

**SECTION 02813
IRRIGATION**

PART 1 - GENERAL

1-1. SCOPE OF WORK. The work includes all labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery, and installation of "irrigation," complete as shown on the drawings and as specified herein.

1-2. QUALITY ASSURANCE.

It is the intention of this specification to accomplish the work of installing an automatic irrigation system, which will operate in an efficient and satisfactory manner according to the workmanlike standards established for landscape installation and sprinkler irrigation operation as set forth by the California Landscape Contractors Association. The specification can only indicate the intent of the work to be performed rather than a detailed description of the performance of the work. It shall be the responsibility of the contractor to install said materials and equipment in such a manner that they shall operate efficiently and evenly and support optimum plant growth and health.

1-3. INTENT OF CONSTRUCTION DRAWINGS.

Irrigation piping and related equipment are drawn diagrammatically. Scaled dimensions are approximate only. Before proceeding with work, carefully check and verify dimensions and immediately notify the District of discrepancies between the drawings or specifications and the actual conditions. Although sizes and locations of plants and of irrigation equipment are drawn to scale wherever possible, it is not within the scope of the drawings to show all necessary offsets, obstructions, or site conditions. The contractor shall be responsible to install his work in such a manner that it will be in conformance to site conditions, complete, and in good working order.

Piping and equipment is to be located within the designated planting areas wherever possible unless specifically defined or dimensioned otherwise.

1-4. SUBMITTALS.

Prior to installation of any irrigation work, the contractor shall submit for approval, by the District, a list of all materials and equipment proposed for use. Submit catalog cuts for the following materials for approval:

Main line and lateral pipe
Gate valves
Service saddles
Air relief valves
Valve boxes
Controllers, controller cabinets and electrical GFI etc.
Anti-drain valves
Swing joints
Waterproof splices
Solvent cement
Backflow preventer & enclosure cage
Sprinkler heads (for each type)
Flush valves (for each type)
Pressure reducing valves (for each type)
Paint products
Drip irrigation components
Remote control and master valves
Flow and rain sensors

Upon 15 days after the contractor has received the District's notice to proceed, the contractor shall submit to the District three (3) typewritten lists of all materials proposed, along with the manufacturer, model number, cut sheets and source, manufacturer's specifications and other data needed to prove compliance with the specified requirements and manufacturer's recommended installation procedures which, when approved by the District, will become the basis for accepting or rejecting actual installation procedures used on the work.

1-5. GUARANTEE.

Contractor guarantees all equipment, materials, and labor furnished or performed under the contract (unless furnished by the District) against defects in design, materials and workmanship for a period of one year, unless otherwise specified, from the date of final acceptance of work.

Neither the final certificate for payment nor any provision in the contract documents shall relieve the contractor of responsibility for faulty materials or workmanship, and he shall remedy any defects due thereto and pay for any damage to other work resulting therefrom which may appear within a period of one year from the date of final acceptance of work.

1-6. PROTECTION OF WORK AND PROPERTY.

All materials and equipment shall be stored properly and protected as required by the contractor. The contractor shall be entirely responsible for damages or loss by weather or other cause to work under the contract. Materials shall be furnished in ample quantities and at such times as to ensure uninterrupted progress of the work.

The contractor shall continuously maintain adequate protection of all his work from damage, destruction, or loss, and shall protect the District's property from damage arising in connection with this contract. Contractor shall make good any such damage, destruction, loss or injury. Contractor shall adequately protect adjacent property as provided by law and the contract documents.

Prior to excavation for irrigation piping or equipment, contractor shall locate underground utility lines and take proper precautions to avoid damage to such improvements. In the event of a conflict between such lines and irrigation piping or equipment locations, contractor shall notify the District's representative and arrangements will be made for relocation as necessary. The contractor assumes responsibility for making repairs for damages resulting from work as herein specified.

1-7. POINTS OF CONNECTION.

The contractor shall verify with the District the most appropriate location and source for the water and electrical points of connection.

The electrical point of connection (if necessary) shall be made by a licensed electrical contractor per governing codes.

1-8. TEMPORARY UTILITIES

All temporary piping, wiring, meters, panels and other related appurtenances required between source of supply and point of use shall be provided by the contractor and coordinated with the District's representative. Existing utilities may be used with the written permission of the District.

1-9. CUTTING, PATCHING, TRENCHING AND DIGGINGS

The contractor shall do all cutting, fitting, trenching or patching of his work that may be required to make its several parts come together properly and fit them to receive or be received by work of other contractors shown upon, or reasonably implied by, the drawings and specifications for the completed project. Contractor shall do all that is necessary to accomplish the joining of said several parts in a neat and workman-like manner to the satisfaction of the District's representative.

Trenching shall be performed only during the period when beneficial and optimum results may be obtained. If the moisture content of the soil should reach a level that working it would destroy the soil structure, digging and trenching operations shall be suspended until the moisture level is increased or reduced to acceptable levels and the desired results are likely to be obtained.

The contractor shall not endanger any work by cutting, digging or otherwise, and shall not cut or alter the work of any other contractor without the consent of the District's representative.

1-10. USE OF PREMISES.

The contractor shall confine his apparatus, the storage of materials and the operations of his workmen to limits indicated by the law, ordinances, or permits and shall not unreasonably encumber the premises with his materials.

1-11. APPLICABLE CODES AND STANDARDS.

Wherever references are made in the contract to standards or codes in accordance with which work is to be performed or tested, the edition or revision of the standards and codes current on the effective date of this contract shall apply, unless otherwise expressly set forth. Unless otherwise specified, reference to such standards or codes is solely for implementation of the technical portions of such standards and codes.

In case of conflict among any referenced standards or codes or between any referenced standards and codes and the specifications, the District shall determine which shall govern.

1-12. CONTROLLER CHARTS.

Provide one controller chart for each automatic controller installed. Controller chart shall be blackline print of actual "as-built" drawing showing the area covered by that controller and reduced to fit in the controller cabinet. Keep reduction to maximum size possible to retain full legibility.

Identify the area of coverage of each remote control valve, using a distinctly different pastel color, drawn over the entire piping system of area of coverage.

Following approval of charts by consultant hermetically seal chart between two layers of 20 mil. thick plastic sheet.

Charts must be completed and approved prior to final walk-through of irrigation system.

The charts shall be affixed to the inside of the controller cabinet doors using an approved mastic or fastening system and in the maintenance room area, if any.

1-13. SITE OBSERVATIONS.

Site observations herein specified shall be made by the District during office working hours on each of the steps or conditions listed below. The contractor or his authorized representative

shall be on the site at the time of each observation. The contractor will not be permitted to initiate the succeeding step of work until he has received approval to proceed by the District. The contractor shall notify the District of a site observation at least 3 days in advance of an observation.

All changes and deviations to the plans and specifications by the District to the contractor shall be confirmed in writing.

The contractor shall have sufficient work personnel available during normal working hours to correct deficiencies immediately upon request of the District. Such repair or re-work services are to be performed without interference of regular project schedule.

Site observations will be required for the following parts of the work:

LANDSCAPE AND IRRIGATION PRE-CONSTRUCTION MEETING: Immediately prior to the commencement of work of this section, the District, landscape architect, and contractor shall meet for approval of the materials specified, equipment, schedule of work and the method of installation.

TRENCHING AND SLEEVING REVIEW: completion and installation of all trenching and sleeving.

PRESSURE MAIN LINE TEST: Completion of installation and testing, prior to backfilling.
LATERAL LINE TEST: completion and testing, prior to backfilling.

ADJUSTMENT AND COVERAGE TEST: Adjust and test all installed irrigation systems prior to commencement of planting operations with the exception of specimen tree planting.

PRE-MAINTENANCE OBSERVATION: Entire system shall be completely installed and operational. This observation shall be coordinated with the pre-maintenance observation of the planting installation. A written "punch" list indicating all items to be corrected and the beginning date of the maintenance period will be sent to the contractor. This is not final acceptance and does not relieve the contractor from any of the responsibilities in the contract documents.

FINAL SITE OBSERVATION AND ACCEPTANCE: At the conclusion of the maintenance period a final site observation will be made. The contractor shall show evidence that the District has received all charts, records, drawings, and extra equipment as required before final acceptance. The contractor shall show all corrections made from "punch" list. Any items deemed not acceptable shall be reworked and the maintenance period will be extended. The contractor will be notified in writing that the contract work and maintenance period has been accepted or that the maintenance period has been

extended to correct any deficiencies remaining. Final acceptance shall establish the beginning date for the guarantee period.

Site observation of the work shall not relieve the contractor of the obligation to fulfill all conditions of the contract.

1-14. DELIVERY, STORAGE AND HANDLING.

Deliver products to the job site in the manufacturer's original container or packing, with labels intact and legible. Maintain materials in original packing until time of use. Protect from damage and weathering. Promptly remove any damaged material and unsuitable items from the job site and replace with the approved required materials, at no cost to the Owner.

PART 2 - PRODUCTS

2-1 MATERIALS.

All materials shall be of standard, approved and first grade quality and shall be new and in perfect condition when installed and accepted.

The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and configuration desired only. Other manufacturer's equipment may be submitted for approval with written approval by the District. Only upon submittal and subsequent written approval of the material list shall these items be permitted. Changes to hydraulics brought about by the use of other equipment than that specified shall be recalculated by the contractor and submitted to the District for written approval. Such work shall not be installed prior to receipt by the contractor of the written approval.

Whenever such terms as "in accordance with manufacturer's specifications" is used, it shall mean in strict accordance with the manufacturer's printed directions. If those directions conflict with this specification, the matter shall be brought to the attention of the District for clarification prior to proceeding with work.

Approval of any items or substitutions indicates only that the product(s) apparently meet the requirements of the drawings and specifications on the basis of the information or samples submitted. The contractor shall be responsible for the performance of substituted items. If the substitution proves to be unsatisfactory, the contractor shall replace said items with the originally specified items, including all necessary work and modifications to replace the items, at no cost to the District.

2-2. PIPING MATERIAL. Individual types of pipe and fittings supplied are to be of compatible manufacturer unless otherwise approved. Pipe sizes shown are nominal inside diameter unless otherwise noted.

2-2.01. Brass pipe and fittings. Brass pipe shall be 85% red brass, American National Standard Institute (ANSI), schedule 40-screwed pipe. Fittings shall be medium brass, screwed 125-pound class.

2-2.02. Copper pipe and fittings. Copper pipe shall be type k, hard tempered in accordance with ASTM b 88. Fittings shall be solder type wrought copper for 2-1/2 inch and smaller pipe. Cast brass fittings shall be used for pipe over 2-1/2 inch.

2-2.03. Plastic pipe and fittings.

All pipe shall be free of blisters, internal striations, cracks, or any other defects or imperfections. The pipe shall be continuously and permanently marked with the following information: manufacturer's name or trade mark, size, class and type of pipe pressure rating, quality control identifications and date of extrusion.

Pressure mainline for piping upstream of remote control valve:

4" diameter pipe and larger: Use AWWA C-900 alertline PVC.

3" diameter and smaller: Use schedule 40 PVC, CL-315 PVC or CL-200 PVC, marked 1120-2200, and bearing the seal of the National Sanitation Foundation for potable systems.

Non-pressure lateral line for piping downstream of remote control valves: plastic pipe for use with solvent weld or threaded fittings. Shall be manufactured rigid virgin polyvinyl chloride PVC 1220 (type 1, grade 2) conforming to ASTM d 1785, class 200, SDR 21. (all 1/2" diameter pipe class 315).

Fittings and connections:

Fittings for 4" diameter pipe and larger: the fitting shall be an integral part of the pipe barrel. It shall consist of a thickened section, which has an expanded bell with groove to retain a rubber-sealing ring of uniform cross section.

Fittings for 3" diameter pipe and smaller shall be plastic manufactured rigid virgin polyvinyl chloride PVC 1220, (type ii, grade 1), conforming to ASTM d 2464 or d 2466, SCH. 40, high impact molded suitable for either solvent weld or threaded connections as required.

2-3. PIPE CONNECTION MATERIALS.

2-3.01. Threaded connections - Teflon tape or approved equivalent, UL listed.

2-3.02. Solvent weld connections - primer and adhesive solvent shall be type as recommended by manufacturer of pipe and fittings:

All cans of solvents and primers shall have labels intact and shall be stamped with the date and manufacturer. No cans dated over two years old will be permitted.

No thinning of solvent or primer in any manner will be permitted.

2-3.03. Nipples and risers:

Metallic: red brass, standard pipe size, schedule 40, ASTM b43. Composition: nominal copper content to be 85 percent (min. 83%, max. 86%), nominal zinc content to be 15 percent. Maximum allowable lead and iron content to be 0.05 percent each.

Plastic: plastic nipples and risers shall be manufactured rigid virgin polyvinyl chloride PVC, (type i, grade i), conforming to ASTM d 1784 or d 2464, SCH. 80 with molded threads.

2-4. BACKFLOW PREVENTION DEVICES.

All sprinkler irrigation systems that are using water from potable water systems shall require backflow prevention. All backflow prevention devices shall be installed in accordance with requirements set forth by local codes and the health department.

Backflow preventer device shall be brass and bronze with all bronze or stainless steel trim and all moving parts of non-corrosive materials. All parts shall be removable or replaceable without removal of the unit from the line.

Reduced pressure principle type shall be integrally fitted with a ball valve at both the inlet and outlet points.

See irrigation legend for manufacturer and model type.

Backflow preventer assembly is to be housed within expanded metal backflow preventer cage. Color to be painted green. Size as required to allow 12" minimum clearance around assembly.

2-5. PRESSURE REGULATOR.

Pressure regulator shall be a bronze body with threaded fittings and y strainer equipped with sillcock. See irrigation legend for manufacturer and model type.

2-6. BALL VALVES.

Ball valves for 3/4" through 2-1/2" shall be of PVC, block, tru-union design with HDPE seals and o-ring.

Ball valves for 3" and larger shall be gate design and shall be iron body, brass or bronze mounted awwa gate valves, and shall have a clear waterway equal to the full nominal diameter of the valve, and shall be rubber gasket, flanged or mechanical joint only, and shall be able to withstand a continuous working pressure of 150 psi. Valve shall be equipped with a square-operating nut.

All ball valves located in a valve manifold shall be the same size as the mainline (1-1/2" size minimum). Provide pipe-reducing adapters down stream of valves, as required. All ball valves in line shall be the same size as the pipe.

See irrigation legend for manufacturer and model type.

2-7. CHECK VALVES.

Swing check valves 2" and smaller shall be 200 lbs., W.O.G., bronze construction with replaceable composition, neoprene or rubber disc and shall meet or exceed federal specification WW-V- 5ld, class a, type iv.

Anti-drain valves shall be of heavy-duty virgin PVC construction with f.i.p. thread inlet and outlet. Internal parts shall be stainless steel and neoprene. Anti-drain valves shall be field adjustable against draw out from 5 to 40 feet of head shall be Hunter "hcv" or approved equal.

2-8. REMOTE CONTROL VALVES.

Remote control valves shall be electrically operated, single seat, normally closed configuration, equipped with flow control adjustment and capability for manual operation.

Valves shall be actuated by a normally closed low wattage solenoid using 24 volts, 50/60 cycle solenoid power requirement. Solenoid shall be epoxy encased. A union shall be installed on the discharge end.

See irrigation legend for manufacturer and model type. Valves shall be wired to controller in same numerical sequence as indicated on plans.

2-9. BUBBLER HEADS.

All bubbler heads shall be as indicated on the irrigation legend.

2-10. AUTOMATIC CONTROLLER.

Automatic controller shall be electric, self-contained outdoor type, wall or pedestal mounted, 120 volt, 60 cycle controller, shall be completely automatic and also be able to operate manually. Independent stations shall be adjustable from 2 to 60 minutes and the programming shall be capable of at least two (2) independent programs with at least three starts per day. Controller shall have a master switch, which shall be possible to operate each valve manually, independent of the clock, or any other valve. Automatic irrigation controller shall utilize either evapotranspiration or soil moisture sensor data and non-volatile memory shall be required for irrigation system scheduling.

2-11. ELECTRICAL CONTROL WIRING.

2-11.01. Low voltage

The electrical control wire shall be direct burial type UF, no. 12 AWG, solid, single conductor, copper wire UL approved or larger, if required to operate system as designed.

Color code wires to each valve. Common wire shall be white. All master valve or fill valve wires to be blue. All spare wires to be solid red.

If multiple controllers are being utilized, and wire paths of different controllers cross each other, both common and control wires from each controller to be of different colors.

Control wire connections and splices shall be made with Rainbird Pentite connectors, or similar dry splice method. Control wire splices: allowed only on runs of more than 300 feet.

2-11.02. High voltage

Shall be of type as required by local codes and ordinances.

Shall be of proper size to accommodate needs of equipment it is to serve.

2-11.03. Wire markers: white, self-laminating, vinyl-impregnated cloth with printed letters and numerals. Legend color: black. Background color: white. Minimum dimension of complete marker: 3/4" by 1-1/2". Markers shall be insta-code pcm series as manufactured by Panduit Corp. or equal.

2-11.04. Tracer wires: shall be no. 14 direct burial plastic coated copper wires. Wire shall be of color not used to wire valves.

2-12. VALVE BOXES AND MATERIALS.

Valve boxes: valve boxes shall be constructed of ABS (acrylonitrile butadiene styrene) plastic, green in color, with rigid base and sides and shall be supplied with bolt lock cover secured with stainless steel bolts. Cover shall be identified as shown on plans. Provide box extensions as required.

For gate valves and wire stub boxes use 12" diameter box. For control valves 3/4" to 2", use Carson #1419 - 13b box. For drip assemblies use #1419 - 13b. Install per details.

2-13. CONCRETE THRUST BLOCKS.

Size for average safe soil-bearing load of 700-lbs./sq. Ft.

2.14. EQUIPMENT TO BE FURNISHED TO DISTRICT

As a part of the contract, the contractor shall supply the following extra equipment at the conclusion of the maintenance period. A signed receipt by the District will be required at the time of final acceptance.

Two (2) sets of keys for each automatic controller.

Three (3) sets of special tools required for removing, disassembling and adjusting each type of bubbler and valve supplied on this project.

Four (4) bubblers of each type used.

2-15. INCIDENTAL MATERIALS AND EQUIPMENT.

Furnish all materials and equipment not specified above which are necessary for completion of the work as intended.

2-16. MAINLINE BEDDING SAND.

Sand shall consist of natural or manufactured granular material, free of organic material, mica, loam, clay or other substances not suitable for the intended purpose.

PART 3 - EXECUTION

3-1. PREPARATION AND SITE REVIEW.

Contractor shall consult all other relevant specification sections to determine the extent and character of work specified elsewhere but related to the irrigation system.

Contractor shall be responsible for scheduling and coordinating to facilitate the most expeditious completion of the project in a workmanlike manner, including all required irrigation utility connections with other project trades.

Contractor shall obtain all information pertaining to locations of all existing and proposed utilities, lines, and appurtenances prior to irrigation installation. Section 4216/4217 of the government code requires a dig-alert identification number be issued before a "permit to excavate" will be valid. For your dig-alert i.d. number call underground service alert toll free 811 two working DAYS BEFORE YOU DIG.

Unsatisfactory Surface Conditions. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected and approved.

3-2. LAYOUT AND VERIFICATION.

Locations and drawings are diagrammatic and approximate only. Actual work shall be changed and adjusted as necessary and as directed to meet existing conditions and obtain complete water coverage.

Contractor shall stake out locations of all pipe, valves, equipment and irrigation heads and emitters using an approved staking method and maintain the staking of the approved layout in accordance with the drawings. Verify all horizontal and vertical site dimensions prior to staking of heads. Do not exceed spacing shown on drawings for any given area. If such modified spacing demand additional or less material than shown on the drawings, notify the District before beginning any work in the adjacent area.

Minor changes in locations of the above from locations shown shall be made as necessary to avoid existing specimen tree planting or proposed piping, utilities, structures, etc. At the contractor's expense or when directed by the District.

The contractor shall be held responsible for relocation of any items without first obtaining the District's approval. The contractor shall remove and relocate such items at his expense if so directed by the District.

Before starting work on irrigation system, carefully check all grades to determine that work may safely proceed, keeping within the specified material depths. The contractor shall be aware of the fact that the drawings are based on horizontal dimensions. Actual measurements taken along the slope of a bank will differ from those shown on the drawings. Mow curbs and specimen trees shall be in place before installation of irrigation system.

No fittings shall be installed on pipe underneath pavement or walls. If such a need should occur, the contractor shall notify the District before beginning any work.

All changes shall be recorded on the redline "as-built" blueprint on Friday of every week.

3-3. TRENCHING.

Perform all trenching and excavations as required for the installation of the work included under this section, including shoring of earth banks to prevent cave-ins. Trench, backfill, and compact in accordance with provisions of section 02221.

Make trenches for mains, laterals and control wiring straight and true to grade and free of protruding stones, roots or other material which would prevent proper bedding of pipe or wire.

Excavate trenches wide enough to allow a minimum of 4" between parallel pipe lines and 8" from lines of other trades. Do not install irrigation lines directly parallel or vertically over one another. Maintain 3" vertical clearance between irrigation lines. Minimum transverse angle is 45 degrees. All pipes shall be serviced or replaced without disturbing the other pipes.

Trenches for pipelines shall be made of sufficient depth to provide the minimum cover from finished grade as follows:

Pressure main line: 18" below finish grade and 24" below paved areas in SCH. 40 PVC sleeves, 3" dia. or smaller; 36" below finish grade, 4" dia. or larger.

Lateral lines: 12" below finish grade and 18" below paved areas in SCH. 40 PVC sleeves.

Control wiring: to the side of pressure mainline and 24" below paved areas in SCH. 40 PVC sleeves.

Trenching within "drip line" of existing trees shall only be by written approval of the District prior to start of trenching operations.

When trenching through areas where imported soil has been spread, deposit imported soils on one side of trench and subsoil on opposite side. Replace imported soil at the top when backfilling trench.

Trenches through paved areas shall be resurfaced with same material of same quality as existing material as part of contract. Piping may be installed under existing pavement by jacking, boring, or hydraulic driving except, no hydraulic driving will be permitted under asphalt concrete pavement. Where cutting or breaking of existing pavement is necessary, secure permission from the owner before cutting or breaking pavement, and then make necessary repairs and replacements to the approval of the owner.

3-4. PIPING ASSEMBLY.

3-4.01. General.

Install assemblies and pipe to conform to respective details and where shown diagrammatically on drawings, using first class workmanship and best standard practices as approved. All fittings that are necessary for proper connections such as swing joints, offsets, and reducing bushings that are not shown on details shall be installed as necessary and directed as part of the work.

Do not install multiple assemblies on plastic lines. Provide each assembly with its own outlet.

Dielectric bushings shall be used in any connections of dissimilar metals.

Carefully inspect pipe and fittings before installation, removing all foreign materials as necessary. Install pipe with markings up for visual inspection.

3-4.02. Brass pipe.

Cut brass piping by power hacksaw, circular cutting machine using an abrasive wheel or hand hacksaw. Cut no piping with metallic wheel cutter of any description. Ream and remove rough edges of burrs so smooth and unobstructed flow is obtained.

Carefully and smoothly place on male thread only. Tighten screwed joints with tongs or wrenches, caulking is not permitted.

3-4.03. Copper pipe.

Copper pipe shall be made with sweated solder joints. Before jointing, the end of the pipe (to the depth of the fitting) and the interior of the fitting shall be buffed to a bright finish and coated with solder flux. A continuous solder bead shall show around the joint circumference after soldering. Copper pipe shall be joined to steel galvanized pipe with a dielectric union.

3-4.04. Galvanized steel pipe.

Cut galvanized steel iron pipe by power hacksaw, circular cutting machine using an abrasive wheel, or hand hacksaw. Ream and remove rough edges or burrs so smooth and unobstructed flow is obtained.

Carefully and smoothly place on male thread only. Tighten screwed joints with tongs or wrenches. All threaded pipe connections shall be made using Teflon tape applied to male threads only.

Metal to non-metallic connection shall be couplings of the same material as the metallic item or as shown on detail.

3-4.05. Plastic pipe

Gasketed plastic pipe: pipe to pipe joints or pipe to fittings shall be made in accordance with manufacturer's specifications.

Solvent weld or threaded plastic pipe:

Installation of all pipe and fittings shall be in strict accordance with manufacturer's specifications.

Because of the nature of plastic pipe and fittings, exercise caution in handling, loading and storing, to avoid damage. All pipe and fittings shall be stored under cover until used. Transport only on a vehicle with a bed long enough to allow pipe to lay flat to avoid undue bending and concentrated external load. Any pipe that has been dented or damaged shall be discarded until damaged section is cut out and rejoined with coupling.

Pipe shall be cut using approved PVC pipe cutters only. Sawed joints are disallowed. All field cuts shall be beveled to remove burrs and excess before gluing.

Pipe ends and fittings shall be lightly sanded & wiped clean before welding solvent is applied. Welded joints shall be given a minimum of 15 minutes to set before moving or handling. Excess solvent on the exterior of the joint shall be wiped clean immediately after assembly.

Plastic to metal connections shall be made with plastic adapters and if necessary, short (not close) brass threaded-nipples. Work the metal connection first. Connection shall be made with four (4) wraps of Teflon tape or non-hardening pipe dope and hand tightened plus one turn with a strap wrench.

Pipe shall be assembled and welded on the surface. Cure all joints per manufacturer's recommendations before placing into trench. All joints must cure at least 24 hours before permitting water through pipe.

Snake pipe horizontally in trench to allow one (1) foot of expansion and contraction per 100 feet of straight run.

Threaded pipe joints shall be made using Teflon tape. Solvent shall not be used with threaded joints. Pipe shall be protected from tool damage during assembly. All damaged pipe shall be removed and replaced. Take up threaded joints with light wrench pressure.

No close nipples or risers are allowed. Cross connections in piping is disallowed.

Center load pipe with small amount of backfill to prevent arching and slipping under pressure. Other than this preliminary backfill all pipe joints, fittings and connections are to remain uncovered until successful completion of hydrostatic testing and written approval.

3-5. FLUSHING AND TESTING.

Do not allow or cause any of the work of this Section be covered up or enclosed until it is inspected, tested and approved.

3-5.01. Flushing.

Openings in piping system during installation are to be capped or plugged to prevent dirt and debris from entering pipe and equipment. Remove plugs when necessary to flush or complete system.

After completion and prior to the installation of any terminal fittings, the entire pipe line system shall be thoroughly flushed to remove dirt, debris or other material.

3-5.02 Testing.

After flushing, the following tests shall be conducted in the sequence listed below. The contractor shall furnish all equipment; materials and labor necessary to perform the tests and all tests shall be conducted in the presence of District's representative.

Water pressure tests shall be performed on all pressure mainlines and lateral lines before any couplings, fittings, valves and the like are concealed.

Immediately prior to testing, all irrigation lines shall be purged of all entrapped air or debris by adjusting control valves and installing temporary caps forcing water and debris to be discharged from a single outlet.

Test all pressure mainline at 150 psi. For a minimum of four (4) hours with an allowable loss of 5 psi. Pressure and gauges shall be read in psi. And calibrated such that accurate determination of potential pressure loss can be ascertained.

Test all non-pressure pipes at 100 psi. For a minimum of two (2) hours with an allowable loss of 5 psi.

Re-test as required until the system meets the requirements. Any leaks, which occur during test period, will be repaired immediately following the test. All pipe shall be re-tested until final written acceptance.

All materials and installation procedure used for making corrections are to be the same as specified herein.

3-6. PIPE BACKFILLING AND COMPACTING.

Irrigation trenches shall be carefully backfilled with material approved for backfilling and free of rocks and debris one (1) inch in diameter and larger.

Under no circumstance is pipe to rest on concrete, rock, wood blocks or similar items.

Backfill shall be compacted with approved equipment to 90% maximum density. Finish grade of all trenches shall conform to adjacent grades without clips or other irregularities. Dispose of excess soil or debris off site at contractor's expense.

Restore all surfaces and repair existing underground installations damaged or cut as a result of the excavation to their original condition, satisfactory to the District's representative.

Any settling of backfill material during the maintenance or warranty period shall be repaired at the contractor's expense, including any replacement or repair of soil, lawn, and plant material or paving surface. Surface drainage flows shall be maintained by design.

3-7. INSTALLATION OF EQUIPMENT.

3-7.01. Backflow preventer.

Install per details at location designated on the plans and with approval of District's representative.

All tests and certificates required for operation shall be performed by the contractor at his cost.

Pressure regulator: Install as shown on detail at locations designated on drawings. Set regulator for required psi per manufacturer's specifications.

Gate valves: Install as required at locations designated on drawings in a valve box.

Check valves: Install as shown on detail at locations necessary to prevent low head run off.

3-7.02. Remote control valves.

Install as shown on detail at locations designated on plans and house each valve in an individual box. Group valves together where practical and locate in shrub areas.

Valve manifolds and quick-coupling valves shall be separate allowing use of a quick coupler with all remote control valves shut off.

Review all valve box locations with District's representative prior to installation of valves. Install boxes no farther than 12" from edge of paving and perpendicular to edge of paving and parallel to each other. Allow 6" clearance between adjacent boxes.

3-7.03. Bubbler heads.

All mainlines and lateral lines, including risers, shall be flushed and pressure tested before installing bubbler heads, after which a water coverage test shall be performed.

Install specified bubbler heads as shown in details at locations shown on the plans. Adjust layout of bubblers as necessary to ensure adequate access of rootball to water.

3-7.04. Irrigation controllers.

Install as per manufacturer's instructions and/or detail, where indicated on the plans. District's representative shall approve location before installation.

Remote control valves shall be connected to controller in numerical sequence as shown on the plans.

Controller shall be tested with complete electrical connections. The contractor shall be responsible for temporary power to the controller for operation and testing purposes.

Connections to control wiring shall be made within the pedestal of the controller. All wire shall follow the pressure main insofar as possible.

Electrical wiring shall be in a rigid PVC plastic conduit from controller to electrical outlet. The electrical contractor shall be responsible for installing all wiring to the controller, in order to complete this installation. A disconnect switch shall be included.

Inside the controller cabinet, the letter of the controller as designated on the plans, shall be painted on with black or white oil base enamel paint.

3-7.05. Wiring.

Low voltage

Control wiring between controller and electrical valves shall be installed in the same trench as the mainline where practical. The wire shall be bundled and secured to the lower quadrant of the trench at 10-foot intervals with plastic electrical tape.

When the control wiring cannot be installed in same mainline trench it shall be installed a minimum of 18 inches below finish grade and a bright colored plastic ribbon with suitable markings shall be installed in the trench 6 inches below grade directly over the wire.

An expansion loop shall be provided every 500 feet in a box and inside each valve box. Expansion loop shall be formed by wrapping wire at least eight (8) times around a $\frac{3}{4}$ " pipe and withdrawing pipe.

Provide one control wire to service each valve in system.

Provide one common wire per controller.

Run two (2) spare #14-1 wires from controller along entire mainline to last electric remote control valve on each and every leg of mainline. Label spare wires at controller and wire stub to be located in a box.

All control wire splices not occurring at control valve shall be installed in a separate splice valve box.

Wire markers (sealed, 1" to 3" square) are to identify control wires at valves and at terminal strips of controller. At the terminal strip mark each wire clearly indicating valve circuit number.

High voltage wiring for automatic controller

All electrical work shall conform to local codes, ordinances and any authorities having jurisdiction. All high voltage electrical work to be performed by licensed electrician.

The contractor shall provide 120-volt power connection to the automatic controller unless noted otherwise on plans.

3-7.06. Valve boxes.

Install one valve box for each type of valve installed as per the details.

Gravel sump shall be installed after compaction of all trenches. Final portion of gravel shall be placed inside valve box after valve is backfilled and compacted.

Heat-brand valve number and controller letter on top of valve box lid.

3-7.07. Tracer wire.

Tracer wire shall be installed with non-metallic plastic irrigation mainlines where controller wires are not buried in the same trench as the mainline.

The tracer wire shall be placed on the bottom of the trench under the vertical projection of the pipe with spliced joints soldered and covered with insulation type tape.

Tracer wire shall be of a color not used for valve wiring. Terminate wire in a valve box. Provide enough length of wire to make a loop and attach wire marker with the designation "tracer wire".

3-8. ADJUSTMENT AND COVERAGE TEST.

3-8.01. Adjustment.

The contractor shall flush and adjust all bubblers and all other equipment to ascertain that they function according to the manufacturer's data.

3-8.02. Coverage/Fill test.

The contractor shall perform the coverage and fill tests for the District's representative after all bubblers and dripline have been installed, flushed and adjusted. Each section is tested to provide uniform and adequate coverage of the areas serviced.

Any systems that require adjustments for full and even coverage shall be done by the contractor prior to final acceptance at the direction of the landscape District's representative at no additional cost. Adjustments may also include realignment of pipes, dripline, addition of extra heads, and changes in nozzle type or size.

The contractor at no additional cost shall immediately correct all unauthorized changes or poor installation practices.

The entire system shall be operating properly with written approval prior to any planting operations.

3-9. FINAL INSPECTION

Clean, adjust and balance all systems. Verify:

Remote control valves are properly balanced.
Heads are properly adjusted for radius and arc of coverage.
The installed system is workable, clean and efficient.

3-10. CLEAN-UP.

Clean up shall be a continuous operation throughout the duration of the work. Contractor shall be responsible for disposing of, off site, at no additional expense, any trash or debris generated by the installation of the work.

3-11. GENERAL MAINTENANCE AND THE MAINTENANCE PERIOD.

General maintenance shall begin immediately after installation of irrigation system. The general maintenance and the maintenance period shall include the following:

On a weekly basis the contractor shall keep the irrigation system in good running order and make inspections on the entire system for proper operation and coverage. Repair and cleaning shall be done to keep the system in full operation.

Records of all timing changes to control valves from initial installation to time of final acceptance shall be kept and turned over to the District at the time of final acceptance.

During the last week of the maintenance period, provide equipment familiarization and instruction on the total operations of the system to the personnel who will assume responsibility for running the irrigation system.

At the end of the maintenance period, turn over all operations logs, manuals, instructions, schedules, keys and any other equipment necessary for operation of the irrigation system to the representative of the District who will assume responsibility for the operations and maintenance of the irrigation system.

The maintenance period for the irrigation system shall coincide with the (360) day maintenance period for the landscape plant materials.

END OF SECTION