



INTEGRA WATER
TECHNICAL SPECIFICATIONS
FOR
WATER MAINS

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SECTION W-1

POLICIES AND PROCEDURES

1. GENERAL PROVISIONS:

A. The specifications herein are to be used by the Developers Design Engineer in the preparation of construction documents for the construction of potable water systems to be owned, operated and maintained by Integra Water, LLC, herein after called Owner.

B. These specifications do not include Design Criteria required to determine the size, location, capacity, or other parameters for water mains and appurtenances. The Developers Design Engineer is advised to meet with the Owner or his designated representative prior to design to discuss and determine specific design criteria pertinent to the project.

C. Construction documents prepared by the Developers Design Engineer must be reviewed with and approved by the Owner prior to commencement of any construction. Construction documents shall be in conformance with generally accepted engineering practice, the specifications herein, and the design criteria as set forth by the Owner.

D. Construction shall be executed in accordance with the construction documents prepared by the Developers Design Engineer and as approved by the Owner. The Contractor shall be experienced in water system construction, properly licensed in the governing state, and be approved by the Owner. Any deviation from the approved construction documents must receive approval from the Design Engineer and the Owner prior to execution of the work. The Owner reserves the right to request changes to the work during construction where conditions require.

E. Prior to final acceptance of the constructed project, all required tests, inspections, as-built drawings, certifications and/or warranties must be accepted and approved by the Owner, and any agency or entity having jurisdiction over the project.

F. All construction activities are to be performed in compliance with any applicable permitting requirements and safety standards required by the Contractor to perform the work. The Contractor must comply with all Federal, State and local safety rules and regulations, including those of the Occupational Safety and Health Administration (OSHA). The Owner will not inspect for compliance with safety regulation, and disclaims any responsibility to ensure the safety of workers.

G. These Specifications are subject to change, and interested parties are advised to check with Integra Water in the event there are any questions concerning the status of this document. Any updates to these Specifications will be made available by Integra Water.

SECTION W-2

CONSTRUCTION SPECIFICATIONS FOR WATER MAINS

1. DESCRIPTION OF WORK TO BE DONE:

A. This project consists of the installation of potable water systems. The Contractor will be responsible for the furnishing and placing of all materials required and shown on the construction documents. The Contractor shall comply with all applicable regulations of Federal, State or local Authorities.

B. The Contractor shall perform all excavation for the pipe lines; protect all existing utilities or other underground structures (water, gas, telephone, storm drains, etc.). The Contractor shall be responsible for the safety of all employees while on the job and for maintaining traffic safety along the roads and streets.

C. All work shall be done with equipment large enough for the job and with adequate number of personnel to complete the project on schedule.

D. The Contractor shall complete the project expeditiously, do all the clean up necessary and satisfy all conditions of any requirements by Federal, State or local Authorities

2. INSPECTION:

A. All materials, pipe, valves, embedment items, concrete, etc., shall be subject to site inspection at all times. Any materials found defective in anyway prior to unloading shall be removed from the project immediately.

B. Any material determined to be defective in transit will be removed from the job site. If claims are to be filed the Engineer will aid the Contractor in making such determination and claim.

C. At any time during the progress of the job that materials to be permanently installed in the project are found faulty in any way, they shall be tagged by the Engineer and removed immediately from the project site.

3. UNLOADING OF PIPE:

A. All pipe shall be unloaded by a method approved by the manufacturer. The pipe shall be unloaded in "pipe units" along the pipe route and out of the way of traffic and off private property. After the unloading the Contractor shall be responsible for all materials until permanently installed into the project and accepted by the Owner and Engineer.

B. DO NOT USE CHAINS OR SINGLE CABLES TO UNLOAD PIPE.

4. UNLOADING VALVES, HYDRANTS, MISCELLANEOUS ITEMS:

A. Unload all valves, hydrants, rubber rings, lubricants, fittings, etc., in a central area designated by the Engineer for the Contractor and distributed to the work area as needed.

5. PREPARATION OF THE SITE:

A. Prior to beginning excavation, the Contractor and representative of Owner (inspector for the Engineer) shall make a visual survey of the pipe line route and make written notes and or photographs of possible controversial areas where conflicts might occur in interpreting the requirements "*replaced to the same condition prior to the project*".

B. The Contractor shall complete all of the clearing and grubbing required to have sufficient room to construct and excavate the ditch for the pipe placement.

6. EXCAVATION AND PREPARATION OF TRENCHES THE MINIMUM DEPTH TO THE TOP OF THE PIPE SHALL BE 36":

A. General: The trench shall be dug to the alignment and depth required and far enough in advance of pipe crews, so as not to delay or interfere with pipe laying. The bottom of the trench shall be smooth and drained so that work can be done safely and efficiently. Excavation shall include undercutting for embedment material when required by the Engineer.

B. Pipe Foundation: The bottom of the ditch shall be prepared so that the entire length of the pipe is on sound material. The bed soil of the pipe shall have no sharp rocks or gravel larger than 1 2/3" diameter and shall contain no roots or humus material unsuitable for pipe foundation.

When the material in the bottom of the trench is not suitable for pipe bed a one foot depth of embedment material (as specified) shall be placed in the trench bottom.

C. Braced and Sheeted Trenches: Whenever necessary to prevent caving, excavations in gravel, sandy soil or other unstable material shall be adequately sheeted and braced. Where, in the opinion of the Engineer, sheeting is required to protect adjacent paving, structures, or other property, sheeting shall be used when ordered by the Engineer. Where sheeting and bracing are used, the trench width shall be increased accordingly. Trench sheeting shall remain in place until the pipe has been laid, tested for defects and repaired if necessary, and the earth around it compacted to a depth of 2 feet over the top of the pipe.

7. CARE OF SURFACE MATERIAL FOR RE-USE:

A. If local conditions permit their re-use, all surface materials suitable for re-use in restoring the surface shall be kept separate from the general excavation materials, and reused.

1. Manner of Piling Excavated Material: All excavated material shall be piled in manner that will not endanger the work and will avoid obstructing sidewalks and

driveways. Gutters shall be kept clear or other satisfactory provisions made for street drainage. Also, storm drains shall be kept clean.

2. Trenching by Machine or by Hand: The use of trench digging machinery will be permitted except in places where operation of same will cause damage to trees, buildings or existing structures above or below ground; in which case hand methods shall be employed.

3. Barricades, Guards and Safety Provisions: To protect persons from injury, and to avoid property damage, adequate barricades, construction signs, torches, lanterns and guards, as required, shall be placed and maintained during the progress of the construction work and until it is safe for traffic to use the trenched highway. Rules and regulations of the local authorities requesting safety provisions shall be observed.

4. Traffic and Utility Controls: Excavation for pipe laying operations shall be conducted in a manner to cause the least interruption to traffic. Where traffic must cross open trenches, the Contractor shall provide suitable bridges at street intersections and driveways. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire or police call boxes, or other utility controls shall be left unobstructed and accessible during the construction period.

5. Flow of Drains and Sewers Maintained: Adequate provisions shall be made for the flow of sewers, drains and water courses encountered during construction, and the structures which may have been disturbed shall be satisfactorily restored upon completion of the work.

6. Property Protection: Trees, fences, poles and other property shall be protected unless their removal is authorized; and any property damaged shall be satisfactorily restored by the Contractor. Where mailboxes must be removed for laying the pipe, the mailbox shall be temporarily set to permit the delivery of mail. Immediately upon backfilling and cleanup all mailboxes shall be permanently set at the location and to the condition as found before disturbing.

7. Interruption of Water Service: No valve or other control on the existing system shall be operated for any purpose by the Contractor without approval by the Engineer, and all consumers affected by such operation shall be notified by the Contractor at least one hour before the operation and advised of the probably time when the service is to be restored.

8. Removing Pavement: The Contractor shall remove pavement as necessary for installing the new pipe lines and appurtenances and for making connections to existing pipe lines. Pavement shall be cut back from the top edges of ditch lines for a distance of at least nine inches on each side of the ditch to allow for solid bearing edges for pavement to be replaced.

a) Marking: Before removing any pavement, the pavement shall be marked for cuts. Neatly paralleling pipe lines and existing street lines. Asphalt pavement shall be broken along the marked cuts by use of jack hammer or other suitable tool. Concrete pavement shall be scored to a depth of

approximately 1 1/2" along the marked cuts. Scoring shall be done by use of a rotary saw, after which the pavement may be broken below the scoring by use of jack hammer or other suitable material.

- b) Machine Pulling: No pavement shall be machine pulled until completely broken and separated along the marked cuts.
- c) c. Damage to Adjacent Pavement: The pavement adjacent to pipe line trenches must not be disturbed or damaged due to any cause such as caving ditch banks, indiscriminate use of construction machinery, etc. The Contractor shall remove the damaged pavement and shall replace at this own expense.

8. UNDERCROSSING OF CONSTRUCTED HIGHWAYS AND COUNTY ROADS:

A. Where shown on the construction documents, the Contractor shall construct an undercrossing, details of which have been approved by the Federal, State or local Authorities having jurisdiction. The work done shall not create a hazard, produce interruption of traffic or required additional maintenance by Highway Department forces.

B. The Contractor will be responsible for applying and obtaining all required permits to complete the work as well as for complying with all conditions of the permits.

C. Access pits, head and tail ditches shall be protected by sheeting and bracing as required to provide safe working conditions.

1. Casing Pipe

- a) As a general rule, the locations and approximate lengths of the encasements are indicated on the construction documents for the information of bidders, but the precise locations, length of the encasement will be specified in the permit issued by the Railroad or Highway Department involved.
- b) The casing pipe shall be new and made of steel in accordance with API 5L standard weight line pipe and be provided with continuous welded joints. The casing pipe shall be jacked through a hole of the proper size that has been previously bored for the purpose, or be installed by excavating and installing liner plates as the hole is advanced. It may be installed by the continuous boring and jacking method.
- c) The wall thickness of the steel casing pipe shall be 0.25" for all sizes 20" and smaller, 0.375 for sizes 24" through 36".
- d) The contractor shall provide all casing spacers and end seals required for conventional bores. The casing spacers shall be of the polyethylene type and the end seals shall be of the slip on type.
- e) Casing installation shall be by boring and jacking. Suitable equipment shall be employed to provide a mechanically augured bore followed immediately with the casing pipe. No water can be used at any time during the work and

the casing will maintain a firm continuous contact with the surrounding earth.

- f) The minimum cover of the casing shall be as shown on the permit drawings.

9. LAYING PIPE, FITTINGS AND APPURTENANCES IN PREPARED DITCH:

- A. Only pipe with approved elastomeric gasket joints may be used.
- B. Gaskets, O-rings, and other products used for joining pipes, setting meters or valves, or other appurtenances which will expose the material to water shall not be made of natural rubber or any other material which will support microbial growth.
- C. Only lubricants recommended by pipe manufacturers may be used.
- D. Lubricants shall not support microbial growth.
- E. All pipe shall be laid to and maintain at required lines and grades shown on the construction documents. Fittings, valves, air vents, and hydrants shall be installed at required location with valves and hydrants plumb.

10. HANDLING PIPE AND ACCESSORIES INTO TRENCH:

- A. Proper implements, tools and facilities shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, fittings, valves, and hydrants shall be carefully lowered into the trench, piece by piece, by means of a derrick, ropes or other suitable tools and equipment, in such a manner as to prevent damage to pipe or pipe coating. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.

11. HAMMER TEST:

- A. Before lowering and while suspended, the pipe shall be inspected for defects and rung with a light hammer to detect cracks. Any defective, damaged or unsound pipe shall be rejected.

12. PIPE KEPT CLEAN:

- A. All foreign matter or dirt shall be removed from the inside before it is lowered into its position in the trench, and it shall be kept clean by approved means during and after laying.

13. LAYING THE PIPE:

- A. The spigot shall be centered in the bell, the pipe shoved into position, and brought into the alignment; it shall be secured there with earth carefully tamped under and one each side of it, excepting at the bell holes. Care shall be taken to prevent dirt from entering the joint space.

14. PREVENTING TRENCH WATER FROM ENTERING PIPE:

A. At times when pipe laying is not in progress, the open ends of pipe shall be closed by approved means, and no trench water shall be permitted to enter the pipe.

15. CUTTING PIPE:

A. Cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe.

16. BELL ENDS TO FACE DIRECTION OF LAYING:

A. Unless otherwise directed, pipe shall be laid with bell ends facing in the direction of laying; and for lines on an appreciable slope, bells shall, at the discretion of the Engineer, face upgrade.

17. PERMISSIBLE DEFLECTION AT JOINT:

A. Wherever necessary to deflect pipe from a straight line; either in the vertical or horizontal plane, to avoid obstructions, to plumb stem, or where long radius curves are permitted, the degree of deflection shall be approved by the Engineer.

18. UNSUITABLE CONDITIONS FOR LAYING PIPE:

A. No pipe shall be laid in water, or when the trench conditions or weather is unsuitable for such work, except by permission of the Engineer.

19. PIPE JOINTS:

A. Mechanical Joints: All fittings, valves and accessories shall be installed as recommended by the pipe manufacturer. Bolts on M. J. fittings shall be tightened with a torque wrench set a maximum of 50 ft. lbs. The pipe manufacturer shall furnish special PVC insets for all mechanical fittings. The Contractor shall be responsible for placing the inserts as directed.

B. Valve Boxes

1. Cast iron boxes shall be firmly supported and maintained centered and plumb over the wrench nut of the gate valve, with box flush with the surface of the finished pavement or at such other level as may be directed.

2. All valve boxes shall have a concrete collar poured around them near the surface as detailed. This collar will be installed whether or not the box is in a road or easement.

3. At the time of installation the valve box shall be suitably marked by referenced points and aid points recorded and placed on the "As-Built" drawings.

C. Back Siphonage to be Prevented: Drainage branches or blow offs shall not be connected to any sewer or submerged in any stream or be installed in any other manner that will permit back siphonage into the distribution system.

20. SETTING HYDRANTS (FIRE OR FLUSH):

A. General Location: Hydrants shall be located in a manner to provide complete accessibility, and in such manner that the possibility of damage from vehicles or injury to pedestrians will be minimized. Unless otherwise directed, the setting of any hydrant shall conform to the following:

B. Location Re-Curb Lines: When placed behind curb, the hydrant barrel shall be set so that no portion of the pumper or hose nozzle cap will be less than 18 inches nor more than 30 inches from the gutter face of the curb, or less than 30 feet from the curb line intersection of any street; if set between streets, the hydrants shall be placed in the manner designated by the Engineer.

C. Location Re-Sidewalk: When set in the lawn space between the curb and the sidewalk, or between the sidewalk and the property line, no portion of the hydrant or nozzle cap shall be within 12 inches of the sidewalk.

D. Position of Nozzle: All hydrants shall stand plumb, and shall have their nozzles parallel with or at right angles to the curb with the pumper nozzle pointing normal to the curb except that hydrants having hose nozzles at an angle of 45 degrees shall be set normal to the curb. They shall conform to the established grade, with nozzle at least 12 inches above ground.

E. Connection to Main: Each hydrant shall be connected to main pipe as shown on the Detail Sheet of the construction documents.

F. Drainage at Hydrant: Whenever hydrants are set in impervious soil, a drainage pit 2 feet in diameter and 2 feet deep shall be excavated below each hydrant and filled compactly with coarse gravel or broken stone mixed with coarse sand, under and around the bowl of the hydrant and to a level 6 inches above the waste opening. No hydrant drainage pit shall be connected to a sewer.

G. Anchorage for Hydrant: The bowl of each hydrant shall be well braced against a concrete thrust block and shall be tied to the pipe with mechanical joint retainer glands. In no case shall the waste opening of the fire hydrant be obstructed from free drainage. Gravel shall be installed around hydrant weep hole as specified on detail sheet in construction documents.

H. Cleaning: Hydrants shall be thoroughly cleaned of dirt or foreign matter before setting.

I. Plugging Dead Ends: Standard plugs shall be inserted into the bells of all dead ends of pipes, tees, or crosses, and spigot ends shall be capped. Plugs or caps shall be jointed to the pipe or fittings in the appropriate manner.

21. ANCHORAGE OF BENDS, TEES AND PLUGS:

A. Limiting Pipe Diameter and Degree of Bend: Reaction or thrust backing shall be applied on all pipe lines 4 inches in diameter or larger at all tees, plugs, caps, and at bends deflecting 22 1/2 degrees or more.

B. Materials for Reaction Backing

1. Reaction or thrust backing shall be of concrete of a mix not leaner than 1 cement, 2 1/2 sand, 5 stone, have compressive strength of not less than 2,500 psi. Backing shall be placed between solid ground and the fitting to be anchored; shall be that required by the Engineer. The backing shall, unless otherwise directed, be so placed that the pipe and fitting joints will be accessible for repairs. No extra payment will be made for this material, but shall be included in the unit price bid for the various size pipe.

2. Reaction backing shall be poured against undisturbed soil and minimum areas of reaction backing in contact with undisturbed soil shall be as follows:

3" pipe:	0.50 S.F.	(9" X 9")	12" pipe:	6.75 S.F.	(32" X 32")
4" pipe:	0.75 S.F.	(11" X 11")	14" pipe:	9.25 S.F.	(36" X 36")
6" pipe:	1.75 S.F.	(16" X 16")	16" pipe:	12.00 S.F.	(42" X 42")
8" pipe:	3.00 S.F.	(21" X 21")	18" pipe:	15.25 S.F.	(48" X 48")
10" pipe:	4.75 S.F.	(26" X 26")	20" pipe:	19.00 S.F.	(52" X 52")

C. Metal Harness: Metal harness of tie rods and pipe clamps of adequate strength to prevent movement, or other suitable means may be used instead of concrete backing, as directed or approved by the Engineer. Steel rods and clamps shall be galvanized, or otherwise rustproof treated, or shall be painted as directed or approved by the Engineer.

22. HYDROSTATIC TEST:

A. Pressure during Test: After the pipe has been laid and partially backfilled as specified, all newly laid pipe, or any valved section of it, shall be subjected to hydrostatic pressure of a minimum of 150 psi or 1.5 times the working pressure of the pipe, whichever is greater.

B. Duration of Pressure Test: The duration of each pressure test shall be at least 6 hours or until the line has been completely inspected for visible leaks.

C. Procedure

1. A pipeline or segment thereof that has not been bacteriologically certified shall not be physically connected to any water main or segment of any water system in active service during the hydrostatic testing process.

2. Each section of pipe shall be slowly filled with water and the specified test pressure, measured at the highest point elevation, shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection,

gauges and all necessary apparatus shall be furnished by the Contractor. All pressure tests shall be conducted using a certified and accurate recording pressure gauge furnished by the Contractor which shall indicate pressure versus time of test. The recorded test chart shall also indicate the date of the test, the segment of the system which is being tested, and the total leakage experienced for the duration of the test. Charts from these tests shall be furnished to the Owner and Engineer and retained by the Engineer through the one year warranty period. Prior to acceptance, the section of water main being tested shall be "pumped up" to the specified test pressure and the amount of water required to reach this test pressure shall be measured.

D. Expelling Air Before Test: Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at points of highest elevation, and afterwards tightly plugged.

E. Permissible Leakage: Suitable means shall be provided by the Contractor for determining the quality of water lost by leakage under normal operating pressure. No pipe installation will be acceptable until or unless this leakage (evaluated on a pressure basis of 150 psi) is less than 10 U.S. gallons per 24 hours per mile of pipe per inch nominal diameter of pipe. All visible leakage shall be repaired regardless of the quantity of leakage.

F. Variation from Permissible Leakage: Should any test of combined section of pipe laid disclose leakage per mile of pipe greater than that specified, or if individual sections show leakage greater than the specified limit, the Contractor shall, at his own expense, locate and repair the defective joints until the leakage is within the specified allowance.

G. Leakage Defined: Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section of it, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

H. Time for Making Test

1. Pipe may be subjected to hydrostatic pressure, inspected, and tested for leakage at any convenient time after partial completion of backfill.

2. The Contractor shall be required to pressure test the entire system (or a portion thereof) on two separate occasions as follows:

3. The system shall be tested to 150 psi as specified herein before any service taps are made to the system.

4. After successfully testing the system the service taps shall be made under system pressure and service connections to the curb stop completed. Service taps to dry mains will not be permitted.

5. After service taps have been made the Contractor shall again test the system to 150 psi as specified herein. The recorder test chart requirements shall be applicable to this final test only.

23. BACKFILL:

A. Backfill

1. Backfill material shall be free from rocks or boulders and shall be deposited in the trench simultaneously on both side of the pipe for the full width of the trench in 4 inch layers to an elevation of at least 6 inches above the top of the barrels of the pipe, leaving the joints exposed for examination during the pressure test as previously specified. Material shall be dry enough to compact to the equivalent density of the surrounding earth. If too dry, the backfill material shall be dampened. Backfill containing broken pavement shall not be used.

2. Backfill material and pipe bedding material shall be select sand clay borrow material or other materials as authorized by the Engineer. In place material removed from trench shall be disposed of by the Contractor. Should local material be acceptable material as determined by the Engineer, it may be used in lieu of borrow material.

3. Backfill shall be in 4 inch layers, tamped with hand tamps to 8 inches above the top of the pipe. The remainder of the trench shall be backfilled to 6 inch layers and tamped with a mechanical tamp unless otherwise authorized by the Engineer.

24. RE-PAVING:

A. Any paved streets cut by these operations shall be re-paved in a workmanlike manner and restored to their original condition as shown or specified. The paving shall be of material at least equal to that removed and shall be laid in accordance with the specifications covering the type of paving. Where paved streets are cut, shell or gravel shall be provided immediately following backfill, and such crossing shall be maintained until repaved. The cost of furnishing the shell or gravel and maintaining the ditches shall be borne by the Contractor and included in the price bid for laying pipe. When flexible pavement is replaced, a 6 inch black bituminous base shall be laid for the top width of trench 1 1/4 inches below the finish grade of the existing pavement. After the base has been set, the remaining 1 1/4 inches shall be paved with a bituminous surfacing of the same type as that removed. Prior to replacing the pavement, a coat of 0.05 gallons per square yard of cut back asphalt shall be applied. Where concrete or other types of pavement are removed they shall be replaced with the same type and thickness as that removed. Just prior to repaving, edges shall be squared and cut to a string line so that the patch will present a neat appearance.

B. Where pipe is placed the length of an existing paved street, paving shall be done the full width of the street.

25. CHLORINATION OF COMPLETED PIPE LINE:

A. Before placing into service all new water distribution systems, or extensions to existing systems, or a valved section of such extension or any replacement in the existing water distribution system shall be chlorinated.

B. Any of the following methods of procedures shall be followed, subject to approval of the Engineer:

1. Liquid Chlorine gas-water mixture
2. Direct chlorine feed
3. Calcium Hypochlorite and water mixture

C. Preliminary Flushing: Prior to chlorination, all dirt, foreign matter shall be removed by a thorough flushing through the hydrants, or by other approved means. Each valve section of newly laid pipe shall be flushed independently. This shall be done after the pressure test is completed. Each pipe section shall be flushed with a rate of flow through the pipe to create a velocity of 2.5 feet per sec., minimum.

D. Liquid Chlorine: A chlorine gas-water mixture shall be applied by means of a solution-fed chlorinating device, or if approved by the Engineer, the gas shall be fed directly from a chlorine cylinder equipped with proper devices for regulating the rate of flow and effective diffusion of gas within the pipe. (Chlorination with the gas-water mixture is preferred to direct feed.)

E. Point of Application: The preferable point of application of the chlorinating agent shall be at the beginning of the pipe line extension, or any valved section of it, and through a corporation stop inserted in the horizontal axis of the newly laid pipe. The water injector for delivering the gas-water mixture into the pipe shall be supplied from a tap on the pressure side of the gate valve controlling the flow into the pipe line extension. In a new system, application may be at the pumping station, or the elevated tank, or the standpipe, or the reservoir if available. If a supply of water is not available, the Contractor shall haul the water by tank truck or other approved means. All water used for testing or chlorinating shall be approved by the Engineer. No additional payment will be made to the Contractor for hauling water.

F. Rate of Application: Water from the existing distribution system or other source of supply shall be controlled to flow very slowly into the newly laid pipe line during the application of chlorine. The rate of chlorine gas-water mixture flow shall be in such proportions to the rate of water entering the pipe that the chlorine dose applied to the water entering the newly laid pipe shall be at least 40 to 50 ppm.

G. Back Pressure Prevented: Back pressure, causing a reversal of flow in the pipe being treated, shall be prevented.

H. Retention Period: Treated water shall be retained in the pipe long enough to destroy all non-spore-forming bacteria. This period shall be at least 24 hours and preferably longer as may be directed. After the chlorine treated water has been retained for the required time, the chlorine residual at pipe extremities and at other representative points shall be at least 25 ppm.

I. Chlorinating Valves and Hydrants: In the process of chlorinating newly laid water pipe, all valves or other appurtenances shall be operated while the pipe line is filled with the chlorinating agent.

J. Final Flushing and Test: Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipe line at its extremities until the replacement water throughout its length shall, upon test, both chemically and bacteriologically, prove

equal to the water quality served the public, and approved by the Public Health Authority having jurisdiction. The Contractor will supply the appropriate bacteriological sampling bottles and will collect samples. The Contractor will transport the samples to a certified local testing laboratory of the Contractor's choice. The test results shall be reported to the Contractor, Owner and Engineer.

K. Repetition of Procedure: Should the initial treatment prove ineffective, the chlorination procedure shall be repeated until confirmed test shows that water sampled from the newly laid pipe conforms to the requirement of CHLORINATION OF COMPLETED PIPE LINE.

L. Calcium Hypochlorite

1. On approval of the Engineer, a mixture of calcium hypochlorite of chlorine content and water may be substituted as an alternative for liquid chlorine.

2. Calcium Hypochlorite (comparable to commercial products known as "Perchloron:, and Maxochlor") and water shall consist of 5 percent of powder and 95 percent of water by weight.

3. This calcium hypochlorite and water mixture, first made into a paste and then thinned to a slurry, shall be injected or pumped into the newly laid pipe under conditions heretofore specified for liquid chlorine application, after preliminary flushing.

4. Provisions for final flushing, testing, and approval under this alternative shall be the same as those described previously.

M. Procedure when Cutting into Existing Pipe Lines: Unless the Engineer shall direct otherwise, cuts made in existing pipe lines for the insertion of valves, fittings, repairs, or for any other purpose shall be chlorinated by shaking a quantity of the powder, predetermined by the Engineer, into the pipe on each side of the cut-in. After slowly filling the section and reversing the flow, the chlorinated water shall be retained for several hours, then flushed until no odor of chlorine can be detected in the waste water, or preferable until a check shall have been made for residual chlorine as provided for herein.

N. Resumption of Service: After satisfactory chlorination by any of these alternative procedures, the consumers may be served from the newly laid pipe line or the service may be resumed on existing pipe line.

O. House Services: After the distribution mains have been laid, tested, and chlorinated as hereinbefore specified, all house services shall be installed as directed by the Engineer. All corporation stops and service lines that are not connected to other pipe and meters shall have the ends plugged in an approved manner to prevent water and dirt from entering the fitting or pipe. (House services will be installed only when called for on the construction documents or under the direction of the Engineer.) **Main taps for service connections shall be made under pressure after successfully testing the system. Service taps to dry mains will not be permitted.**

P. Service crossings under paved surfaces, especially State Highway, shall be jacked or dry bored.

26. CLEAN UP:

A. Where these operations are on City, State, County, or private property, the job shall be kept clean at all times. Loose dirt shall not be allowed to clog ditches or cover sidewalks. Soft clay or other undesirable material removed from the trenches shall be removed from the streets, sidewalks, or ditches. The Engineer reserves the right to demand that the Contractor's forces be diverted to this clean-up at any time the Engineer rules that condition of streets, sidewalks or private property warrants such diversion.

27. GRASSING:

A. All scarred areas shall be fertilized and seeded per State Highway Department Specifications. Seeding shall be done after all trenches are adequately compacted and level, and clean-up has been completed. A stand of grass will be required before acceptance. All scarred areas subject to erosion shall be similarly seeded.

28. MAINTENANCE OF SURFACES:

A. Maintenance: Following the certification of completion by the Engineer the Contractor shall maintain the surface of the unpaved trenches, adjacent curbs, sidewalks, gutters, shrubbery, fences, sod, and other surface disturbed for a period of 3 months thereafter, and shall maintain and repave areas (if paved by the Contractor) and adjacent curbs, gutters, and sidewalks for one year after said certifications. All material and labor required for the maintenance of the surface and adjacent structures shall be supplied by the Contractor and the work shall be done in a manner satisfactory to the Engineer.

B. Ingress and Egress: In areas where there is limited access to residences, businesses, public and private buildings, and other facilities, the Contractor shall plan his work to afford access to property abutting the Work at all times except when absolutely necessary including providing immediate backfill of pipe, shells, for temporary surfacing, and adequate signing and flagmen to control and direct traffic.

29. EROSION CONTROL:

A. Scope: These Specifications shall govern the erosion control requirements for site/grading work.

B. Materials: Materials of this Section shall be as specified herein.

C. Erosion and Property Control: Any existing sod or grass removed shall be replaced with new sod as specified therein.

1. Flow of Drains and Sewer Maintained: Adequate provisions shall be made for the flow of sewers, drains and water courses encountered during construction, and the lines and structures which may have been disturbed shall be immediately restored to their original condition at the expense of the Installer.

2. Property Protection: Trees, grass, fences, signboards, poles and all other property shall be protected unless their removal is authorized; and any property damage shall be satisfactorily restored by the Installer and at the expense of the Installer.

3. Erosion: The Installer shall at all times take necessary precautions to prevent erosion or transportation of soil due to natural or induced water flows. Spoil banks and soil stockpiles shall be contained to prevent transportation of soil by run-off waters.

30. EROSION CONTROL NETTING:

A. Erosion control netting shall be utilized in location where specifically required by the Owner/Engineer and installed in accordance with the Federal, State or local Authority having jurisdiction.

31. SILT FENCE:

A. Silt fences shall be constructed at locations approved by the Owner/Engineer and installed in accordance with the Federal, State or local Authority having jurisdiction.

32. HAY BALES:

A. Hay bales shall be native hay or any other approved material. The bales shall be securely anchored by the use of stakes and wire or other approved method.

33. EXCESS MATERIAL:

A. After backfilling, excess material shall be removed and disposed of by the Contractor off the site.

END OF CONSTRUCTION SPECIFICATIONS FOR WATER MAINS

SECTION W-3

MATERIAL SPECIFICATIONS FOR WATER MAINS

1. DUCTILE IRON PIPE:

A. **Ductile iron pipe shall be used on all projects unless otherwise directed or approved by the Owner. Minimum size of main shall be 8-inches unless approved by Owner.** Ductile iron pipe shall be Pressure Class 250 (minimum thickness class 51) and shall be manufactured and marked in accordance with AWWA C151. Unless otherwise noted in the construction documents, the pipe shall have a single gasket push on joints manufactured in accordance with AWWA C111, and interior cement mortar lining manufactured in accordance with AWWA C104, and an exterior asphaltic coating of not less than 1 mil thickness. Flanged pipe shall conform to AWWA C115. Accepted manufacturers are American Cast Iron Pipe (ACIPCO), U.S. Pipe and Foundry or approved equal.

2. PVC PIPE:

A. PVC pipe, where approved by the Owner, shall be ASTM D 2241, SDR 21 (aka Class 200 pipe). PVC pipe shall be supplied in 20 foot lengths unless otherwise specified, shall be furnished with integral bell and spigot push on joints and shall be **blue in color**. Gaskets shall be locked in. The pipe and the coupling must both be manufactured by the same company. Minimum Class 200 pipe shall conform to SDR 21 unless otherwise noted in the construction documents.

B. The pipe shall comply with ASTM D1784 for PVC compounds, ASTM D 2241 Product Standard 22 for PVC pipe, and ASTM D-3139 and F-477 for gaskets and joints. PVC pipe shall be SDR 21 Class 200.

3. RESTRAINED JOINTS:

A. Where restrained joint pipe and fittings are required, flexible push on restrained joint ductile iron pipe and fittings shall be used. All restrained joints shall be suitable for a 350 psig working pressure. Ductile iron locking segments, inserted through slots in the bell face, shall provide a positive axial lock between the bell interior and a retainer weldment on the spigot end of the pipe.

B. Restrained joints shall be US TR-Flex, American Flex Ring, or other approved equal.

C. Mechanical joint retainer glands shall be Series 1100 Megalug as manufactured by EBBA Iron.

D. Single seal gasket push-on type joints shall conform to the requirements of ANSI A21.11 and shall be Tyton, Super Bell Tite, or Altite.

4. CASING PIPE:

A. Where water mains are to be installed under railroad tracks and in some cases where they are to be installed under paved highways, they shall be laid inside a casing pipe of the size specified in the construction documents. As a general rule, the locations and approximate lengths of the encasements are indicated on the construction documents for the information of bidders, but the precise locations, length of the encasement will be specified in the permit issued by the Railroad or Highway Department involved.

B. The casing pipe shall be new and made of steel in accordance with API 5L standard weight line pipe and be provided with continuous welded joints. The casing pipe shall be jacked through a hole of the proper size that has been previously bored for the purpose, or be installed by excavating and installing liner plates as the hole is advanced. It may be installed by the continuous boring and jacking method.

C. The wall thickness of the steel casing pipe shall be 0.25" for all sizes 20" and smaller, 0.375 for sizes 24" through 36". The pipe shall be epoxy coated.

D. The contractor shall provide all casing spacers and end seals required for conventional bores. The casing spacers shall be of the polyethylene type and the end seals shall be of the slip on type.

5. FITTINGS:

A. Ductile iron fittings with retainer glands shall be provided. Ductile iron fittings shall be rated for 350 psi working pressure. Fittings shall be manufactured in accordance with AWWA C153 and provided with mechanical joints. All fittings shall be provided with a thin cement lining in accordance with AWWA C104.

B. All fittings shall be wrapped in 6 mil polyethylene encasement extending 6" beyond connection in accordance with AWWA C105.

C. Thrust restraints shall be 2500 psi concrete poured in place against undisturbed soil unless otherwise approved by the engineer.

6. VALVES:

A. All valves shall be furnished with a valve box and shall be furnished with a concrete collar. The use of a valve-nut-in-valve-box centering device is encouraged.

B. Valves for use with ductile iron pipe shall have mechanical joint end connections unless otherwise shown.

C. Gate valves shall be iron body, brass mounted, epoxy coated interior and exterior, and be of the resilient seat type. Gate valves shall have a non-rising stem, "O ring" stem seal, a square operating nut (2") and shall open by turning counterclockwise. Gate valves thru 12" diameter shall be manufactured in accordance with AWWA C509. Gate valves 12" and smaller shall be suitable for a working pressure of 250 psig and shall be tested to 400 psig.

D. Gate valves 16" and 20" shall be suitable for a working pressure of 200 psig. These large valves shall be mounted with vertical stems and shall have sufficient bury to accommodate the vertical mounting. These requirements are applicable to tapping valves. Gate valves shall be Mueller or Clow.

E. Butterfly valves shall be manufactured and tested in accordance with AWWA C504, Class 150B. Butterfly valves shall be provided with operators suitable for underground service that meet all AWWA standards.

F. Where the contract involves extensions to an existing system the Contractor shall verify the direction of opening of existing valves and if this is opposite to the direction specified herein he shall confer with the Owner and the Engineer regarding the direction of opening to be provided on the valves furnished under this contract.

G. Tapping valves and sleeves may be of the mechanical joint or hub end type, Mueller H-615 and H-667, or approved equal. Tapping valves shall be non-rising stem. Working pressure for 2"-12" valves shall be 200 psi with 400 psi test pressure. For valves greater than 12", the working pressure shall be 150 psi with test pressure of 300 psi. Valves and sleeves shall be cast tapping sleeves and valves shall be air tested for duration of 5 minute and 50 psi.

H. Air Release Valves (ARV) shall be manually operated and shall consist of a 2" corporation stop at the main, 2" type K copper tubing to a 2" curb stop housed in a standard meter box set at the nearest right-of-way line. ARVs shall be field located at high points in the water main as directed by the Engineer.

7. **VALVE BOXES:**

A. Valve boxes shall be made of cast iron and be of the two piece adjustable heavy roadway type. They shall have an inside diameter not less than 5 1/4" and be of the screwed type. They shall be provided with a cast iron cover on which the word "WATER" is embossed and shall be suitable for installation on mains laid at the depths specified elsewhere in these specifications.

B. Valve boxes shall be set vertically over the valve and centered about the operating nut. The use of a valve-nut-in-valve-box centering device is encouraged. The cover of the box shall be flush with the street or ground surface unless otherwise directed by the Engineer. Backfill shall be carefully tamped around the box to prevent it from being moved out of position. The bottom flared edge of the box shall not rest directly on the valves or pipe. A concrete block shall be installed under the box. Where the standard depth valve box is not high enough to make the cover flush with the ground surface the Contractor shall provide and install, without additional compensation, valve box riser sections of the required length to achieve this result.

C. After the valve box has been set correctly, a square or round concrete collar shall be poured around the top of the valve box. The concrete shall be neatly formed to 18" square or diameter, poured 4" thick with the surface finished parallel to the surrounding ground surfaces. The concrete shall be Class C 2500 pound mix.

8. FIRE HYDRANTS:

A. Fire hydrants shall be manufactured in accordance with AWWA C502. The main valve shall open against the water pressure and all operating threads shall be isolated from the water. Hydrants shall be Mueller Super Centurion 200, or approved equal.

B. Hydrants shall have a main valve opening of not less than 5 ¼", two 2 ½" hose connections and one 4 ½" pumper connection. Hydrants shall be provided with a permanent lubricating device and "O-ring" packing seals. Hydrants shall open by turning counterclockwise. Operating nuts shall be of the National Standard pentagon type, 1 ½" point to flat. Hydrants shall be provided with a 6" mechanical joint shoe and shall be equipped with a retainer gland follower.

C. Fire hydrants shall be sized to connect with pipelines laid with a minimum cover of 36". In cases where the standard length of hydrant is not sufficient to leave a distance of at least 18" between the ground surface and the bottom of the lowest connection, the Contractor shall provide and install an extension section of the proper length.

D. Hose and pumper connections shall be furnished with Underwriters National Standard threads in the case of hydrants to be installed in new systems. Hydrants furnished for extensions to existing systems shall be furnished with threading similar to the existing hydrants except in cases where an effort at standardization of the use of National Standard threading is being made. In these cases, the Contractor and his material supplier are required to investigate the existing conditions and to furnish hydrants equipped with the direction of opening and the type of threads desired by the Owner. Where the contract covers a new water works system, two operating wrenches and a main valve assembly wrench shall be furnished with the hydrants. These items shall be delivered to the Owner.

E. Hydrants shall be set perfectly plumb, using a spirit level on two sides of the barrel. The gravel shall be placed around the base to permit drainage from the waste opening.

F. Fire hydrants shall be factory painted in the color chosen by the Owner.

G. All fire hydrants shall be equipped with a 6" isolation gate valve. The lead pipe to the hydrants shall be 6"-diameter PC 250 ductile iron.

9. BLOW-OFF HYDRANTS:

A. Blow-off Hydrants shall be Dry Barrel Type Hydrants. The Main valve shall be open against water pressure and all operating threads shall be isolated from the water. Post Type Hydrants shall be Mueller 2 1/8" Post Type Hydrant.

B. Blow-off Hydrants shall have a main valve opening of not less than 2¼", with one 2½" hose connection. Hydrants shall be provided with a permanent lubricating device and "O-ring" packing seals. Hydrants shall open by turning counterclockwise. Operating nuts shall be of the National Standard pentagon type, 1½" point to flat.

Hydrants shall be provided with a 3" mechanical joint shoe and shall be equipped with a retainer gland follower.

C. Blow-off Hydrants shall be sized to connect with pipelines laid with a minimum cover of 36". In cases where the standard length of Post Type Hydrant is not sufficient to leave a distance of at least 16" between the ground surface and the bottom of the lowest connection, the Contractor shall provide and install an extension section of the proper length. Flush Type Hydrants shall be furnished with a high strength cast iron box and cover. The location of the Flush Type Hydrants shall be marked with a water valve marker.

D. Hose connections shall be furnished with Underwriters National Standard threads in the case of hydrants to be installed in new systems. Hydrants furnished for extensions to existing systems shall be furnished by threading similar to the existing hydrants except in cases where an effort at standardization of the use of National Standard threading is being made. In these cases, the Contractor and his material supplier are required to investigate the existing conditions and to furnish hydrants equipped with the direction of opening and the type of threads desired by the Owner.

E. The hydrant lead to post type hydrants shall be made with ductile iron pipe extending from the cast iron anchoring tee installed in the main to the hydrant show regardless of the type of pipe used in the construction of the main to which the hydrant is connected.

F. Mechanical joint shoe on flush type hydrants shall be connected to one section of ductile iron pipe regardless of the type of pipe used in construction of the main to which the hydrant is connected.

G. Hydrants shall be perfectly plumb on the precast slab, using a spirit level on two sides of the barrel. Gravel shall be placed around the base to permit drainage from the waste opening.

10. FLUSH ASSEMBLY:

A. Flushing

1. All water mains shall be flushed to remove all sand and other foreign matter. The velocity of the flushing water shall be at least 4-feet per second. Flushing shall be terminated at the direction of the Engineer. The Contractor shall dispose of the flushing water without causing a nuisance or property damage. No line flushing will be performed without prior notice to and approval from the Engineer.

B. Cleaning

1. Prior to pressure and leakage testing, the interior of each main shall be cleaned of accumulation of sand and other foreign matter by pressure or hand methods. Hand cleaning methods may consist of shoveling the material and pressure cleaning with a water hose. Care shall be exercised in cleaning to prevent damage to the pipe lining.

C. Flush assemblies shall be placed at locations as shown on the construction documents or directed by the Engineer. Flush assemblies are placed to facilitate the flushing of mains that are eight-inches in diameter and larger, said flushing that requires high flows to create a velocity in the water main at 4.0 feet per second.

D. The assembly shall consist of a main size by 6" "hydrant" tee at the main, a six-inch gate valve, fittings and size of pipe to construct the assembly as detailed on the construction documents.

E. A 48" by 48", minimum, concrete slab shall be constructed to prevent wash-outs when a main is flushed.

11. SERVICE CONNECTIONS AND SERVICE RECONNECTIONS:

A. The new pipe under this project will be constructed in areas now served by small diameter pipe. The services connected to these small diameter mains shall be reconnected to the new mains. The in-place small diameter mains shall be abandoned.

B. Corporation stops shall be 3/4" size unless otherwise noted and shall comply with AWWA C800-66, Mueller H-15008, or approved equal. Corporation stops shall be compatible with type of service pipe specified.

C. Curb stops shall be Mueller Curb Ball Stop 3/4"(B-24350 R) w/quarter turn check and lockwing or Ford equivalent B-43-232 WSNQ.

D. Ductile Iron water lines are to be Direct Tapped and equipped with 3/4" H-15008 Mueller corporation stop or Ford F-1000-3Q corporation stop. Where PVC mains are approved by the Owner, service saddles shall be used to connect services to PVC mains. The saddles shall be JCM #402-0663x07CC Epoxy coated or Electro Galvanized steel straps for CL200 SDR21 PVC O.D.

E. Meters shall conform to AWWA C700-90, shall be a first line meter and shall have a hermetically sealed and magnetically driven register. All meters shall be manufactured and assembled in the United States, shall be provided with all bronze case, and shall be of the positive displacement type. Each meter shall be provided with a leak detector separate from the sweep hand, and shall be calibrated in gallons unless otherwise noted in the Special Specifications.

F. Meters shall be manufactured by Elster with ALL BRONZE cases or approved equal unless otherwise specified in the Special Specifications. Meters should also include a Meter Interface Unit for Automatic Meter Reading system.

G. Backflow preventors shall be 3/4" Mueller H14242 dual check valve, rated for 150 psig, or other approved equal, as required by the latest STATE regulations.

H. Meter boxes shall be approximately 12"x17"x12" deep, rectangular in shape, complete with plastic top and metal hinged reading lid. The plastic shall be of the fiber reinforced polyolefin type. The box and cover shall be Carson Brooks Model 1220-12.

1. Carson Brooks Jumbo - CB 1220-12B HDPE(Base) Color; Black
 2. CB 1220-6B, HDPE(Lid) Color; Black, PVC w/c.i.rdr attached via steel roll pin
- I. Water meters shall be located as indicated on the construction documents.
 - J. Service pipe used in making service connections and service transfers will be paid for separately on a unit price basis and is not included in the price of the service connection assembly.
 - K. When the service pipe is connected to ductile iron pipe 3" and larger, the connection at the main shall consist of a 3/4" tap in the main and a corporation cock. When connected to mains smaller than 3", the connection at the main shall consist of a 3/4" hole drilled in the main, a single strap service clamp and a corporation cock.
 - L. Where taps larger than 1" diameter are to be installed on ductile iron pipe, a split tapping sleeve or tapping saddle shall be provided and a disc shall be cut from the pipe wall by a special tapping machine.
 - M. When copper or plastic service tubing is used, it may be connected directly to the corporation cock.
 - N. The tap or drilled hole in the main shall be made at an angle of not more than 30 degrees to the horizontal in order to keep service pipe adjacent to the main at the required depth.
 - O. The curb stop shall be installed inside the meter box immediately adjacent to the inlet side of the meter and under general conditions the box shall be set with the top flush with the ground surface.
 - P. Where service taps are installed on ductile iron pipe, the price bid shall include wrapping the brass corporation stop and not less than three feet of connected copper service tubing with two wraps of Tapecoat dielectric insulating type to prevent corrosion.
 - Q. When the furnishing of a meter larger than 1" is called for in the construction documents, it shall include a cutoff valve with handwheel of the same size as the meter inlet, and a meter box, Carson Brooks, or equal. The box shall be 15" by 20" and equipped with a rectangular hinged reading lid set in the cover.

12. SERVICE PIPE:

- A. The service pipe to be used shall be Copper, Type K.
- B. Copper tubing shall conform to Federal Specifications WW-T-799, Type K. Unless otherwise noted in the construction documents, service pipe shall be 3/4" in diameter. The cost of fittings shall be included in the price of the pipe.
- C. Service pipe shall be laid with a cover not less than 24", and the requirements for trenching and backfilling shall be the same as specified for mains. Where the service

pipe crosses a paved street or sidewalk it shall be laid by means of pushing or boring. The cutting of pavements or sidewalks will not be permitted. The requirement for a cover of 24" over the pipe shall be maintained under side ditches and at the high point of the curve in the pipe where it connects to the main. On Highway rights-of-way the minimum cover shall be as specified by the Highway Department but in no case less than 36".

13. VALVE MARKERS:

A. Pipeline Markers - shall be installed on the pipeline alignment at a maximum of five hundred (500) foot intervals and shall be as manufactured by Carsonite.

1. CRM 306208 Stake (Blue) with
2. CFA. 400301U Curv-Flex Anchor (attached; with a CW-112 Decal (Caution: Water Pipeline) 101-P Decal(Inscription: "Integra Water 968-6323") attached.

B. Valve Markers - shall be installed adjacent to all valves and shall be as manufactured by Carsonite.

1. CRM 306201 (White) with CFA 400301U Curv-Flex Anchor attached with a CWV 116 Decal (Caution: Water Valve) 101-P Decal (Inscription: "Integra Water 968-6323") attached.

14. FLANGES:

A. Flanges shall conform to the dimensions shown in Table 10.14 of AWWA C110, and shall be adequate for a working pressure of 250 pounds. The bolt circle and bolt holes of these flanges shall match those of the Class 125 flanges shown in ANSI B161. Gaskets shall be of 1/8" thick rubber. Machine bolts shall be of high strength steel and shall have hexagon heads and nuts.

15. CONSTRUCTION EQUIPMENT:

A. The Contractor shall be responsible for any damage done to paved surfaces or lawns, whether at the site of the work or when moving the equipment from one place to another.

16. SAFETY PRECAUTIONS:

A. During the prosecution of this contract the Contractor shall at all time employ all necessary safety precautions to ensure the complete protection of both lives and property of his own forces as well as those of the general public. Flagmen shall be placed along public streets and highways as work is being installed along them and the necessary warning barricades and blinking lights shall be set out each night to clearly mark the areas under construction.

B. All ditches shall be shored and braced where necessary and the excavated material shall be kept a safe distance away from the ditch. Safety precautions instituted

along State Highway rights-of-way shall conform to the requirements as may be deemed necessary will also be provided by the Contractor.

C. The Contractor, and he alone, shall be solely responsible for the adoption of all necessary safety standards and precautions, and for the implementation institution, maintenance, supervisions of and payment for all devices and arrangements required to carry out the requirements of such standards. He shall hold and save harmless the Owner, the Engineer, or any employees thereof against all actions or suits filed in connection with any accidents or damage to property caused by inadequate or insufficient safety precautions being placed in effect by him to ensure the complete safety of all construction, inspection or supervisory forces employed around the project, or of the general public.

17. PERMITS:

A. The Contractor is responsible for applying and obtaining all permits for all Federal, State or local Authority having jurisdiction. All conditions of the permit must be met.

18. MILL CERTIFICATES:

A. When required by the Owner, mill certificates showing the results of hydrostatic pressure tests made on all types of pipe as required by the manufacturer's specifications shall be furnished.

19. EXCAVATION AND TRENCHING:

A. Trenches for the mains shall be excavated in the locations indicated on the construction documents or as directed by the Engineer. All trees, telephone and power line poles along the line of the work must be protected, and at night a sufficient number of barricades and lights to prevent accidents shall be provided. Where mains are laid between the curb and sidewalk or in other places where shrubbery and grass lawns are encountered the Contractor shall carefully remove and replace the shrubbery and cut the grass sod in sections, laying it to the side and replacing it after the compacted trench has been backfilled.

B. In general, the excavated material shall be kept clear of the sidewalks except where unusual conditions prevent this being done. Unless otherwise approved by the Engineer, all pipe shall be installed under driveways by boring and jacking, but where the driveway is cut it shall be backfilled as soon as the pipe is laid. No driveway shall remain inaccessible at the end of the day's work and all street crossings shall be backfilled and opened to traffic before work is stopped for the night.

C. On paved streets, wherever possible, the mains will be located between the curb and the sidewalk, and in all cases the mains will be located as to keep cutting and replacing pavement to a minimum.

D. The width of the trenches shall be in accordance with the manufacturer's recommended installations procedures. The depth of the trenches shall be such that all pipe will have a cover of at least 36".

E. Unless approved by the Engineer, all trenches shall be closed at the end of the workday.

F. All signs shall be re-erected in a manner satisfactory to the Engineer at the end of each workday. Signs shall be permanently re-installed back to the original condition at the end of the project.

G. All travel-ways shall be kept clean of mud, dust, dirt, or other debris. This requires a daily cleaning of travelways to the extent that dust is not a nuisance and roadways do not become hazardous.

20. INSTALLING PIPE:

A. All pipe shall be laid in accordance with procedures outlined by the Ductile Iron Pipe Research Association or Uni-Bell PVC Pipe Association. A copy of these procedures shall be kept by the Contractor on the job site at all times that pipe laying operations are occurring.

B. Before the pipe is lowered into place, the bottom of the trench shall be uniformly graded so that the pipe will have a bearing on earth for its full length. Where the excavation is in rock or other hard material, sufficient loose earth shall be shoveled into the trench to form a bed for the pipe. Each section of pipe shall be carefully examined for defects and the inside cleaned with a swab to remove all dirt and mud before it is installed.

C. At each joint shall be excavated a hole sufficient large to receive the bell or coupling so that the pipe barrel will rest uniformly in its bed of loose earth. Where pipe equipped with joints of the push on type utilizing a rubber ring is used, the bell shall be wiped clean before the ring is fitted into position, following which the spigot shall be coated with a thin film of lubricant, if so required by the manufacturer, and then pushed home.

D. On iron pipe equipped with mechanical type joints, before the section of pipe is pushed home the bell into which it fits shall be wiped clean, the end of the pipe being placed shall be wiped with a soapy water solution and the cast iron gland and rubber ring slipped on. After the section of pipe is in its final position, the rubber ring and gland shall be slid up to the joint, bolts inserted and the nuts tightened uniformly so that the bolts, particularly on the under side, shall be provided. In the case of pipe smaller than 4" in diameter being laid in a wet or muddy ditch bottom, the Contractor will be permitted to joint not more than 100 feet together on the ditch bank provided that the pipe is then carefully lowered into position with one man at each joint to preserve the alignment.

E. Where pipe laying is suspended at the lunch hour, at night, during inclement weather or at any other time, the open end of the pipeline shall be provided with a plug in order to prevent the entrance of dirt, mud and animals.

F. All fittings installed in the mains and the ends of all dead end lines shall be restrained by pouring a concrete block as shown on the drawings at the point where it will resist the pressure. Thrust blocks will be sized in accordance with the Design &

Construction or Thrust Restraint Design for DUCTILE IRON PIPE published by Ductile Iron Pipe Research Association.

21. INSTALLING APPURTENANCES:

A. Valves, fittings, hydrants and other appurtenances shall be placed in the locations shown on the construction documents or in the manner designated by the Engineer. Any omission of these appurtenances shall be corrected by the Contractor without additional cost to the Owner. All valves and hydrants shall be carefully examined to see that the working parts are in good order and that no grit or dirt is present in the valve seats before they are placed in position.

B. Over each valve less than 16" in size shall be placed a valve box, and over valves 16" and larger shall be provided a valve box both for the main valve and the bypass valve. Valve boxes shall be set concentrically around the valve operating nut and the top of the box shall be level with the ground surface.

22. GRAVEL ROADS:

A. Surfaces of all gravel roads where water lines are laid shall be brought back to their original condition on the same day they are disturbed. If necessary, additional base material as specified in the construction documents shall be spread, smoothed and compacted to the satisfaction of the Engineer.

23. SERVICE TRANSFERS (RECONNECTIONS):

A. Where an item for service transfer or service reconnections is provided in the construction documents, the Contractor will be required to make a tap in the new main, insert a corporation cock in the case of ductile iron main or set a tapping saddle in the case of PVC main, install sufficient service pipe to reach the existing service tubing as shown by the construction documents, furnish reconnect brass and all materials as specified herein.

B. When the new main has been hydrostatically tested, flushed and successfully chlorinated the new service pipe shall be flushed and chlorinated with water from the new main. The service shall be disconnected from the main to be abandoned and the new service tubing shall be connected to the existing tubing serving the in-place meter.

24. SURFACE OBSTRUCTIONS:

A. Each building, wall, fence, pole, bridge, railroad, driveway or other property or improvement encountered is to be carefully protected from all injury, and in the event that any of the foregoing are damaged or removed during the progress of the work the same shall be repaired or replaced within a reasonable time, and before final acceptance of the work shall be returned to as good condition as before the work started. Special care must be exercised in trenching under or near railroads in order to avoid or minimize delays and the danger of injury resulting therefrom, and the Contractor must use care in all phases of the construction work, for he will be held liable for damages caused by carelessness.

25. SUBSURFACE OBSTRUCTIONS:

A. In excavating, backfilling and laying pipe care must be taken not to remove, disturb or injure any water or sewer pipes or other conduits or structures. If necessary, the Contractor, at his own expense, shall sling, shore up and maintain such structures in operation. Before final acceptance of the work, he shall return all such structures to as good condition as before the work started.

B. When necessary, the Contractor shall give sufficient notice to the interested utility of his intention to remove or disturb any pipes, conduits, etc., and shall abide by their regulations governing such work. In the event that any subsurface structure becomes broken or damaged in the prosecution of the work, the Contractor shall immediately notify the proper authorities, and shall be responsible for all damage to persons or property caused by such breaks. Failure of the Contractor to promptly notify the affected authorities shall make him liable for any needless loss or for interference with the normal operation of the utility.

C. When pipes or conduits are broken during the progress of the work, the Contractor shall repair them at once at his own expense, or if required by the utility involved, shall pay the utility the proper charges for having such repairs made by the utility's own forces. Delays, such as would result in buildings being without service overnight or for a needlessly long period during the day, will not be tolerated, and the Owner reserves the right to make repairs at the Contractor's expense without prior notice. Should it become necessary to move the position of pipe, conduit or structure it will be done by the Contractor in strict accordance with the instructions given by the Engineer or utility involved.

D. The Owner or the Engineer will not be liable for any claim made by the Contractor based on underground obstructions being different than that indicated in these contract documents or construction documents. Where ordered by the Engineer, the Contractor shall uncover subsurface obstructions in advance of construction so that the method of avoiding them may be determined before pipe laying reaches the obstruction. Furthermore, the Contractor shall notify all utility companies involved of his intention to excavate in the locations specified and request that any underground cables be located in advance of construction work.

26. DEWATERING:

A. Water in Excavation: Water shall not be allowed in the trenches while the pipes are being laid and/or tested. The Contractor shall not open more trench than the available pumping facilities are able to dewater to the satisfaction of the Engineer. The Contractor shall assume responsibility for disposing of all water so as not to injure or interfere with the normal drainage of the territory in which he is working. In no case shall the pipelines being installed be used as drains for such water, and the ends of the pipe shall be kept properly and adequately blocked during construction by the use of approved stoppers and not by improvised equipment. All necessary precautions shall be taken to prevent the entrance of mud, sand, or other obstructing matter into the pipelines. If on completion of the Work any such material has entered the pipelines, it must be cleaned as directed by the Engineer so that the entire system will be left clean and unobstructed.

B. The Contractor shall, at all times during construction, provide and maintain ample means and devices with which to promptly remove and properly dispose of all water entering the excavation or other parts of the work and shall keep said excavation and work dry until the structures to be built therein are completed, or until the Engineers direct the Contractor to discontinue de-watering operations. Wherever judged necessary by the Engineer, the Contractor shall employ well points to insure a dry excavation.

C. The trench shall be so drained that workmen can work safely and efficiently therein. The Contractor shall dispose of the water from the work in a suitable manner without damage to adjacent property owners. It is essential that the discharge from trench pumps be led to natural drainage channels.

27. ROCK EXCAVATION:

A. Rock is defined as hard material which cannot be removed by conventional excavating equipment, including a tracked excavator.

B. Where rock is encountered in trenches, the excavation shall be carried to a depth of six inches below the barrel of the pipe; and the excavation shall be backfilled with approved firmly compacted bedding material.

C. The volume of rock paid for will be that from the bottom of the trench, at the elevations specified, or from the bottom of the rock if it lies above the bottom of the trench, to the top of the rock, the form being a prism with vertical sides, and the maximum width of the prism shall not exceed the external diameter of the pipe plus 18 inches. In no case shall any rock be left nearer than 6 inches from the outside of the pipe.

D. Where rock is encountered the Contractor shall “mattress” the trench during blasting operations and shall use all precautions necessary to protect adjacent property against damage resulting from his operations. Rock excavation in proximity to other pipes or structures shall be conducted with the utmost care to prevent damage to the existing structures, and any such damage caused shall be promptly repaired by the Contractor at his expense. Blasting operations shall not be conducted within 24 feet of installed pipe; and rock excavation shall be completed at least 24 feet ahead of pipe laying.

E. The Contractor shall be fully responsible for the protection of lines and property from any harm or damage as would result from exposure to the construction work. The Contractor shall, in all his acts and work, comply with the safety and health regulations referred to hereinabove and with all local ordinances and regulations pertaining to the work. The area of the work shall be isolated by warning signs and barricades; guards shall be stationed to prevent entry into the area; and efficient and adequate signal system shall be employed to give warning before blasting; and it shall be the responsibility of the Contractor to determine that the area is clear before the signal to fire is given. The handling, storing, loading, and firing of explosives shall be performed only by workmen experienced in blasting work. The Contractor hereby agrees to indemnify and save harmless the Owner and the Engineer against all claims, damages, and expense arising from or caused by, in any manner whatsoever, the handling, storage, or use of explosives on the work, or by any blasting on the work.

28. BLASTING:

- A. The Contractor or his insurer shall perform pre-blast surveys of all structures within 500 feet of the blasting areas to document and photograph the pre-existing conditions.
- B. The Contractor shall employ the services of a registered Professional Engineer with the applicable state with a minimum of five years experience in pipeline construction to design and approve all blasting procedures used in the removal of rock. All primary and secondary blasting shall be monitored by a registered blasting consultant to conduct daily blast noise, vibration and overpressure surveys during the progress of blasting operations. These surveys will be delivered to the Engineer daily.
- C. The Contractor is responsible for adhering to all conditions of any Federal, State or local Authority having jurisdiction. Required permits are of the Contractor's responsibility to apply for and obtain. All conditions of the permits must be met.
- D. The Contractor is reminded that he has sole and complete responsibility for the conditions on, in, or near the jobsite, including safety of all persons and property during performance of the work.
- E. The required duty of the Engineer to conduct construction review of the Contractor's performance does not, and is not intended to, include review of the adequacy of the Contractor's safety measures in, on, or near the construction site.
- F. The observation of safety provisions of applicable laws and local building and construction codes shall be the responsibility of the Contractor. The blasting consultant shall be present and supervise all blasting design, loading and shot firing at all times.

29. PIPELINES UNDER PAVEMENT:

- A. Where mains are to be laid under paved streets or parking lots, and the installation of casing pipe or the use of cast iron pipe inserted in a bored hole is not required or specified, the Contractor will be permitted to cut and replace this pavement. In the event that subsurface operations result in injury or damage to the pavement, the necessary repairs shall be made by the Contractor at no additional cost to the Owner. In the event of the pavement on either side of the pipeline trench cracking or otherwise becoming disturbed or broken due to the Contractor's operations he shall repair or replace same at his own expense and without additional compensation.
- B. Paving replacement shall conform to the construction documents. No paving replacement shall be installed without first notifying the Owner at least eight hours in advance so his representative may be present while the work is performed.
- C. All backfill under areas where paving will be replaced shall be mechanically tamped to the following densities as defined by AASHTO T-99 Standard Proctor Density:

Backfill around pipe	- 95%
Remaining Subgrade	- 95%
Select Base Material	-100%

30. PIPELINES UNDER SIDEWALK:

- A. Where pipelines are to be laid underneath paved sidewalks, the Contractor will be required to install them by means of a boring machine, auger or other suitable apparatus wherever possible, and where it becomes necessary to cut and replace the sidewalk it shall be replaced as soon as practicable after the trench has been backfilled and tamped. The replaced surface shall be 12 inches wider than the width of the trench, the excess width being equally distributed on both sides.
- B. The Contractor will receive no additional compensation for laying pipe or fittings under sidewalks.

31. CONNECTIONS TO EXISTING MAINS:

- A. Where “cut in” connection is indicated on the construction documents or directed by the Engineer, the Contractor shall connect the new mains to, and install valves in, the existing mains. These connections will normally be made in the afternoon, but where required to do so the Contractor shall be prepared to make them at night. Before any existing mains are cut the Contractor will work out a plan of procedure with the Owner, so that all customers who will be without water during the process will be notified and the valves to be closed will be located and uncovered.
- B. The Contractor will not be permitted to cut the existing main until he has everything ready to make the connection. The Contractor shall be fully and properly equipped to do the work entirely with his own resources and under no conditions shall he place himself in the position of having to borrow any material, equipment or labor from the Owner. Failure to have everything in readiness to the satisfaction of the Owner may result in a postponement of the connection.
- C. Where indicated on the construction documents, tapping sleeve and valves shall be used to make the connection. Where used, the tapping sleeve and valve shall be subjected to an air pressure test of 240 psi for 30 minutes or as directed by the Engineer.

32. PRESSURE TESTING:

- A. After the mains and appurtenances have been installed, they shall be subjected to a hydrostatic pressure test. The pressure shall be applied by a motor driven test pump and an accurate recording pressure gauge shall be provided at a suitable point on the main. The test shall be conducted at 150% of the working pressure or the rated pressure of the pipe, whichever is greater. The test pressure shall be applied for not less than three hours on uncovered pipe and for not less than eight hours on covered pipe. The test pressure must be maintained at a constant pressure and continuously recorded by a chart recorder on a chart not less than 8” in diameter.
- B. The allowable leakage for water mains shall be measured in gallons per hour per one thousand feet of pipe. Allowable leakage shall not exceed the following formula:

$$L = \frac{SD\sqrt{P}}{133,200} \quad \text{when} \quad \begin{array}{l} L = \text{Allowable Leakage, GPH} \\ S = \text{Length of Pipeline Section, LF} \end{array}$$

D = Diameter of Pipe (Nominal), Inches
P = Average Test Pressure, psig

C. The following leakage rates per 1,000 linear feet of typical pipe sizes shall not exceed the following values: Water shall be supplied to the main during the test period as required to maintain the test pressure as specified. The quantity used, which shall be compared to the above allowable quantity, shall be measured by pumping from a calibrated container. A 5/8-inch meter installed on the suction side of the pump may be used to measure the leakage for large mains when approved by the Engineer.

Pipe Diameter (D) Inches	Allowable Leakage (L) Gal/Hr.	Pipe Diameter (D) Inches	Allowable Leakage (L) Gal/Hr.
3	0.28	14	1.29
4	0.37	16	1.47
6	0.55	18	1.66
8	0.74	20	1.84
10	0.92	24	2.21
12	1.10	30	2.76

D. The Contractor shall be responsible for maintaining accurate records of each pressure test. The date, time, length of line tested, a recording of the test pressure, the times and amounts of make up water required, and a comparison of actual leakage versus allowable shall be compiled in a neat and organized format, certified by the inspector for the Owner, and delivered to the Engineer in triplicate. All pressure testing must be witnessed by the Engineer or the Owner and recorded by a continuous automatic chart recorder.

E. The Contractor shall leave a hydrant nozzle or other connection open when the pressure is first applied in order to exhaust air from the line. If no connection near the high point of the section being tested is available, he shall tap the main and install a corporation cock through which to exhaust the air.

F. All breaks, leaks or defects in the main appurtenances, dripping valve glands and hydrant gaskets shall be repaired, following which the test pressure shall be again applied. If the pressure gauge then remains steady the Contractor will notify the Engineer that the main is ready for inspection. The Contractor shall make the preliminary test and repair all defects before requesting an inspection by the Engineer.

G. In cases where the Contractor has elected to backfill the main prior to testing, it shall be his responsibility to fulfill the test requirements even if it becomes necessary to uncover any or all of the pipe in order to find the cause of a leak or other defect. Where practicable the mains shall be tested in sections not exceeding 1,500 feet in length.

33. DISINFECTION:

A. After the pipelines, valves, fittings and appurtenances have been installed and tested, they shall be disinfected in accordance with the method set forth in the latest edition of AWWA C651, and all applicable Federal, State or local regulations.

B. This procedure involves a preliminary flushing of the mains at a velocity of at least 4.0 feet per second, pumping a 50 ppm chlorine solution into the main through a corporation cock, filling the main slowly, allowing the chlorinated water to stand for 24 hours and then flushing out the main until the heavily chlorinated water has been discharged and a chlorine residual of no more than 0.2 ppm has been achieved.

C. The cost of disinfecting the mains shall be included in the price bid, and the Contractor shall provide all required equipment and the chlorinating agent. He shall also make a tap in the main at the beginning of each section to be tested and shall provide the necessary corporation cocks. The responsibility of ensuring satisfactory bacteriological samples shall be the Contractor's and he shall if necessary repeat the disinfection procedure until satisfactory results are obtained.

D. When cross connections to existing mains have been made, there is a tendency for contaminated water to gather in the main between the cross or tee and the valve on the existing main. When the new main is flushed to remove the heavily chlorinated water the valves on the cross mains shall be partly opened to allow the pressure from the distribution system to force out any contaminated water that might have gathered in these sections of the mains.

E. Water samples shall be taken by the Contractor in the presence of the Engineer or Owner. All bacterial testing shall be performed at a certified laboratory approved by the authority having jurisdiction.

34. CONNECTION TO EXISTING SYSTEM:

A. All connections to existing mains shall be made after complete disinfection of the proposed system and shall be made under the direction of the Owner. Valves separating the mains being installed from existing mains shall be operated by or under the direction of the Owner's representative. The cost of the work in making the connections shall be paid for by the Contractor.

B. In the event the proposed main is to be connected to a main which has one or more active services between the point of connection and the first existing line valve, a temporary plug or cap shall be installed on the new main until the pressure tests and disinfecting are completed. Upon satisfactory completion, the cap or plug shall be removed from both mains and the connection made with pipe which has been swabbed out with a solution of chlorine and water. The connection shall be made as swiftly as possible and any water in the ditch shall be kept below the level of the pipe. The pipeline shall then be placed in service by the Owner's personnel.

35. BACKFILLING AND CLEANUP:

A. All backfill under areas where paving will be replaced shall be mechanically tamped to the following densities as defined by AASHO T-99 Standard Proctor Density:

Backfill around pipe	- 95%
Remaining Subgrade	- 95%
Clay gravel base 4" thick	-100%

B. After the pipe has been installed and tested, the trench shall be immediately backfilled. However, the Contractor may backfill the trenches prior to testing if he so desires but in this case he will comply with the requirements for testing the mains as specified elsewhere. Where pavement or sidewalk has not been cut to lay the pipe the backfill shall be tamped around and over the pipe to a depth of 12 inches over the top of the pipe. The remaining earth may be filled in and neatly mounded over the trench. Where the pavement or sidewalk has been cut to lay the pipe the backfill shall be thoroughly tamped in six inch layers for the full depth of the trench.

C. Where the trench is excavated in rock or other hard material which remains in lumps or pieces after being excavated, dry earth shall be provided and tamped around and over the pipe to a height of 12" above the top of the pipe. No large chunks or fragments of rock shall be placed into the backfill of the ditch.

D. In places where the trench has been excavated along the side of a paved street not provided with curb and gutter or where construction operations or the weather have spread the excavated material over the surfaces of unpaved streets, the Contractor shall employ a heavy duty motor grader to clean out the side ditches, shape the shoulders and restore the smoothness of the street surface to as good a condition as existed before the work was started. In the even that excavations on the shoulders of streets indicate that washouts or collapse of the shoulder are liable to occur, the backfill shall be carefully tamped and any earth washed out prior to the date of final acceptance shall be replaced. The use of mechanical equipment for this work does not remove from the Contractor the obligation to employ hand labor for the final dressing up.

E. Before final acceptance of the work all surfaces shall be returned to as good condition as before the work started.

F. All excavated material shall be cleared from adjacent street surfaces, gutters, sidewalks, parkways, railroads, grass plots, etc., using hand labor where necessary to achieve a satisfactory result, and the whole left in a tidy and acceptable condition.

G. The Contractor shall at all times keep the backfilled trenches, particularly those across the streets and driveways, filled to grade, and shall make a daily inspection to see that those needing additional fill are attended to. He shall maintain them in a good and safe condition and will be held responsible for any connection up to the date of final acceptance of the work by the Owner.

H. Where mains are laid across State or County highways or City streets and the pavement has been cut to make the installation, the Contractor shall backfill the section under the pavement with an acceptable backfill and tamped in 6" layers for the entire depth of the trench to the densities specified above.

36. INSPECTION OF VALVES:

A. After all work has been completed the Contractor shall make a careful inspection of all valves, either previously existing or new, which have been opened or closed during the course of the work, to make sure that all valves that should be opened are open and vice versa. No valve shall be opened or closed without the consent of the Owner.

B. At the same time all valve boxes shall be inspected to make sure that they are still plumb, centered over the operating nut, at the correct elevation and the cover in position. The use of a valve-nut-in –valve-box centering device is encouraged.

END OF MATERIAL SPECIFICATIONS FOR WATER MAINS