut should be put on the rod before inserting into the concrete insert body. Insert the nut into the slot and turn rod so the elongated nut lies across the slot. Screw rod through nut until rod is firmly against the top of the recess.

After assembly of pipe, clevis and rod, the vertical position of the clevis on the rod shall be adjusted to provide consistent clearance between the pipe and the bridge deck. The hanger rod nuts shall be tightened securely. Each completed hanger assembly shall be coated with 17.5 mils of Koppers Bitumastic 300-M, or equal.

SECTION 2P

EROSION CONTROL

2P-01. SCOPE: Erosion and sediment control shall be provided during the entire construction period as outlined below:

A. If no erosion and sediment control details and specifications are included on the construction drawings, then erosion and sediment control measures shall be used as needed to protect the construction site and to meet the requirements of the Spartanburg County Land Development Standards or other local, State, or Federal authority having jurisdiction. Control methods shall be as required by the authority having jurisdiction.

B. If erosion and sediment control details and specifications are included on the construction drawings, then erosion and sediment control measures shall be used as required and specified on the construction drawings and as specified herein.

2P-02. GENERAL: Contractor shall comply with all local, State, and Federal laws, ordinances, rules, and regulations pertaining to erosion and sediment control. Contractor shall indemnify and hold harmless the Owner from and against all claims, damages, losses, and expenses resulting from such work. Contractor shall install erosion and sediment control measures including, but not limited to, silt fences, check dams, channel protection, Class I rip rap, seeding and mulching.

2P-03. EROSION AND SEDIMENT CONTROL MEASURES: Contractor shall take all measures to control erosion and sedimentation along pipeline construction site. Work shall be scheduled so that all exposed or disturbed areas are seeded within fourteen (14) days of the date they are exposed or disturbed. Temporary protection shall be required and maintained for exposed or disturbed areas until permanent vegetation is established and shall consist of temporary grass cover as defined in Section 2Q, GRASSING, mulch, netting, or plastic sheets. All temporary erosion and sediment control measures shall be removed within 30 days after final site stabilization is achieved. Trapped sediment remaining in place after removal of temporary measures shall be permanently stabilized to prevent further erosion and sedimentation.

2P-04. EMERGENCY CONDITIONS: If unusually intense storms cause planned control measures to fail, prompt restoration and cleanup of sediment deposits shall be made, including damage to adjacent property. If construction is delayed or shut down, temporary cover of exposed and disturbed areas shall be provided.

SECTION 2Q

GRASSING

2Q-01. SCOPE: This section covers cultivating, fertilizing, and planting grass on all pipeline rights-of-way, and on all fill slopes, cut slopes, graded areas, and disturbed areas as shown on the plans or as directed by the Engineer.

2Q-02. GENERAL: All areas exposed or disturbed by the Contractor shall be seeded within fourteen (14) days of the date that the area is exposed or disturbed. A complete permanent grass cover of all areas to be grassed shall be obtained before these areas will be acceptable. All eroded areas shall be filled and completely covered with grass before being acceptable. An acceptable grass cover is defined as a minimum 2-inch stand with bare spots less than one (1) square foot after the first mowing.

2Q-03. FERTILIZING AND GRASSING:

A. Material shall be acceptable to the Engineer prior to use. Fertilizer shall be delivered in undamaged waterproof bags showing weight, chemical analysis, and manufacturer. Lime shall be delivered in bags with a tag or label showing brand or trade name, magnesium carbonate equivalent, and other pertinent information. Seed shall be delivered in original undamaged containers showing name of seed, net weight, percentage of pure seed, and germination, origin, and date of packaging.

(1) Fertilizer: Commercial type 4-12-2 or equivalent, conforming to State law.

(2) Lime: Agricultural grade ground limestone, containing at least 34% magnesium carbonate.

(3) Seed: Fescue, Bermuda, or Pensacola Bahia, Rye as required by seasonal or soil conditions, with at least 90% purity and 80% germination, conforming to State law.

B. Planting:

(1) Areas to be grassed shall be cultivated to a depth of four (4) inches by mechanical tiller, with all clods or clumps broken up and foreign material and debris removed.

(2) Fertilizer shall be applied at a minimum rate of 1000 lbs/acre, and a lime applied at a minimum rate of 2000 lbs/acre. Fertilizer and lime shall be thoroughly incorporated into the top 3 to 4 inches of soil, and the surface raked smooth before applying seed. Fertilizer and lime may be applied in one operation.

(3) Seed shall be applied evenly by a commercial applicator and raked in lightly. Seed shall not be sown immediately following rain, when the ground is too

dry, or during windy periods. Seeded areas shall be compacted and dressed smooth with a roller or other means acceptable to the Engineer. Minimum application rates of seed shall be as specified below; heavier applications shall be made where necessary to provide an acceptable cover.

Fescue	200 lbs/acre
Bermuda	40 lbs/acre
Pensacola Bahia	40 lbs/acre
Fescue/Rye (winter only)	200 lbs/acre

(4) Immediately after seeding, the area shall be sprayed with asphalt emulsion or covered with a suitable erosion control fabric, straw or other acceptable material. Asphalt emulsion shall be a type specifically designed for mulching of seeded areas. Erosion control fabric shall be manufactured of materials which are biodegradable within 4 to 8 months of outdoor exposure, and shall be applied in accordance with the manufacturer's recommendations.

(5) After seeding is completed, seeded areas shall be watered as necessary until an acceptable grass cover is obtained.

C. Temporary Cover: Temporary Rye grass seeding may be used only if needed as a fast temporary cover. Rye will be mixed with Fescue for winter time applications, and only if approved by the Engineer. Rye shall be broadcast at a rate of 100 lbs./acre with a cyclone seeder, drop spreader, or cultipacker seeder. The seed shall be raked into the soil and lightly packed to establish good contact with the soil. Commercial type 4-12-2 fertilizer shall be applied at a rate of 800 lbs/acre. Grain straw mulch shall be applied at a rate of 90 lbs/1000 sq. ft. and anchored with tilled mulch. If temporary growth is not fully adequate, the area shall receive a top dressing with 10-10-10 fertilizer.

(1) After temporary seeding is completed, the seeded areas shall be watered until an acceptable grass cover is obtained.

D. Maintenance: During the period of the guarantee, the Contractor shall repair all damage due to erosion and other causes, and shall maintain all grassed areas in an acceptable condition. During the maintenance period, grass shall be mowed at regular intervals and watered as required to prevent grass and soil from drying out.

(1) Maintenance instructions shall be furnished to the Owner, and shall include cutting method and maximum grass height, and types, application frequency and recommended coverage of fertilizer and lime.

SECTION 3

MATERIAL SPECIFICATIONS

3.01 Scope: This section contains the current specifications for materials to be used in projects to be integrated into the Inman-Campobello Water District. The Inman-Campobello Water District has established specific manufacturers as the standard for various items within its system. Such standardization is for the express purpose of expediting maintenance procedures. All requests for approval of an "or equal" item must be submitted to the Inman-Campobello Water District in writing. All pipe, fittings, packing, joint materials, valves and fire hydrants shall conform to Section C of the AWWA Standards. All materials or products that contact potable water must be third party certified as meeting the requirements of ANSI/NSF61. The certifying party shall be accredited by ANSI.

<u>Section Number</u>	<u>Title Section</u>
Section 3A	Pipe Materials
Section 3B	Fittings
Section 3C	Tapping Saddles and Sleeves
Section 3D	Valves and Valve Boxes
Section 3E	Fire Hydrants

3.02: Water mains which have been previously used for conveying potable water may be reused provided they meet applicable criteria from AWWA Section C, ANSI/NSF 61, and ASTM D1785 or D2241. The mains must be thoroughly cleaned and restored practically to their original condition.

SECTION 3A

PIPE MATERIALS

3A-01. DUCTILE IRON WATER PIPE (3-inch through 42-inch)

- A. The Contractor shall furnish and install the required Ductile Iron Pipe, designed in accordance with ANSI/AWWA C150/A21.50, and ANSI/NSF 61 latest edition.
- B. Ductile Iron Pipe shall be centrifugally cast and conform to ANSI/AWWA C151/A21.51, latest edition. 3-inch and 4-inch Ductile Iron Pipe shall be furnished in Class 51 or greater wall thickness, 6-inch through 42-inch shall be furnished in Class 50 or greater wall thickness. The pipe material shall have a minimum tensile strength of 60,000 psi, minimum yield strength of 42,000 psi and minimum elongation of 10%. Steel encasement pipe must conform to AWWA C200 and ASTM A53, A120.
- C. The pipe is to be supplied in minimum 18 foot lengths with either mechanical or push-on "Super Bell-Tite," "Fastite," or "Tyton" joint.
- D. The pipe shall be lined in accordance with ANSI/AWWA C104/ A21.4, latest edition. The pipe shall have the standard thickness cement lining inside and bituminous coat outside in accordance with ANSI/AWWA C104/A21.4. The inside cement lining shall be treated with a seal coat of asphaltic material in accordance with ANSI/AWWA C104/A21.4. The seal coat shall have no deleterious effect upon the quality, color, taste or odor of potable water and shall be approved by National Sanitation Foundation (NSF).
- E. The pressure rating, thickness class, net weight of pipe without lining, length of pipe and name of manufacturer shall be clearly marked on each length of pipe.
- F. Lead Ban
- (1) Any pipe, solder, or flux which is used in the installation or repair of any public water system shall be lead free.
 - (2) Any pipe, solder, or flux which is used in any plumbing in a residential or nonresidential facility which provides water, through connection to a public water system, for human consumption shall be lead free.
 - (3) Lead free shall be defined, when used with respect to solders and flux, as those containing not more than 0.2 percent lead.
 - (4) Lead free shall be defined, when used with respect to pipes and pipe fittings, as those containing not more than 8.0 percent lead.
 - (5) Leaded joints necessary for the repair of cast iron pipes shall be exempt from the lead free requirement.

- G. Natural rubber or other material which will support microbiological growth may not be used for any gaskets, O-rings, and other products used for jointing pipes, valves, or other appurtenances which will expose the material to the water. All gaskets shall be AWWA approved.
- H. No asbestos cement pipe will be allowed to be installed.
- I. Vegetable shortening shall not be used to lubricate joints.

SECTION 3B

FITTINGS

3B-01. DUCTILE IRON FITTINGS

- A. Fittings shall be ductile iron fittings manufactured in accordance with ANSI/AWWA C153/A21.53, latest revision. Where compact fittings are not available, fittings shall be full size iron fittings manufactured in accordance with ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11, latest revisions. The working pressure rating shall be 350 psi.
- B. Ductile iron shall be in accordance with ASTM A-536, latest revision, with minimum physical qualities of 70,000 psi tensile strength, 50,000 psi yield strength and 5% elongation.
- C. Fittings shall have cement mortar lining and seal coating in accordance with ANSI/AWWA C104/A21.4, latest revision and shall be mechanical joint in accordance with ANSI/AWWA C111/A21.11.
- D. Fittings shall be supplied by the same company which manufactures and supplies the ductile iron pipe for this project. The fittings supplied shall be the appropriate type to match the type of pipe supplied.
- E. Lead Ban
- (1) Any pipe, solder, or flux which is used in the installation or repair of any public water system shall be lead free.
 - (2) Any pipe, solder, or flux which is used in any plumbing in a residential or nonresidential facility which provides water, through connection to a public water system, for human consumption shall be lead free.
 - (3) Lead free shall be defined, when used with respect to solders and flux, as those containing not more than 0.2 percent lead.
 - (4) Lead free shall be defined, when used with respect to pipes and pipe fittings, as those containing not more than 8.0 percent lead.
 - (5) Lead joints necessary for the repair of cast iron pipes shall be exempt from the lead free requirement.
- F. Natural rubber or other material which will support microbiological growth may not be used for any gaskets, O-rings, and other products used for jointing fittings, valves, or other appurtenances which will expose the material to the water. All gaskets shall be AWWA approved.

G. Vegetable shortening shall not be used to lubricate joints.

3B-02. STEEL COUPLINGS AND BELL JOINT CLAMPS

Steel couplings and bell joint clamps for joining cast iron, ductile iron or steel water mains of all sizes shall be Dresser Style 38 or 138 and Style 60 or 60S, respectively.

SECTION 3C

TAPPING SADDLES AND SLEEVES

3C-01. TAPPING SLEEVES: Tapping sleeves for main line taps shall be as specified in the list below:

TAPPING SLEEVES FOR TAPS ON DUCTILE IRON PIPE

<u>MANUFACTURER</u>	<u>STYLE</u>	<u>SIZE</u>
Mueller	H-615	4 x 4 - 24 x 24
American Darling	M & J	4 x 4 - 24 x 24
Ford	Stainless Steel Wrap Around with D.I. or S.S. Flange	
Romac	Stainless Steel Wrap Around with D. I. or S. S. Flange	

3C-02. TAPPING SADDLES AND CORPORATION STOPS: All pipe saddles and corporation stops for air relief, flushing and testing and disinfection shall be as specified in the list below. Tapping saddles will be required when the tapping machine is not capable of making a direct tap.

SADDLES FOR DUCTILE IRON PIPE

	3/4"CC Single Strap	1"CC Single Strap		1-1/2"FIP Double Strap	2"FIP Double Strap
Smith/Blair	315	315		317	317
Romac	101	101		202	202

SADDLES FOR C-200 PVC

	3/4"CC	1"CC		1-1/2"FIP	1-1/2"FIP
Dresser	194	194			
Romac	101S	101S		202S	202S

McDonald	M3891	M3891			
Smith/Blair				317	317

Note: CC Denotes Type Thread

CORPORATION STOPS

	3/4"	1"	1-1/2"	2"
Mueller *	H-15000	H-15000	Gate Valve	Gate Valve

* CC Thread Inlet & Flare Copper Outlet

**CC Thread Inlet & Male Iron Pipe Outlet

TAPPING MACHINES

<u>Type</u>	<u>Tap</u>	<u>Size</u>
E-5	Saddle	3/4" - 1"
D-5	Saddle	3/4" - 2"
B100, B101	Direct	3/4" - 1"
A-3	Direct	1" - 2"
Tap Mate 2	Saddle	3/4" - 2"

SECTION 3D

VALVES AND VALVES BOXES

3D-01. GENERAL: Valves and appurtenances shall be of the type and size shown on the plans. Underground valves shall have standard mechanical joint ends. Valves above ground or installed within structures shall have flanged ends. Flanges shall be Class 125 except where Class 250 is specifically noted. Valves shall be at least the same class as the pipe with which they are used. All exposed valves shall be shop primed. Valves shall conform to the requirements of AWWA C-500, C-504 or C-509 and ANSI/NSF 61. All horizontal valves shall be set so that the operating nut is vertical.

3D-02. GATE VALVES:

- A. (1) Gate valves 2-inch and smaller shall be Ford Ball Valves. The valve is to open left.

(2) Gate valves for water service, 3-inch through 12-inch, shall have a cast iron body, bonnet and gate. The valve shall close to a drop tight shut off by way of resilient seating. Double disc and wedge are not acceptable. The valve stem shall be non-rising construction and supplied with a 2-inch operator unless otherwise specified on the drawings. The stem and stem nut shall be made of bronze. The stem shall have a minimum of two o-rings, one above and one below the stem thrust collar. The valve shall conform to all requirements of AWWA C-509, latest edition, designed for a minimum operating pressure of 200 psi. The valve shall open counter clockwise (open left). Acceptable valve manufacturers are: Mueller, Kennedy and American-Darling Valve.

(3) Gate valves for water service 14-inch and larger shall be cast iron body, bronze mounted double disc and wedge, parallel seat type. The valve stem shall be non-rising with a bevel gear, weather tight gear case and grease case tracks. The stem is to be sealed with a minimum of two o-rings, where available. Valves 16-inch and larger shall include trunnions, scrapers and an appropriately sized by-pass. The valves for water service shall conform to all requirements of AWWA C-500 latest edition. Acceptable valve manufacturers are: Mueller, Kennedy and American- Darling Valve.

- B. All gate valves will be furnished with Mechanical Joint and all necessary bolts, nuts, gaskets, glands and other necessary appurtenances. All external valve body bolts shall meet the requirements of ASTM-A307 and shall be hot-dip zinc coated. The bolts and nuts are to have hexagonal heads. The nuts shall be bronze. Natural rubber or other material which will support microbiological growth may not be used for any gaskets, O-rings, and other products used for jointing pipes, valves, or other appurtenances which will expose the material to the water. All gaskets shall be AWWA approved.

C. All valves to be coated in accordance with AWWA C-500 or C-509, latest edition. All ferrous parts except for the disc, resilient seat and bearing surfaces shall be given two (2) coats tar varnish or other approved materials in accordance with AWWA/NSF. After the valve is assembled and tested, a third coat shall be applied to the exterior surface.

D. Valve stem sizes must meet the minimum standard set by AWWA C-500 and C-509. Valves 16-inches and larger shall have the number of turns to open stamped on the valve. The minimum number of turns to open shall be as specified in AWWA C-500 and C-509 for all valves.

E. All valves shall be given an operational test, seal test and a hydrostatic test in accordance to AWWA C-500 and C-509. Certified test results shall be available on request.

3D-03. VALVE MARKERS: Valve markers shall be manufactured of 3,000 psi concrete and provided as shown on the plans, and carefully set to assure the markers are plumb. The letters on the markers shall face the valves. Valve markers shall be marked with revised letters, MV for valves, AV for air or air/vacuum valves or BO for blow-offs.

3D-04. VALVE BOXES: Valve boxes shall be furnished for all underground valves and shall be cast iron, three-piece stack type with covers and bases. All boxes shall be gray cast iron in accordance with ASTM #A-48, Class 20.

3D-05. BALL VALVES - SWING CHECK VALVES: Ball valves and swing check valves are typically not allowed to be installed within the ICWD. However, if installed, these valves shall conform to AWWA C507 and C508.

SECTION 3E

FIRE HYDRANTS

3E-01. GENERAL. All fire hydrants shall comply fully with AWWA Standard C502, latest revision and ANSI/NSF 61, for dry barrel hydrants and standards and specifications of the Inman-Campobello Water District. Where discrepancies exist, the more stringent (in the opinion of the Water District) shall govern. Hydrants shall be the particular model name or number by either of the manufacturers listed in Paragraph 3E-02 and shall be modified as specified in this section.

3E-02. MANUFACTURE AND NOMENCLATURE: Hydrants shall be either of the following:

Mueller – Super Centurion 250
American-Darling - Mark 73
M & H – M & H 129

3E-03. GENERAL CONSTRUCTION: Hydrants shall be compressive type, self-lubricating, non-freezing, and provided with a safety flange and coupling. The operating unit shall be totally sealed from the barrel and all working parts shall be continuously and automatically lubricated. Drain mechanism shall be simple, positive and automatic in operation. The safety flange on barrel and safety coupling on valve stem shall operate to prevent damage to barrel and stem in case of a traffic accident. The force of the impact shall break the flange and spread the coupling. The ground line shall be marked on the lower barrel and the flange and coupling shall be above the ground line marking and constructed so as to permit rapid and inexpensive replacement. Hydrant shall be constructed to permit rotating nozzles in any direction by loosening safety flange bolts and revolving the upper barrel at any time without digging or cutting off water. All working parts of the hydrant, including the seat ring, shall be removable through the top without digging or removing the hydrant, including the shoe, from its installed location. Seat rings shall be so shaped and arranged as to be readily removable. Hydrants shall have bronze to bronze seating and bronze to bronze threads. Natural rubber or other material which will support microbiological growth may not be used for any gaskets, O-rings, and other products used for jointing pipes, valves, or other appurtenances which will expose the material to the water. All gaskets shall be AWWA approved.

3E-04. Hydrants shall be the type as listed above by any of the manufacturers listed above, but with modifications or features as listed in the remainder of this section.

A. Hydrants shall be designed for a working pressure of 150 psi and tested to 300 psi. At the time of delivery, the supplier shall furnish written certification that each hydrant has been tested and has passed the test.

B. Three nozzles shall be provided. Two 2 1/2-inch connectors shall be provided 180 degrees apart and one 4 1/2-inch at 90 degrees to the other nozzles shall be provided. Nozzles shall be all bronze threaded into the barrel, or "locked" to the

barrel and sealed with o-ring seat and locked into place with locking device. Locking device shall be inaccessible from outside the hydrant. Threads shall be the standard of Inman-Campobello Water District. Caps shall have nuts of the same size as the operating nut specified in Paragraph C below. The size shall be the standard of the Inman-Campobello Water District. Caps shall be secured to the barrel with non-linking chain loop on the caps for free turning of the cap during removal.

C. The operating nut shall be one piece bronze or cast iron construction, pentagon shape, and measure 1 1/4-inch from the point to flat area of the base and shall be the same size as the nozzle cap. An arrow shall be cast into the weather cap or bonnet indicating the direction of opening which shall be counterclockwise (open left). An o-ring seal shall be provided to seal operating nut to the bonnet. Hold down nut shall be all bronze with o-ring seals on the inside sealing against the operating nut and on the outside sealing against the bonnet.

D. Lubrication system shall be either oil or grease. Oil reservoirs shall have an external filler plug made of brass or stainless steel. Grease fittings shall be brass or stainless steel. Oil and grease reservoirs shall be sealed to a bronze stem sleeve by two (2) o-rings. Bronze stem sleeves shall be o-ring sealed to the stem. All thrust bearing surfaces shall be able to be lubricated without bonnet removal. A thermoset anti-friction washer shall be located between the thrust collar of the operating nut and the hold down nut or plate. Oil filter plug or grease fitting shall permit adding lubricant, filling reservoir, and checking lubricant level without removing bonnet, or weather cap.

E. Hydrants shall be traffic models having the upper and lower barrels joined approximately 2 inches above the bury line by a traffic flange, breaking ring, or ground-line coupling, providing 360 degree rotation of the upper barrel while hydrant is in service. "Break-away" bolts will not be acceptable. The lowest nozzle shall be a minimum of 18 inches above the ground- line or bury line. A corrosion proof safety coupling shall connect the upper and lower stems. The safety coupling shall be attached to the stem with either bronze or stainless steel pins, screws or clips. The safety coupling shall be of the torque diverting type and shall be designed such that no pieces fall into the lower barrel when the coupling fractures upon impact and designed to prevent fractures through the screws or pins holding the coupling to the stem.

F. The upper barrel shall be manufactured of cast iron. The lower barrel and shoe shall be manufactured of cast iron or ductile iron. Interior of shoe shall be coated with epoxy, a total of 4 mils thick, or with two (2) coats of an asphaltic varnish, each coat with a minimum thickness of 1 1/2 mils and a total minimum thickness of 3 mils. Any coating shall meet the requirements of AWWA C502 and shall be suitable for potable water. The brand name, year of manufacture and valve opening size shall be cast on the outside of upper barrel.

G. Drain holes shall be provided at the lowest possible elevation to assure complete drainage of all water from the hydrant. A minimum of two external drain holes or ports 180 degrees apart shall be provided with a minimum diameter of 1/4-inch. Two internal drain holes shall be provided, each at least 1/4-inch diameter.

Hydrant design shall be such that drain ports are flushed with full line pressure each time the hydrant is opened and closed. Drain valve facings shall be mechanically attached to the upper valve plate by means of stainless steel or bronze screws or stainless steel pins. If two drain holes are provided, they shall be 180 degrees apart, and no drain holes shall be at the back base of the shoe where concrete thrust blocks will be poured. Seat rings shall be bronze and shall screw into bronze drain or shoe rings. Seat rings shall be sealed by o-rings. All internal bronze components shall conform to Section 2.1, Table 1 of AWWA Standard C502.

H. Hydrants shall be for 3'-6" bury (unless otherwise specified by the Inman-Campobello Water District) when ordered. Bury shall be cast in lower barrel or stenciled in 2-inch painted letters. Hydrants shall be extendable in 6-inch increments by means of extensions. Extensions shall be provided which shall be of the same material as the shoe and lower barrel and shall be complete with one (1) set of all necessary bolts and nuts, safety flange, gaskets, stem couplings and stem extensions and stem pins.

I. Main-valve assembly and seat ring shall be removable with a lightweight seat wrench furnished by the manufacturer. All tools required for this assembly shall be furnished by the supplier. At least one complete set of disassembly tools shall be furnished for every 50 hydrants supplied. One operating wrench shall be supplied for each twelve (12) hydrants supplied based on a "running total" number of hydrants sold and not each order.

3E-05. MATERIALS AND EQUIPMENT: A particular manufacturer of hydrants may not have the exact part described below, which is acceptable. It is the intent of these specifications that a manufacturer will supply this standard hydrant modified or with options supplied as specified.

A. Hydrants shall be equipped with the following options at the factory prior to shipment.

- (1) Rubber (Buna N) or cellulose fiber gaskets throughout;
- (2) Travel stop nut or equivalent for position stop;
- (3) Rubber or metal weather shield;
- (4) Bronze to bronze drain arrangement - bronze hydrant seat and bronze o-ring;
- (5) Chains to attach nozzle cap to hydrant;

B. Hydrant materials shall be in accordance with the table as follows:

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>MATERIAL</u>
1.	Operating Nut	Bronze or Cast Iron
2.	Weather Cap/Weather Seal	Cast Iron or Rubber
3.	Hold Down Nut "O"-Ring	Rubber
4.	Hold Down Nut	Bronze
5.	Bonnet "O"-Ring	Rubber
6.	Anti-Friction Washer	Plastic, Nylon
7.	Thrust Washer	Plastic, Teflon
8.	Lubrication Plug	Brass or Stainless Steel
9.	Bonnet	Cast Iron
10.	Bonnet Bolts	Cadmium or Zinc Plated Steel (Galvanized) - ASTM 307
11.	Bonnet Gasket	Rubber
12.	Upper Stem	Steel with Bronze Sleeve
13.	Stem "O"-Rings	Rubber
14.	Nozzle Retaining Screw	Stainless Steel
15.	Hose and Pumper Nozzles	Bronze
16.	Hose and Pumper Nozzles Gasket	Rubber
17.	Hose and Pumper Nozzles "O"-Ring	Rubber
18.	Hose and Pumper Nozzle Cap	Cast Iron
19.	Chains	Steel
20.	Chain Connector	Steel
21.	Upper Barrel	Cast Iron
22.	Safety Stem Coupling	Anodized Steel or Cast Iron

23.	Safety Flange Bolt	Cadmium or Zinc Plated (Galvanized) Steel - ASTM 307
24.	Safety Flange Gasket	Rubber
25.	Safety Flange	Cast Iron
26.	Cotter Pins	Stainless Steel or Bronze
27.	Clevis Pins	Stainless Steel or Bronze
28.	Lower Stem	Steel
29.	Lower Barrel	Cast Iron or Ductile Iron
30.	Stem Pin	Stainless Steel
31.	Drain Valve Pin	Stainless Steel
32.	Drain Valve Facing	Rubber, Polyethylene, or leather
33.	Drain Valve Facing Screw	Stainless Steel or Bronze
34.	Upper Valve Plate	Bronze Iron
35.	Shoe Bolt	ASTM 307 - Steel Cadmium or Zinc (Galvanized) Plated
36.	Drain Ring Housing Gasket	Rubber
37.	Elbow/Bottom Gasket	Rubber
38.	Top Seat Ring "O"-Ring	Rubber
39.	Drain Ring Housing	Cast Iron
40.	Drain Ring Housing Bolt	Zinc Plated (Galvanized) or Cadmium Plated ASTM 307 Steel
41.	Drain Ring	Bronze
42.	Seat Ring	Bronze
43.	Bottom Seat Ring "O"-Ring	Rubber
44.	Main Valve	Rubber or Neoprene

45.	Bottom Valve Plate	Cast Iron
46.	Lower Valve Plate	Cast Iron
47.	Cap Nut Seal	Rubber
48.	Lock Washer	Stainless Steel
49.	Cap Nut	Ductile Iron
50.	Shoe	Cast Iron or Ductile Iron

(1) Clarification of the materials are as follows:

(a) Rubber refers to Buna N synthetic rubber. Natural rubber shall not be provided in any parts.

(b) Stainless steel refers to ASTM 276, Grade 302 or better.

3E-06. PAINTING

A. The interior and exterior parts of the hydrant shall be cleaned in accordance with AWWA Specification C502, latest edition, Section 4. Interior coatings shall be suitable for potable water.

B. A primer shall be applied from the ground line up in accordance with the AWWA C502, latest edition, Section 4.C. All exposed exterior surfaces below the ground line shall be coated with two coats of asphalt varnish. Each coat shall be at least 2 mils thick. The first coat shall dry thoroughly before the second coat is applied.

D. Interior surfaces shall be coated with two (2) coats of asphalt varnish in accordance with AWWA C502, latest edition. Each coat shall be at least 2 mils thick.

E. Caps, bonnet and chains shall receive two coats, at least 2 mils thick each, of aluminum paint. Base coat shall dry for a minimum of 48 hours before second coat is applied.

F. The body shall receive two coats, each 2 mils thick, of yellow paint. The first coat shall be thoroughly dry before the second is applied.

G. Paint shall be as follows:

(1) Body, caps, chains and bonnet yellow paint shall be Sherwin-Williams Enamel Yellow.

SECTION 4A

PVC PIPE MATERIALS

4A-01. PVC PIPE MANUFACTURE: PVC pipe shall be 4-inch through 12-inch nominal diameter in accordance with AWWA C900, ASTM D2241 and ANSI/NSF 61.

A. All PVC pipe shall be designed and manufactured in accordance with SDR 21, latest revision, from virgin polyvinyl chloride resin meeting cell Class 12454-A or 12454-B as defined in ASTM D1784. All compounds shall qualify for a rating of 4000 psi for water at 73.4 degrees Fahrenheit per the requirements of PPI TR3.

B. PVC pipe shall be pressure class 200 furnished in ductile iron pipe equivalent outside diameters in 20-foot lengths and shall be approved by the National Sanitation Foundation (NSF) Standard 14.

C. Each length of PVC pipe shall bear markings indicating the following information at intervals not to exceed five (5') feet: (1) manufacturer's name or trademark, (2) nominal pipe size and OD base, (3) AWWA material code designation, (4) dimension ratio, (5) AWWA pressure class, and (6) product record code.

D. All PVC pipe shall be elastomeric-gasket bell-end pipe. Gaskets and lubricants to be used with PVC pipe shall be made from materials that are compatible with PVC and with each other, but that will not support the growth of bacteria or adversely affect, in any way, the quality of the potable water to be transported. One gasket shall be furnished with each length of PVC pipe.

E. Fittings used in the laying of PVC pipe shall be iron fittings as described in Section 3B of these specifications. PVC fittings will not be acceptable.

F. Solvent-weld PVC pipe and fittings shall not be used in water mains four (4) inches and larger.

4A-02. PIPE INSPECTION:

A. Each pipe shipment shall be inspected with care by the Contractor and the Engineer. Any pipe which is warped, cracked, discolored, abraded, misshapen, or otherwise damaged shall be considered unsuitable and shall not be used. Any unsuitable material discovered during the inspection or at any other time shall be removed from the job site.

B. If the load shifted during transport, has broken packaging, or shows rough treatment, each pipe length shall be carefully inspected for damage.

C. It is assumed that all handling and storage of the PVC pipe by all persons who handle, transport, and/or store, these PVC pipe materials prior to their delivery to the job site is in accordance with the requirements of the Uni-Bell PVC Pipe Association. Any damage resulting from improper handling, transportation, or storage prior to or during the time the pipe material is on the work site shall cause the piping materials to be rejected.

4A-03. SHIPPING, RECEIVING, UNLOADING PVC PIPE:

A. Shipping: All pipe material shall be shipped in a manner to ensure that the pipe is not damaged.

B. Receiving: When receiving the PVC pipe shipment at the job site, the Contractor shall exercise established precautions.

C. Unloading: Preferred unloading is in package units using mechanical equipment; however, the pipe can be unloaded individually by hand. Mechanical equipment shall be operated so that it does not strike adjacent pipe and that pipe being moved does not strike anything.

(1) Unloading unpackaged PVC Pipe: PVC pipe may be unloaded and moved individually by hand if not packaged or if mechanical equipment is not available.

(2) Unloading Package Units: When unloading package units, the following instructions shall be carefully followed:

(a) Remove restraints from the top unit loads.

(b) If there are boards across the top and down the sides of the load which are not part of pipe packaging, remove them.

(c) Use a fork lift with thin chisel forks, extend forks (or front end loader equipped with forks) to remove each top unit (one at a time) from the truck. Remove back units first. Do not run the forks too far under units as fork ends striking adjacent units may cause damage. Insure forks are fully engaged.

(d) If a fork lift is not available, a spreader bar with fabric straps which are capable of handling the load (with straps spaced approximately 8 feet apart and looped under the load) may be used. Cables may also be used if cushioned with rubber hose

sleeves or other material to prevent abrasion of the pipe.

(e) During the removal and handling, be sure that the units do not strike anything. Severe impact could cause damage, particularly during cold weather.

(f) Do not handle units with individual chains or single cables, even if padded.

(g) Do not attach cables to unit frames or banding for lifting.

(h) Pipe package units shall be placed and stored on level ground.

(i) Package units shall not be stacked more than eight feet high. Units shall be protected by dunnage.

(j) To unload lower units, repeat the above unloading process.

(k) If unloading equipment is not available, pipe may be unloaded by removing individual pieces by hand. However, care shall be taken to insure that pipe is not dropped or damaged.

4A-04. STORAGE REQUIREMENTS FOR PVC PIPE:

A. PVC pipe shall be stored, if possible, at the job site in the unit packages provided by the manufacturer. Caution shall be exercised to avoid compression, damage or deformation to the bell ends of the pipe. Pipe shall be stored on level ground.

B. If stored as individual pieces, pipe shall be arranged and supported so that there can be no compression, damage or deformation to the bell ends.

C. When unit packages of PVC pipe are stacked, insure that the weight of the upper units does not cause deformation to the pipe in lower units.

D. PVC pipe unit packages shall be supported by racks or dunnage to prevent damage to the bottom during storage. Supports shall be spaced to prevent pipe bending.

E. When exposure to direct sunlight for an extended period is unavoidable, PVC pipe shall be covered with opaque material while permitting adequate air circulation above and around the pipe as required to prevent excessive heat accumulation.

F. PVC pipe shall not be stored close to heat sources or hot objects such as

heaters, boilers, steam lines, engine exhaust, etc.

G. When unit packages of PVC pipe are stacked, insure that the height of the stack does not result in instability which could cause stack collapse, pipe damage or personnel injury.

H. The interior as well as all sealing surfaces of pipe, fittings and other accessories shall be kept free from dirt and foreign matter.

I. Gaskets shall be protected from exposure to heat, direct sunlight, ozone, oil, and grease.

4A-05. HANDLING REQUIREMENTS FOR PVC PIPE:

A. When using fork lifts or other handling equipment, prevent damage to PVC pipe.

B. When handling PVC pipe, avoid impact blows, abrasion damage, and gouging or cutting by metal surfaces or rocks. Avoid stressing bell joints and damage of bevel ends.

C. Pipe shall be lowered, not dropped, from trucks and into trenches.

D. In preparation for pipe installation, placement of pipe (stringing) shall be as close to the trench as practical and on the opposite side from the excavated earth. Bell ends shall point in the direction of work progress.

E. Pipe stringing shall not extend further than 100 feet beyond the installation.

F. In subfreezing temperatures, extra caution is required in handling PVC pipe to prevent impact damage.

SECTION 4B

TRENCH EXCAVATION FOR PVC PIPE

4B-01. SCOPE: Work consists of all necessary site grading, trench excavation, and related work as shown on the plans and as specified herein.

4B-02. GENERAL: All excavation and grading shall be confined to the right-of-way or easement as shown on the plans, and shall be done in an approved manner with proper equipment. Excavation, filling and grading work shall be suspended during rain and inclement weather, or when unsatisfactory field conditions are encountered, unless otherwise directed by the ICWD Water District. At all times during construction, the Contractor shall maintain proper drainage in the construction area, and shall take all measures necessary for erosion and sediment control as required in Section 2P, EROSION CONTROL.

A. Excavation and Preparation: Trenches shall be excavated true to line and grade so that the pipe can be installed to the alignment and depth required. The trench shall not be opened any further ahead of pipe laying operations than is necessary for proper laying and backfilling operations and as approved by the ICWD Water District. Trenches shall be progressively backfilled within 100 feet of the pipe laying and installation operations unless otherwise approved by the ICWD Water District. No trenches may be left open overnight without the approval of the ICWD Water District. When approved, proper traffic protection, lighting and signs in accordance with requirements of South Carolina Department of Transportation shall be provided by Contractor.

B. Trench Width: The minimum clear width of the trench, sheeted or unsheeted, measured at the spring line of the pipe shall be not less than one foot greater than the outside diameter of the pipe to allow backfill material to be installed in the haunching area. If this trench width is exceeded, pipe zone haunching shall be compacted on each side of the pipe for a distance of at least one pipe diameter or to the trench walls, whichever is less. Minimum trench widths therefore are as follows:

<u>PIPE SIZE</u>	<u>MINIMUM TRENCH WIDTH</u>
4 inch	16 inch
6 inch	18 inch
8 inch	20 inch
12 inch	24 inch

Trenches shall be of such extra width, when required, to permit the placing of timber supports, sheeting and bracing.

C. Excavation to Grade: The trench shall be excavated to the depth required so as to provide a UNIFORM AND CONTINUOUS ditch bottom between the bell holes and to provide for a minimum 36-inch cover over the top of the pipe. Ledge rock, boulders and large stones must be removed to provide not less than 6 inches of soil cushion on all sides of the pipe and appurtenances. Any part of the trench bottom excavated below the specified grade shall be corrected by adding approved material to the required grade and compacting to not less than 95% of the maximum dry density as determined by the Standard Proctor Test (ASTM D698). The finished subgrade shall be prepared accurately by means of hand tools.

D. Bell Holes: Bell holes shall be provided at each pipe joint to permit proper joint assembly and pipe support. Bell holes shall be excavated to sufficient depth and width to allow the pipe to rest uniformly on the bedding material and to allow the joint to be properly made. The pipe bell shall not bear directly on the soil.

E. Excavation in Soil: Where the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders, refuse, vegetable, or other organic material which, in the opinion of the Inspector should be removed, then the material shall be removed to the width and depth required. Before the pipe is laid, the subgrade shall be prepared by backfilling with an approved material in three (3") inch uncompacted layers. Each layer shall then be thoroughly compacted, as specified in Section 2F, BEDDING OF PIPE AND BACKFILLING OF TRENCHES, of these specifications in order to provide a uniform and continuous firm bearing and support for the pipe at every point between bell holes.

F. Crushed Stone Stabilization: Wherever, in the opinion of the Inspector, the subgrade is by nature too soft or mucky for the proper installation of the pipe, the trench shall be excavated as directed by the Engineer, and backfilled with No. 67 Stone (3/4" and down) and brought to the grade required and compacted.

G. Excavated Material: All surface materials which are suitable for reuse in restoring the surface shall be kept separate from the general excavated materials.

(1) Storage of Excavated Material: All excavated material shall be stored in a manner that will not endanger the work and which will avoid

obstructing sidewalks, driveways, or traffic. Fire hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes or other utility controls shall be left unobstructed and accessible until the work is completed. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural water courses shall not be obstructed. Mail boxes shall be left unobstructed and accessible when possible.

H. Trench Bracing: The Contractor is responsible for the safety of the site. This is to include complying with all safety regulations concerning trench bracing to State and Federal requirements.

I. Dewatering: An adequate dewatering system shall be provided, if required by the Inspector. If a well-point system is used, the Contractor shall submit plans to the ICWD Water District for approval. The system shall be capable of removing any water that accumulates in the excavation and maintaining the excavation in a dry condition while construction is in progress. Dirt placed on the surface of the ground shall be sloped away from the excavation. If necessary, piping shall be provided to prevent surface water from entering the excavation. Disposal of water from the dewatering operation shall be done in a manner that does not interfere with normal drainage, and does not cause damage to any portion of the work or adjacent property. All drains, culverts, storm sewers and inlets subject to the dewatering operation shall be kept clean and open for normal surface drainage. The dewatering system shall be maintained until backfilling is complete or as otherwise directed by the Inspector. All damage resulting from the dewatering operation shall be repaired by the Contractor to the satisfaction of the Inspector and at no cost to the Inman-Campobello Water District.

J. Underground Utilities: The Contractor is responsible for locating and protecting all existing underground utilities as required in Section 2B, EXISTING UTILITIES AND STRUCTURES.

SECTION 4C

PVC PIPE JOINT ASSEMBLY

4C-01. GENERAL: All pipe and fittings shall be assembled and jointed in accordance with the manufacturer's instructions and with this section. When gaskets are color coded, refer to the PVC pipe manufacturer's literature for significance. All work shall accurately conform to the lines and grades established on the plans.

A. Handling: Proper and suitable tools and equipment for the safe and convenient handling and laying of PVC pipe shall be used. Care shall be taken to prevent the pipe or fittings from being damaged, particularly the lining on the interior of the iron fittings. All pipe and fittings shall be carefully examined for cracks, broken lining or other defects. No pipe or fitting shall be laid which is known to be defective. If any pipe or fitting is discovered to be cracked, broken or defective, after being laid, it shall be removed and replaced with acceptable new pipe or fittings. All pipe and fittings shall be thoroughly cleaned before being laid and shall be kept clean until accepted in the completed work.

B. Cleaning Pipe and Fittings: In all cases, clean the gasket, the bell or coupling interior, especially the groove area (except when the gasket is permanently installed) and the spigot area with a rag, brush or paper towel to remove any dirt or foreign material before assembling. If, in the opinion of the Inspector, the interior of the pipe is not clean, the entire length of pipe shall be SWABBED clean by the use of a circular cloth swab having a diameter equal to the inside diameter of the pipe.

C. Inspection of Pipe: Inspect the gasket, pipe spigot bevel, gasket groove and sealing surfaces for damage or deformation. When gaskets are not permanently installed in the pipe, use only gaskets which are designed for and supplied with the pipe. Insert them as recommended by the pipe manufacturer.

D. Placing in Ditch:

(1) Proper tools and equipment shall be used for careful placement of PVC pipe in the trench to prevent damage. Under no circumstances shall pipe or accessories be dropped into the ditch.

(2) Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. If the pipe laying crew cannot place the pipe into the trench and in place without getting earth into it, a heavy, tightly woven canvas bag of suitable size shall be placed over each end before lowering the pipe into the trench and left in place until the connection is to be made. During laying operations, no

debris, tools, clothing or other material shall be placed in the pipe. When pipe laying is not in progress, open ends of installed pipe shall be plugged with ICWD approved plugs to prevent the entrance of trench water, dirt, or other foreign matter. Any dirt or foreign matter which is found in the pipe shall be removed before joining occurs.

E. Lubrication: Lubricant shall be applied as specified by the pipe manufacturer. Bacterial growth, damage to the gaskets or the pipe may be caused by use of non-approved lubricants. Use only lubricant supplied by the pipe manufacturer for use with the pipe provided and in potable water systems. Care must be taken in the use and storage of the joint lubricant provided. Lubricant contaminated by dirt or other material shall be discarded. Any lubricant must be ANSI/NSF approved.

(1) The socket (except when gasket is permanently installed), gasket, and spigot shall be thoroughly cleaned with a rag, brush, or paper towel before the gasket is inserted into the socket recess. Insert gasket as recommended by manufacturer.

(2) Good alignment of the pipe is essential for ease of assembly. Align the spigot to the bell and insert the spigot into the bell until it contacts the gasket uniformly. Apply firm steady pressure either by hand or by use of a bar and block assembly, until the spigot easily slips through the gasket.

(3) Do not suspend the pipe and swing it into the bell. The use of a backhoe to push the pipe will not be allowed. The use of other construction machinery will be allowed only if recommended by the pipe manufacturer and approved in advance by the Engineer.

(4) The spigot end of the PVC pipe is marked by the pipe manufacturer to indicate the proper depth of insertion. Care shall be taken to insure that the spigot end is inserted to this mark. PIPE SHALL NOT BE OVER-INSERTED.

(5) Care must be taken to assure that previously assembled pipe joints are not disturbed or over-inserted as a result of force applied to subsequent joints.

(6) When pipe installation is performed in cold weather gasket materials should be kept warm until jointing is to occur to aid in the ease of assembly.

(7) If undue resistance to insertion of the pipe end is encountered or if the reference mark does not position properly, the joint shall be disassembled and the position of the gasket checked. If the gasket is twisted or out of

place, the components shall be inspected and damaged items repaired or replaced. Components shall then be cleaned and reassembled making sure both pipe lengths are in concentric alignment. If the gasket is not out of position, verify proper location of the reference mark. The Engineer may relocate the reference mark if it is out of position.

(8) During assembly of the next joint of pipe in the ditch, the joint being installed must be kept straight and in line with the previous joint installed.

F. Permissible Joint Deflection and Longitudinal Bending: Pipe may be deflected if necessary but only after the assembly is completed and only if the manufacturer's literature states that this is allowable. Whenever it is necessary to deflect the pipe from a straight line, either in the horizontal or vertical plane to avoid obstructions, or to properly locate valve stems, or where long radius curves are required; this may be accomplished by longitudinal bending only if the pipe is designed to allow this. If so, the manufacturer's recommendations for shall be followed and not exceeded.

G. Cutting Pipe:

(1) The field cutting of pipe for installing valves, fittings, or nipple pieces shall be done in a neat and workmanlike manner without damage to the pipe and so as to leave a smooth end at right angles to the axis of the pipe. Prior to cutting, the exact location of the cut shall be carefully marked around the entire circumference of the pipe. The cut shall be made following this mark. A square cut is essential for proper assembly.

(2) A hacksaw, handsaw, a power handsaw with a steel blade or cutoff saw or abrasive disc shall be used for cutting PVC pipe.

(3) A factory-finished beveled end shall be used as a guide to ensure proper bevel angle and depth and proper insertion reference mark when assembling to PVC pipe bells. For installation of PVC pipe in iron fittings, all but 1/4-inch of the factory bevel on the spigot end shall be removed.

(4) The end may be beveled by using wood rasp or a pipe beveling tool which will cut the correct taper. A portable sander or abrasive disc may also be used. All sharp edges on the bevel shall be rounded off with a knife or a file.

(5) The minimum nipple length allowed without the approval of the Engineer is 2' - 0".

H. Sequence of Work: Excavation, cleaning, laying, jointing, and backfilling shall be kept up as closely as is possible so as to progress in a uniform, workmanlike manner. In no case shall pipe be left in the trench overnight, without completing the joint. The completed pipeline shall not be left exposed in the trench unnecessarily. The trench shall be backfilled and compacted as soon as possible after laying and jointing is completed. If necessary, exposed ends of pipe shall be properly plugged during laying to prevent dirt and other materials entering the line. Each day at the close of work, and at all times when laying is not in progress the exposed end of the pipeline in the trench shall be closed by the use of an approved temporary water tight plug. If, at any time, it becomes necessary to cover the ends of the uncompleted line with backfill, the end of such pipeline shall be plugged with a water tight plug.

I. Mechanical Joint Fittings: Joints with mechanical joint fittings shall be made by experienced workers.

(1) All but 1/4-inch of the factory bevel on the spigot end of a length of PVC pipe shall be removed before installation of this spigot end into an iron fitting. This shall be removed following the procedures in paragraph F of this Section.

(2) Gaskets, sockets and spigots shall be thoroughly cleaned with a rag, brush, or paper towel before slipping the gland and gasket over the spigot end of the pipe.

(3) The spigot shall be pushed into position and seated evenly in the socket. The gland shall be pushed into position for compressing the gasket. All bolts and nuts shall be tightened to a uniform permanent tightness to 90 lbs. torque. Bolts shall be tightened beginning with the bottom bolt, then the bolt directly opposite and proceeding around the joint using this alternating procedure to provide uniform tightness around the pipe. Care shall be taken to keep the gland square with the socket.

(4) The glands and bolts shall be kept clean and sockets, spigots, and gaskets shall be kept clean until such joint has been completed. Any joint which leaks shall be reassembled.

J. Thrust restraint shall be installed as shown on the approved plans and as required in Section 4E, THRUST RESTRAINT FOR PVC PIPE.

K. Dead-end Lines: Where a line is to terminate in a plug, the last joint of pipe shall be one full length of mechanical joint ductile iron pipe (AWWA C151) with a mechanical joint plug (AWWA C153). The pipeline shall be restrained as required in Section 2J, THRUST RESTRAINT FOR PVC PIPE.

SECTION 4D

BEDDING OF PVC PIPE AND BACKFILLING OF TRENCHES

4D-01. SCOPE: This section shall include specifications for bedding of pipe and backfilling of trenches.

4D-02. GENERAL: All opened trench shall be properly backfilled before the end of the working day unless the Engineer specifically approves leaving the trench open.

4D-03. PIPE BEDDING:

A. Trench Bottom: Before the pipe is laid, the trench bottom shall be constructed to provide a firm, stable, and uniform longitudinal support for the full length of the pipe.

B. Pipe Bedding: PVC Pipe shall be installed with proper bedding providing uniform longitudinal support under the pipe.

(1) Bedding material shall be worked under the sides of the pipe to provide satisfactory haunching from the trench bottom to the spring-line of the pipe. This material shall be selected and placed carefully, avoiding stones, frozen lumps and debris and shall be compacted to 95% Standard Proctor.

C. Bedding Materials: Materials for pipe bedding shall be as indicated on the typical trench section detail, or as specified herein.

(1) Select material shall be suitable material from the excavation free of large stones, hard lumps of debris and other objectionable materials. If select material is not available from the excavation, it shall be hauled to the site.

(2) Angular material shall be sand or crushed stone conforming to ASTM C33, Size No. 67 with a size not larger than 3/4-inch.

D. Trench Earth Dams: Where pipe bedding is angular material, earth dams, consisting of a minimum ten (10) foot trench length of select compacted backfill to replace angular bedding, shall be installed every 200 feet of pipe to prevent groundwater movement in angular bedding material. Compacted backfill 95% proctor shall replace angular bedding.

4D-04. BACKFILLING TRENCHES:

A. All trenches shall be backfilled immediately after the pipe is laid in the trench and bedding is complete, unless otherwise directed by the Engineer. All opened trench shall be properly backfilled before the end of the working day unless the Engineer specifically approves leaving the trench open.

B. Initial backfill material shall be placed to a satisfactory height over the top of the pipe (minimum 12-inches) for impact protection during the final backfill. No mechanical tamps shall be used until this depth has been achieved.

C. Bedding and backfill up to 12 inches over the top of the pipe shall be placed as required above. Backfilling shall be carried up evenly on both sides of the pipe. The remaining backfill may be placed in layers of up to 12-inches for mechanical tamps, (18-inches if a mobile tamp is used) and each layer shall be compacted to 95% standard proctor by using one of the approved tamping devices listed in Paragraph D below. The tamping equipment shall make no less than four (4) passes. One compaction run up the trench and back down the trench is considered one pass.

D. Tamping Equipment: Mechanical tamps (gasoline driven), pneumatic tamps (air tamp), and sheepsfoot trench rollers are acceptable. "Mobile tamps" and/or "sheepsfoot trench rollers" such as "Rammax P-24EC" or approved equal, are permitted.

E. Compaction Test: All backfill for water lines shall be subject to a compaction test by Inman-Campobello Water District personnel or an independent laboratory approved by the Inman-Campobello Water District. If compaction meets test requirements, the Owner will pay for the cost of the test. If compaction fails the test, the Contractor shall remove and replace backfill to the satisfaction of the Inman-Campobello Water District, and shall also pay for the cost of the test and any subsequent test required.

F. Where trenches are in or along existing streets or roadways, PVC pipe shall not be installed. Ductile iron pipe shall be used in this application and Section 2 of these specifications shall apply.

G. Contractor shall be responsible for final subsidence of all trenches, and shall leave trenches flush with the original ground after all settlement has taken place. Any settlement of backfill below finish grade shall be promptly corrected. Trenches shall be protected against scour due to surface drainage.

SECTION 4E

THRUST RESTRAINT FOR PVC PIPE

4E-01. GENERAL: All plugs, caps, tees, bends, reducers, valves, hydrants and other items as may be indicated on the plans or directed by the Engineer shall be restrained or braced as shown on the detail drawings. The weight of fittings, valves, hydrants, and other appurtenances shall not be carried by the PVC piping. Blocking and/or concrete support cradles shall be poured so as to support the full weight of the fitting or appurtenance.

A. Concrete used for thrust blocking, collars, "Deadman" type thrust blocks, and concrete support cradles shall have a compressive strength of 3,000 psi at 28 days. High early strength concrete shall be used. Mixed concrete shall be furnished by a concrete supplier and a mix furnished, if required by the Engineer, to indicate a design mix of 3,000 psi.

B. Concrete support cradles used for carrying the weight of fittings, valves, hydrants, and other appurtenances shall be poured on and bear against undisturbed, hard, solid, firm earth. They shall be poured to bear against the appurtenance and allow sufficient area for repair and the easy removal of nuts and bolts.

C. Concrete Blocking and Rodding:

(1) Concrete blocks shall be poured to the dimensions shown on the detail drawings and formed when directed by the Engineer at no additional cost. The large side (backs) of the blocking shall bear against undisturbed, hard, solid, firm earth. Blocking shall be poured to bear against the fitting and allow sufficient area for repair and the easy removal of nuts and bolts.

(2) Backfilling on poured concrete will not be permitted for 24 hours after pouring unless approved by Engineer and no water will be permitted in mains for at least 24 hours after concrete blocking is poured.

(3) Metal Straps and rods shall be made of steel having a tensile strength of 95,000 psi. If required by the Engineer, the Contractor shall supply acceptable certification of tensile strength. All steel components, including rods, straps, nuts, bolts, couplings and clamps shall be coated with 17.5 mils of Thick and Quick Mastic or equal. Contractor shall supply coating and coat all the tie rods, clamps and miscellaneous steel used for anchoring purposes.

D. Concrete Collars poured on the last joint of pipe in a dead end run, shall be poured around a welded-on steel or ductile iron thrust collar. This collar shall be shop welded on the pipe midway between the MJ bell and the spigot by the pipe manufacturer. The weld shall be a continuous weld around the entire circumference of the pipe. If only one side of the collar is to be welded to the pipe, it shall be the side facing the MJ bell. Pipe manufacturer's shop drawings must be submitted for each size to be used indicating that the collar is designed to, at a minimum, restrain the force created by a 250 psi line pressure as listed in the table below. Field welding thrust collars will not be allowed. A wall pipe flange will not be accepted as a thrust collar.

<u>PIPE SIZE</u>	<u>MINIMUM THRUST RATING</u>
4	4,500 lbs.
6	9,300 lbs.
8	16,000 lbs.
12	34,000 lbs.

SECTION 4F

TRACER WIRE AND WARNING TAPE INSTALLATION

4F-01. GENERAL: Wherever PVC pipe is installed, tracer wire and warning tape shall be installed to facilitate future location of the pipe line.

4F-02. MATERIALS:

- A. Tracer wire shall be 14 gauge solid copper wire. Wire shall be continuous.
- B. Warning tape shall be brightly colored non-biodegradable plastic ribbon. The words "Warning PVC Water Line" shall be printed continuously along the length of the ribbon in large letters.
- C. Test boxes shall be the Glenn 4 Test Station (4-inch diameter, 18-inch length) with a locking cover and 4-terminal terminal board as manufactured by C. P. Test Services, Inc., or equal. Test box shall be 4-inch ID plastic with cast iron cover and collar. The cover shall be painted blue.

4F-03. INSTALLATION:

- A. Tracer wire shall be installed in the pipe trench directly below the PVC pipe.
 - (1) Tracer wires shall begin and terminate in the test boxes. Test boxes shall be installed at each location as shown on the plans, spaced at intervals not exceeding 500 feet. Test boxes shall not be installed in streets or driveways.
 - (2) Tracer wire between boxes shall be continuous, unbroken lengths. The tracer wire shall not be installed in tension, but neither shall there be "coils" in the wire. The ends of the tracer wires shall be installed in the test boxes. The length of each tracer wire in each box shall be long enough to extend no less than one foot and no greater than two feet above ground level and shall be attached to the terminal board.
 - (3) Breaks shall be repaired by splicing with a split-bolt clamp or pre-approved equal. Repairs by "twisting" the two ends together will not be accepted.
- B. Warning tape shall be buried in the backfill approximately one foot over the top of the PVC pipeline. Tape shall be laid in continuous lengths. Any breaks or tears shall be repaired before proceeding with the backfilling operations.

4F-04. TESTING: After construction and backfilling is complete, but before final inspection, the Engineer will test the tracer wire with standard ICWD locating equipment. If the Engineer determines that the tracer is not operating properly, the Contractor shall locate and correct the problem. The pipelines will not be accepted and placed in operation until the tracer system is acceptable to ICWD.