

SECTION 17 IRRIGATION SYSTEM

17.01 DESCRIPTION

This work shall consist of furnishing all the labor, materials, tools, and equipment necessary to construct and complete in an efficient and workmanlike manner the installation of an irrigation system in accordance with the approved plans and these specifications.

17.02 GENERAL

A. Purpose

It is the intention of these specifications to accomplish the work of installing a sprinkler system, which will operate in an efficient manner and provide adequate coverage. The plans indicate the general arrangement of piping and equipment, and do not necessarily indicate all offsets, fittings and accessories that may be required. The Contractor shall furnish incidental materials and labor not specifically called for but required to complete the work.

B. Details

Pipe lines shown parallel on the drawing may be placed in a common trench, providing that a minimum horizontal distance of 6 inches is maintained between buried lines. Discrepancies in dimensions or sizes of areas to be irrigated shall be brought to the attention of the City Engineer, prior to submission of bid. After such time, intent of City will govern all discrepancies.

C. Damage by Leaks

The Contractor shall be responsible for damages to any property or work caused by leaks in the piping systems being installed. He shall repair, at his expense, all damages so caused. All repair work shall be done as directed, and in a manner satisfactory to the City Engineer.

D. Protection

The Contractor shall be responsible for any damage to this work, which occurs before final acceptance. He shall securely cover all openings into the systems and protect all apparatus, equipment and appliances, both before and after being set in place, to prevent obstructions in the pipes and breakage, misuse or disfigurement of the apparatus, equipment or appliance. Contractor shall be responsible for damage to all existing utilities and existing facilities (buildings, turf, and landscape areas, paving, etc.), whether or not they are indicated on drawings.

E. Equipment List and Drawings

Within 15 days following notification of award of the contract, the Contractor shall submit to the City Engineer for approval a list of equipment and material, which he proposes to furnish and install. The list shall be complete as to name of manufacturer, size and catalog number of unit, and shall be supplemented by such other data as may be required, including detailed scale drawings,

plumbing, and wiring diagrams. All of the above data shall be submitted in accordance with Section 2 of the City of West Sacramento Design Standards.

Prior to acceptance of the work, the Contractor shall submit an “As Built” plan showing in detail all construction changes, especially completed schematic circuit diagram.

F. Guarantee

1. The entire sprinkler system shall be unconditionally guaranteed by the Contractor as to material and workmanship, including settling or backfilling areas below grade for a minimum period of one-year following the date of final acceptance of the work.
2. If, within one year from the date of final acceptance of the work, settlement occurs and adjustments in pipes, valves and sprinkler heads, sod or paving is necessary to bring the system, sod or paving to the proper level of the permanent grades, the Contractor, as part of the work under this contract, shall make all adjustments without extra cost to the City, including the complete restoration of all damaged planting, paving or other improvements of any kind.
3. Should any operational difficulties in connection with the sprinkler system develop within the specified guarantee period which in the opinion of the City may be due to inferior material and/or workmanship, said difficulties shall be immediately corrected by the Contractor to the satisfaction of the City at no additional cost to the City, including any and all other damage caused by such defects.

G. Standard of Installation

Material and workmanship shall be in accordance with local codes and ordinances of legally constituted authorities, except where provisions of these Specifications exceed such requirements, these Specifications shall govern.

H. Personnel

All layout, installation, and work relating to the irrigation system shall be performed by personnel experienced in the trade and under the supervision of a Certified Landscape Technician.

17.03 CENTRAL CONTROL SPECIFICATIONS

A. General

1. All materials furnished and installed shall be new and shall conform to the City’s Standard Specifications and Details.
2. The contractor shall organize and conduct a pre-construction meeting with representation from the Equipment Supplier, the landscape architect, and the City inspector present.

3. All materials except interconnect conductors shall have a five year limited warranty. The contractor shall submit proof of warranty to the City inspector prior to the start of the maintenance period. It shall be the contractor's responsibility to obtain the necessary warranty inspections from the equipment supplier. No installation will be accepted without proof of warranty.
4. All new computerized irrigation control system components installed as shown on the plans shall be fully operational prior to final acceptance.
5. All incidental parts which are not shown on the plans or specified herein and are necessary to complete or modify the existing system shall be furnished and installed as though such parts were shown on the plans or in the specifications. All systems shall be in satisfactory operation at the time of completion.
6. Existing interconnect systems shall be maintained in effective operation by the contractor for the duration of the work. The contractor shall notify the City inspector a minimum of two (2) working days prior to performing any work on an existing system.
7. The contractor shall coordinate with the Telephone Company for connections to the service and/or installation of conduits, telephone conductors, jacks, and modems at the locations shown on the drawings. Minor changes caused by actual site conditions shall be made at no cost to the City. All changes to plans shall be approved by the City Parks and Community Services Director, and the City Engineering Division.
8. Landscape and irrigation plans shall be submitted in digital format to the City prior to final acceptance.
9. Soil classification and maintenance schedule recommended by the landscape architect shall be provided to the City prior to final acceptance.

B. Products

General

All product part numbers listed in this section are as supplied by United Green Tech (UGT) unless otherwise noted. "Approved equal" parts may be used only with prior approval of the City Parks and Community Services Director and the City Engineering Division.

1. Conduit

- a. All central control system interconnect conduit and fittings shall be PVC schedule 40, 1 inch in size, unless otherwise noted.
- b. All telephone service interconnect conduit and fittings shall be as approved by the local telephone company.

2. Conductor

- a. The communication cable as required from the submaster satellite assembly to the other satellite assemblies on line shall be a 4-conductor shielded cable (part #EV-CAB-COM). Communication cable may be used to link satellites up to 5,000 feet in length from each other. Cable shall be installed in a 1-inch PVC schedule 40 conduit.
- b. The flow sensor wire as required from the flow sensor into the satellite assembly enclosure shall be a 2-conductor shielded cable (part #EV-CAB-SEN). The sensor cable may be used to connect the flow sensor to a satellite up to 2,000 feet in length from each other. Cable shall be installed in a 1-inch PVC schedule 40 conduit.
- c. All conductors shall be the same type and size shown on the drawings as required for proper operation of the system.

3. Wire Splices

- a. Conductors shall be installed with NO UNDERGROUND splices unless absolutely necessary and unavoidable. Any and all underground splices that are required to be made must be approved by the City inspector and shall be placed in a suitable type 14 inch by 19-inch valve box for easy access.
- b. Wire splices on the communication or sensor cable shall be made with a splice kit (part # ETS-SPLICE)

4. Pull Boxes

- a. Pull boxes shall be fabricated from a durable plastic material resistant to weather, sunlight, and chemical action of soil. Pull boxes shall be a minimum size of 20 inches in length, 15.25 inches in width and 12 inches in height. In paved areas, the pull box shall be concrete type with a cast iron lid.

5. Ground Rod

- a. A 5/8-inch by 8-foot ground rod, clamp and #10 wire shall be provided at every satellite location. It shall be installed within the enclosure, through the concrete, and shall not extend above the surface of the concrete more than 8 inches.
- b. All central control system equipment shall be grounded to conform to requirements of the National Electric Code, current edition as adopted by the City, and the manufacturer's specifications. No solder connections will be allowed. Resistance to ground shall be no more than 75 ohms.

6. Satellite Assembly

- a. The number and location of the satellites shall be as shown on the drawings and shall be as manufactured by Rain Master.

- b. All satellites shall be pre-assembled, hereafter referred to as a “satellite assembly”, by the equipment supplier (UGT) in a top entry (SA6 series) or metered (SA5 series) “Strongbox” stainless steel weather proof, vandal resistant, lockable enclosure manufactured by V.I.T. Products.
- c. The satellite assembly shall consist of a stainless steel enclosure, stainless steel removable backboard, interconnect terminal strips, primary power voltage surge arrester, on/off switch, a ground fault interrupt circuit, ground rod, wire, and clamp.
- d. The satellite assembly (part# SA6-RM7 or SA5-RM7 series) shall include a phone communication circuit board for communicating with the central computer by means of the telephone system.
- e. The satellite assembly (part# SA6-RM8 or SA5-RM8 series) shall include a radio communication circuit board for communicating with the central computer by means of data radio.
- f. The satellite assembly (part# SA6-RM6 or SA5 series) shall include a hard wire communication circuit board for communicating with a submaster satellite assembly (part #SA6-RM7, SA5-RM7, or SA6-RM8) when interconnected by means of hard wire (part #EV-CAB-COM).
- g. The satellite assembly (SA6-RM8) shall include a radio and dome antenna assembly (part #RDM) for line of sight communication or a radio and high gain antennae assembly (part #RHG) for non line of sight. For proper antenna selection, contact United Green Tech at (888) 434-7435.
- h. The satellite assembly (where applicable) shall include a flow sensing assembly with normally open master valve assembly option (part #FSAV series) for each point of connection (maximum of two per satellite/group) or a Dual Flow Sensing Assembly with Master Valves option (part #DFSAV series) for a single point of connection with a bypass to monitor very low and high flows.
- i. The satellite assembly (where applicable) shall include a Rain Master PRO-MAX Transmitter and built-in remote receiver with a controller access code (part #PMR) or PRO-MAX built-in receiver only with controller access code (part #PMR-CAC) which ever is applicable.
- j. The satellite assembly shall be covered by a five year limited warranty.

C. Execution of Work

1. Interconnect Conduit

- a. The interconnect conduit shall be located within the public right-of-way whenever possible. If the conduit is installed outside of the public right-of-way, an easement shall be provided to the City prior to installation.
- b. Conduit runs shall be installed as shown in the approved plans. Any changes shall be approved by the Parks Manager and the City Engineer prior to installation.

- c. The ends of the conduits, whether shop or field cut, shall be reamed to remove burrs and rough edges. Cuts shall be made square and true.
- d. The ends of the conduit shall be capped until the pulling of wiring is started.
- e. Conduit bends, except factory bends, shall have radii of not less than six times the inside diameter of the conduit.
- f. Conduit shall be installed at a depth of not less than 18 inches below finished grade.
- g. Conduit shall be free of soil and debris.
- h. A nylon or polypropylene pull rope with a minimum tensile strength of 500 pounds shall be installed in all conduits, which are to receive future, interconnect cable. At least 2 feet of pull rope shall be extended beyond each end of the conduit run and secured.

2. Interconnect Conductors

- a. All interconnect conductors shall be pulled by hand.
- b. A total of 3 feet of cable shall be left at each satellite assembly and pull box. Sufficient slack shall be left to allow the wire to extend 18 inches above the top of the pull box grade.
- c. The interconnect wire shall be continuous from satellite to satellite. All splices shall occur within the satellite enclosure unless specifically authorized by the Parks Manager and the City Engineer. Splices shall be capable of satisfactory operation under continuous submersion in the water.

3. Pull Boxes

- a. Pull boxes shall be installed at intervals not to exceed two hundred feet and at all changes in direction and where the conduit crosses a roadway, bridge or railroad track (with a 36-inch loop inside the box).
- b. Pull boxes shall be installed in area to be landscaped whenever possible.
- c. The bottom of the pull box shall be bedded in crushed rock six inches deep prior to installation of the interconnect cable.

17.04 MATERIALS

A. Pipe and Fittings

1. Mains

Irrigation mains shall be $\frac{3}{4}$ inch or larger polyvinyl chloride pipe (PVC) Class 315, and shall be manufactured of Type I, Grade I or II, 2,000 psi design stress compound designated as PVC 1120 or 1220, and shall conform to ASTM designation D 1784 for rigid PVC compounds. It shall conform with the requirements of Commercial Standard 207-60. Pipe shall be manufactured to iron pipe size dimensions and furnish in minimum standard lengths of twenty (20) feet.

All plastic fittings shall be molded fittings manufactured of the same material as the pipe and shall be suitable for either solvent weld or screwed connections. Solvent weld type couplings and fittings shall have a pressure rating equal to or greater than that of the pipe and shall be a type recommended by the pipe manufacturer.

2. Laterals

Laterals shall be ½ inch or larger polyvinyl chloride pipe (PVC) Class 200 and shall be manufactured of Type I, Grade I or II, 2,000 psi design stress compound designated as PVC 1120 and shall conform to ASTM designation D1784 for rigid PVC compounds, or brass Schedule 40 B-43 threaded pipe.

PVC pipe joints and fittings shall be the same as specified for irrigation mains.

Brass pipe fittings shall be 150 psi, banded pattern. All nipples shall be of the same material as the pipe.

B. PVC Pipe Cements

1. Primer shall be IPS P-70 PVC, or equal, for all sizes of PVC pipe and fittings.
2. Cement shall be IPS 711 heavy bodied grey cement, or equal, for all sizes of PVC pipe and fittings up to 1-1/2 inch. Applicator shall be a minimum of one-half the diameter of the pipe or fittings.

C. Sprinkler Heads

Sprinkler heads shall be Rain Bird 1804-SAM with matched precipitation rate (MPR) nozzles or approved equal. They shall be constructed of plastic and stainless steel, equipped with a Seal-A-Matic (SAM) check valve.

All heads of a particular type or function in the system shall be of the same manufacture and shall be marked with the manufacturer's name and identification in such a position that they can be identified without being removed from the system. Any substitutions for items specified on the plans must be submitted for approval in writing. Subsequent approval or rejection will be given in writing.

D. Sprinkler Risers

All ½ inch riser nipples shall be threaded Schedule 80 PVC and swing joints shall be Schedule 80 PVC threaded street ells.

All 1-inch riser assemblies shall consist of swing joints rated at 200 psi and two Schedule 80 PVC nipples and one Schedule 80 nipple. See Standard Details.

E. Valves and Valve Boxes

1. Valves

Remote Control Valves (R.C.V.), Electric Solenoid Type, shall be Hydorain Series 100 or approved equal.

The remote control valve shall be 24 volts, 3.5-watt maximum, normally closed, spring loaded and diaphragm actuated. It shall have a mechanical self-cleaning internal control system. The valve shall be slow closing with no adjustments or settings required. A manual flow stem to throttle or close shall

be provided. Each R.C.V. will be equipped with a petcock. The solenoid is to be corrosion proof and molded in epoxy resin to form one integral unit. Valve shall have two inlet tappings (furnished with one plugged) and capable of being installed as either a globe or angle valve. It must have a removable seat and be completely serviceable in the field without removing valve body from the system.

Remote control valves used in drip irrigation systems shall incorporate an adjustable pressure regulator with a regulating range of 5 to 200 psi.

2. Valve Boxes

Valve boxes shall be plastic with lock snap cover, green with the word "irrigation" embossed on the cover, Brooks 1100 series or equal.

3. Gate Valves

Gate valves shall be bronze body, bronze mounted, double disc, parallel seat with non-rising stem. Valves shall have "O" ring seals and have hubs suitable for use with the main distribution pipe furnished for the sprinkler system. Size shall be as indicated on the drawings.

4. Quick Coupling Valves

Quick coupling valves shall be two-piece, one inch diameter Rain Bird 44RC with a coupler key, single lug - Rain Bird 44K or approved equal.

F. Backflow Prevention Devices

The backflow prevention device shall be a reduced pressure type device with a backflow enclosure in accordance with the Standard Detail.

G. Irrigation Controller

The irrigation system controller shall be a U.L. approved, micro-processor based, solid state unit capable of fully automatic or manual operation of the system. It shall be housed in an exterior (16 gauge) weatherproof pedestal mounted lodging case. It shall operate on 117 volts AC, 50/60 Hz power input and be capable of operating 24-volt AC electric control valves. In addition, the controller shall be equipped with or shall be capable of the following:

1. Each station shall have the capability of being individually programmed to operate from one minute to nine hours and 59 minutes, in one-minute increments.
2. It shall have a quick stations function, which allows for rapid programming of a block of stations with the same watering period.
3. It shall have three independent programs with four automatic starts per day per program.
4. Each program shall have its own percentage function which allows the watering length of all stations in the program to be changed from 0% to 300% in 1% increments and at all times be able to display the original watering length of each station.
5. Each program shall be capable of being set on either a seven day weekly repeat cycle where the active days are displayed all at once or on a skip day

basis where the user may select the number of days skipped, from one to thirty, between waterings with the starting day selectable.

6. The controller shall have a review program function, which, with one button, will sequentially bring all its programming information to the displays at a readable rate. The recall display shall be interruptable at any time for changing of the program. Each program shall provide a total duration watering time in hours and minutes.
7. The controller shall allow for setting in a “rain mode” for up to seven days after which, it will revert to the “automatic mode”.
8. Program may be protected by use of an access code.
9. Controller shall be capable of being operated manually at any time without affecting the original program.
10. The controller shall have a rechargeable battery back-up to maintain time and the user’s program.
11. The controller shall have the capability of responding to external remote control signals when coupled to a master remote control system.
12. The controller shall have a built-in self test which allows the user to check each of the following:
 - A. LED’s for lighting and shorts,
 - B. The digital display for lighting and shorts,
 - C. Each key of the keyboard for integrity and proper function, and
 - D. All station outputs.
13. Output power capacity shall be 24 VAC, 1 amp maximum, equivalent to 24VA.
14. When the IBOC battery operated controller is used, a PT2 Nicad rechargeable battery pack shall be used.

The controller shall be housed in a pedestal type enclosure installed on a Class A Portland Cement Concrete foundation as recommended by the manufacturer of the controller. Enclosure shall be a weatherproof, 16 gauge, zinc coated metal locking case to which two keys shall be provided. The controller cabinet shall include a 110-volt electrical outlet with two connections. The enclosure and accessories shall be installed in conformance with the manufacturer’s instructions and recommendations. Foundation to be minimum of 4” inches deep and sufficient width to prevent tipping.

H. Electrical

1. Control Wire

All wiring to be used for connecting the automatic controller to the electric solenoid actuated remote control valve shall be type UF-600V, solid copper, PVC insulation, single conductor, UL approved underground feeder cable. All pilot of “hot” wires are to be of one color and all “common” wires are to be white. Connecting and splicing of wire at the valves or in the field shall be made as follows: The splice shall be insulated with a 3-M Co. 3MDBY Direct Bury #09053 Splice Kit or equal. Field

splices between the controller and valves will not be allowed without prior approval of the City Engineer.

2. Pull Boxes

Pull boxes shall be installed at the locations shown on the plans or at locations designated by the City Engineer at site of work. Contractor may, at his own expense, install such additional pull boxes as may be desired to facilitate the work.

Reinforced concrete covers shall be inscribed "Irrigation 24 Volt". Covers shall be provided with two 3/8-inch brass hold down bolts with brass washers and nuts. Nuts shall be recessed below the surface of the cover. If pull boxes are set in an area subject to vehicle traffic load, they shall have a steel cover of suitable design to withstand such loads.

Top of pull box shall be set 1/4 inch above finished landscaping grade.

3. Service Unit and Meter Socket

The combination Power Company (PG&E) service and termination point for metered service shall be Tesco Class 21-000 service pedestal State or California Type 3 or equal.

4. PVC Conduit

All poly-vinyl-chloride (coded "PVC" on the Drawings) conduit shall be heavy-wall, Schedule 40, with factory made bends, couplings, and fittings; where permitted by NEC.

17.05 INSTALLATION

A. Trenching

Excavation shall be open vertical construction sufficiently wide to provide free working space around the work installed and to provide ample space for backfilling and compacting. Trenches for pipe shall be cut to required grade lines, and trench bottom shall be compacted to provide an accurate grade and uniform bearing for the full length of the line. When two pipes are to be placed in the same trench, it is required that a minimum of 6 inches be maintained between the pipes.

The excavation required for the installation of conduit, foundations, and other appurtenances shall be performed in such a manner as to cause the least possible injury to the streets, sidewalks and other improvements. All lawns or improvements disturbed in excavating shall be replaced or reconstructed with the same kind of material as that damaged or with materials of equal quality. The material from the excavation shall be placed in a position that will not cause damage or obstruction to vehicular and pedestrian traffic nor interfere with surface drainage.

The depth of trenches shall provide a minimum cover above the conduit or wiring as follows:

1. 18 inches over non-pressure lateral lines.
2. 24 inches over mainline under pressure.
3. 24 inches over pipe crossing under paving.

B. Control Wiring

1. Connections between the automatic controllers and the electric control valves shall be made with direct burial copper wire AWG-U.F. 600 volt. Pilot wires shall be a different color wire for each automatic controller.

Common wires shall be white with a different color stripe for each automatic controller. Install in accordance with valve manufacturer's specifications and wire chart. In no case shall wire size be less than #10.

2. Wiring shall occupy the same trench and shall be installed along the same route as pressure supply or lateral lines wherever possible.
3. Where more than one wire is placed in a trench, the wiring shall be taped together at intervals of 4 to 6 feet.
4. Wires installed in conduits shall not be taped together to facilitate replacement of individual wires.
5. An expansion curl should be provided within 3 feet of each wire connection and at least every 100 feet of wire length on runs more than 100 feet in length. Expansion curls shall be formed by wrapping at least five turns of wire around a one-inch in diameter pipe, then withdrawing the pipe.
6. Field splices between the automatic controller and electric control valves will not be allowed without prior approval of the City Engineer.

C. Backfilling

Backfill material shall be of native material free from lumps or stones and placed in 6 inch layers thoroughly compacted by mechanical tamping until the relative compaction is not less than 92 percent.

D. Water Service and Meter

The water service and meter shall be installed by the contractor at the location shown on the plans and shall conform to the Standard Details. Irrigation services shall include a backflow device and enclosure as shown in the Standard Details.

E. PVC/Brass Pipe

Pipe shall be cut with a fine tooth hacksaw or approved cutting tool and any burrs shall be removed. The outside surface of the pipe and the inside surface of the fittings shall be wiped with a clean cloth saturated with methyl isobutyl ketone (MIBK) to remove all dirt and moisture before the cement solution is applied. The cement solution shall be applied to the pipe and fitting socket with a brush having a width approximately one-half the diameter of pipe. The cement solution shall be applied freely with a light wiping action to spread the cement uniformly over the surfaces. The pipe surface or fitting socket shall not be rubbed with a brush any more than is necessary to spread the cement. If the cement thickens, it shall be discarded.

Immediately after the cement has been applied to the surface to be joined, the pipe shall be inserted into the fitting with a twisting motion to the full depth of the fitting socket. Immediately after joining is completed, any excess cement shall be thoroughly wiped from the pipe and fitting. The joined members shall be allowed to cure for at least 5 minutes before they are handled. In cold or damp weather, the curing period shall be increased due to slower evaporation of the solvent. An additional fitting or pipe section may be added to the completed joint within 3 minutes if care is exercised in handling so that a strain is not placed on the previous joint. The male and female pipe threads of all threaded connections on PVC pipe shall be coated with Permatex #51, or equal, pipe joint compound. Tighten fittings finger tight plus no more than one or two turns.

Except as shown on the plans, PVC pipe placed in a trench shall be laid on level, undisturbed, or well compacted, earth and solvent-weld pipe shall be snaked from side to side in the trench at intervals of approximately 50 feet. Pipe shall be held down between joints with small mounds of earth to prevent movement. After completion of the pressure tests on the pipelines and before any backfill is placed, water shall be run through the entire line until the pipe has been cooled to the supply water temperature. The trench shall be immediately backfilled, covering the pipe with soft earth to prevent damage to the pipe from rocks or clods.

Brass pipe joints shall be threaded couplings, rated at 150 psi. Threaded joints shall be made by placing Teflon tape on the male threads only. Use of thread cement or caulking to make joints tight will not be permitted. All cut ends shall be reamed to full pipe bore before assembly.

Brass pipe fittings shall be joined to the pipe in the same manner as specified for pipe joints.

F. Sprinkler Heads

Nozzles on stationary sprinklers shall be tightened after installation and sprinklers having an adjustment stem shall be adjusted on a lateral line for the proper radius, diameter and/or gallonage. They shall be set perpendicular to finished grade and shall be installed as indicated on the plans and shown in the details.

G. Valves

Provide each assembly with its own outlet; no multiple assemblies will be allowed.

Remote control valves shall be adjusted so the most remote sprinkler heads operate at the pressure recommended by the head manufacturer and so a uniform distribution of water is applied by the sprinkler heads to the planting areas for each individual valve system.

All valves shall be installed as shown in the details and in accordance with manufacturers recommendations.

H. Valve Boxes

All remote control valves, gate valves, manual angle, or globe valves shall be installed in a plastic valve box as shown in details, complete with cover, unless otherwise specified on the plans. All plastic valve boxes shall be Brooks, Ametek or Carson with locking lid installed as shown in the Standard Details.

All valve boxes shall be set ¼ inch above finish grade in lawn areas and ½ inch above finish grade in ground cover areas. Under no circumstances shall more than one remote control valve be installed in one valve box.

Valve boxes located near walks, curbs, headerboards and paving shall be installed in such a way as to allow for valve boxes to abut those items with top surface matching plane as items listed above.

I. Irrigation Controller

All controller locations are essentially diagrammatic, and shall be specifically located by the Designated Authority.

All local and applicable codes shall take precedence in furnishing of 120-volt electrical service to the Controller.

This service will be provided by others. The Contractor shall provide and install the service unit and meter socket and make the connection between the power source and the controller.

Adequate coverage and protection of the 24-volt service wire leading from the controller shall be maintained from the bottom of the controller.

17.06 TESTING

After the entire sprinkling system has been completely installed, a complete test of the entire installation shall be made by the Contractor in the presence of the City Engineer before final acceptance of the system by the City.

- A. Testing of Service Lines and Irrigation Main - Service lines and irrigation main shall be tested in accordance with applicable provisions of the Water Distribution Specifications.
- B. Testing Plastic Pipe - After all new sprinkler piping and risers are in place and connected, and all necessary division work has been completed and prior to the installation of sprinkler heads, control valves shall be opened and a full head of water used to flush out the system. After the system is thoroughly flushed, risers shall be capped off and the system pressure tested.

Request for the presence of the City Engineer in writing shall be at least 72 hours in advance of testing. All testing shall be done in the presence of the City Engineer. Apply a continuous static water pressure when welded plastic joints have cured at least 24 hours and with the risers capped as follows:

1. Test main lines and submains at 150 psi for 2 hours.
2. Test lateral lines at line pressure for 4 hours.
3. Repair leaks resulting from tests. Pressure testing shall continue until no leakage or loss of pressure is shown over the entire prescribed test period. At the conclusion of the pressure test, the heads shall be installed and tested for operation in accordance with design requirements under normal operating pressure.

C. Testing of Electrical System

Prior to acceptance of the work the Contractor shall cause the following tests to be made:

1. For continuity of each circuit.
2. For grounds in each circuit.
3. A megger test on each circuit.
4. A functional test in which it is demonstrated that each and every part of the system functions as specified or intended herein.

17.07 MEASUREMENT

The work performed under these specifications will be measured by the unit or lump sum as designated in the contract item for constructing an irrigation system.

If measured by unit, quantities of sprinkler heads, quick coupling valves, backflow preventers, etc. will be determined from actual count of the items in place in the completed work. Quantities of conduit and the various sizes of pipe will be measured by the linear foot in place in the completed work.

17.08 PAYMENT

Payment will be made at the lump sum or unit price for sprinklers, sprinkler heads, bubble heads, quick coupling valve, backflow preventers, control valves, control assemblies, turning unions, or garden valves; and the contract prices per linear foot for the various sizes and types of pipe. Full compensation for furnishing and installing swing joints and pipe used for risers shall be considered as included in the price paid for the contract item requiring the riser or swing joint and riser and no separate payment will be made therefore.

When there are no separate contract items for spray nozzles, valve protectors, valve boxes or any other materials necessary to complete the irrigation system, such materials shall be furnished and installed. Full compensation for this work and materials shall be considered as included in the prices paid for the various contract items of the irrigation system and no separate payment will be made therefore.

The above prices and payments shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals; and for doing all the work involved in installing the irrigation system, complete in place, as shown on the plans, and specified in these specifications and any special provisions, and as directed by the City Engineer, including any structure excavation, structure backfill and water involved.