

SECTION 32 84 00 – LANDSCAPE IRRIGATION**PART 1: GENERAL****1.01 Scope of Standards**

- A. This standard provides general guidance concerning the specific preferences of the Texas State University-San Marcos for Landscape Irrigation.
- B. Texas State University-San Marcos recognizes that project conditions and requirements vary, thus precluding the absolute adherence to the items identified herein in all cases. However, unless there is adequate written justification, it is expected that these guidelines will govern the design and specifications for Texas State University-San Marcos projects.
- C. WATER CONSERVATION is of paramount concern so designs must *maximize distribution uniformity* and *minimize waste* including, but not limited to, NO WATER ON STREETS OR HARDSCAPES either from direct spray or runoff.
- D. Failure to adhere to these standards will result in rejection of proposals or plans.
- E. **Designers and contractors must comply with all applicable Texas rules and standards unless these standards are more stringent.**
- F. These standards are designed primarily for Capital Projects, i.e., from the ground up. Special Project conditions can be quite variable so these standards may not be applicable or appropriate. Consult with the Director, Grounds and Waste Management (GWM), for clarification on Special Projects.

1.02 DESIGN GUIDELINES

- A. It is the intent of the Grounds Operations work group to serve as a model for large area landscape irrigation management in the State of Texas. Toward this end, designs for irrigation systems on our campus must be of high quality and demonstrate the highest level of design competency. Of course, all designs must meet all State requirements for such work but, in addition, our standards include:
 - 1. All TCEQ rules and guidelines will be followed except where Texas State Construction Standards are more stringent.
 - 2. All system design will attempt to maximize distribution uniformity (DU). The *goal* is a DU of at least 75% for rotors and 55% for sprays. To accomplish this, all factors which contribute to DU will be carefully scrutinized. These include (but are not limited to) head spacing, pressure within a zone, pressure at the section valve, the use of Pressure Regulators, and wind derating.

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3. To this end, all heads should properly spaced in each section and there should be no more than 10% pressure variance between heads within each section. **To improve distribution uniformity, head spacing should always be 90% of Manufacturers recommendations.** For example, if the Manufacturer’s recommended head spacing is 50% of diameter, the required spacing will be 45% of diameter. This will ensure a better DU and also be sufficient for wind derating in most cases. Water should still not throw beyond the perimeter of the zone so 50% of diameter may be needed in some cases.
4. All zones shall have heads with matched precipitation rates.
5. All sections are to be hydro-zoned.
6. All section designs will consider slope in the layout. Specifically, when irrigating a slope, sections should run perpendicular to the slope where possible or elevation changes must be included in hydraulic calculations for the section. . One exception to this is where pressure regulation occurs at each head or emitter. Runoff should be minimized while maximizing opportunity for infiltration. This requires the use of check valves to prevent low head drainage, including drip zones.
7. All system designs will account for elevation changes in the site as a part of design pressure calculations.
8. All landscape irrigation designs shall be clearly stamped/sealed by Licensed Irrigator (Texas) and provide a legend with all symbols used. The design pressure calculation(s) for the system’s critical head, or heads if the critical head is not clearly determined, shall be provided with the original design. If a drip zone is likely to be more “pressure challenged,” then a design pressure calculation shall be provided.
9. Sleeves shall be provided under all hard surfaces. Minimum 4” Schedule 40 PVC, extending a foot on each side and capped. Location shall be marked on surface of concrete with a brass bolt. Sleeves larger than 4” shall be SDR Class 200 or pipe with greater pressure rating than Schedule 40.
10. The designer/contractor will be responsible for verifying the Static Pressure reading for the site prior to the system design. The design pressure must be clearly indicated on the design. The “Pressure to Design To” will be shown on the design and represent the Static Pressure minus 10%. The Design Pressure provided must be lower than the Static Pressure.

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11. All projects, even Special Projects, shall have flow controlled master valves to minimize wasted water.
 12. Two-wire systems should follow manufacturer’s guidelines for required parts and installation including all grounding requirements.
- B. In compliance with the Texas State University Stormwater Management Program, mandated by TCEQ MS4 Permit, landscape contractors providing services for on-campus departments are required to follow the Texas State University Campus Standards for Turf Management. A copy of the standards is available for your review on the [Texas State Stormwater Webpage](#). These requirements are effective beginning August 1, 2016. These standards are required for all Texas State departments, as well as outside contractors who perform landscape or irrigation practices on campus, and are subject to random inspection by Texas State University.

1.03 INSTALLATION GUIDELINES

- A. The installation must follow the approved design unless changes are approved by the Director, Grounds Operations.
- B. Either a Licensed Irrigator or a Licensed Technician should be on site at all times and that person’s name and license number shall be provided to the Director of Grounds Operations prior to installation commencing.
- C. For all installations, it is imperative that the contractor maintains at the job site a separate set of plans of the project.
1. This is for the sole purpose of recording, preferably with colored pencil, “as-built” changes and diagrams of those parts of the work as required by TCEQ.
- D. At the conclusion of each project, three (3) copies of good, readable “as-built” schematics will be provided to the Owner, two being specifically labeled for the Grounds Operations Department.
1. All wires, emission devices and valves shall be located on the “as-built” plans.
 2. All pipe sizes shall be indicated, and all valves shall be located by reference to existing features. As-builts must show correct location of these.
 3. All valves on plans shall be marked to identify

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- a. Valve number to correspond to controller section
 - b. Flow in gpm of section
 - c. Valve size in inches
4. Project will not be accepted without as-builts provided.
- E. On all projects, a walk through must be done with Texas State University-San Marcos to determine conditions of the system before work begins.
1. Before final acceptance of any project where irrigation is installed or otherwise impacted, a walk through must be completed and performance testing must be approved by the Director, Grounds Operations, Texas State University-San Marcos.

1.04 DESCRIPTION

- A. The work covered by the plans and specification consists of installing a complete underground irrigation system as shown on the plans.
1. It shall include furnishing and installing piping and fittings, valves, quick-coupling valves, sprinkler heads, controller and all miscellaneous fittings and accessories needed for a complete and operating system.
 2. It is the intention of these specifications, together with the accompanying drawings, to accomplish the installation of a sprinkler system which will operate in an efficient and satisfactory manner according to the standards established for quality sprinkler irrigation.
 3. Certain construction procedures or minor equipment may have been omitted from these specifications that are necessary for the proper installation of the system.

1.05 GUARANTEE

- A. The Contractor shall guarantee the satisfactory operation of the entire system, to the extent possible, under the scope of work included in this contract.
1. The entire system on which work is to be performed shall be guaranteed to be complete and work properly for a period of one year from date of acceptance, and contractor hereby agrees to repair or replace any defects occurring within that year free of expense to the Owner, only on that work performed by him and covering materials furnished by him.

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- A. All of the existing utilities are not shown on the irrigation plans.
 - 1. The Contractor shall use reasonable care in trying to protect utilities encountered during this project. All Utilities shall be located prior to design. Any utilities damaged and requiring repair or replacement shall be the responsibility of the Contractor.

1.07 WORKMANSHIP

- A. Equipment shall be installed in accordance with the recommendations of the manufacturer and the best standard practice for this type of work. It is critical that the installation follow the design as closely as possible to result in a quality irrigation system. Variations from the design, including even slight changes in head spacing, must be approved by the Director, Grounds Operations.

1.08 WATER SUPPLY

- A. Connections shall be made to the existing water line at the location shown on the drawings. Contractor shall be responsible for tap. Connection to water supply shall be done in accordance with TCEQ regulations regarding oversight by a Licensed Irrigator, Irrigation Technician or Plumber and type of backflow prevention device (see Standards relating to backflow).
- B. When connecting to an existing irrigation system, Contractor shall be responsible for installing appropriately sized and located isolation valves so that existing system will continue to operate without interruption.

1.09 OPERATING INSTRUCTIONS

- A. The Contractor shall provide Owner's representative with instructions on the operation and maintenance of the system and all parts thereof. On completion of the work, the Contractor shall furnish to the Owner operating instructions, spare parts lists, and descriptive literature of all items installed.

1.10 AS-BUILT PLANS

- A. The Contractor shall maintain at the job site a separate set of prints of the project for the sole purpose of recording with colored pencil, "as-built" changes and diagrams of those parts of the work in which actual construction is significantly different from the contract drawings.
 - 1. At the conclusion of the project an accurate, three readable copies of the "as-built" system will be given to the Owner, two specifically labeled for Grounds Operations.

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2. All wires, sprinkler heads and valves shall be located on the “as-built” plans as well as controller, back flow prevention device and quick couplers.
3. All pipe sizes shall be indicated and all valves shall be located by reference to existing features.

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- A. The following procedure must be used to obtain approval of substitute materials as an equal:
1. To make a substitution, submit the following to the Owner:
 - a. Actual samples of each material proposed as a substitute.
 - b. Manufacturer's catalog sheet showing full specifications of each material proposed as a substitute, i.e., discharge in GPM, minimum allowable operating pressure at the sprinkler, maximum allowable spacing and distance of throw (coverage).
 - c. New Design Pressure calculations based on the proposed substitute. These pressure loss computations must prove that the proposed substitute will perform in accordance with the intent of the designed system either with the same piping and head layout design or with a change of either. (If a design change is required, drawings must accompany the request for approval of the substitute).
 2. Approval or disapproval will be based on the comparative ability of the material to fully perform all purposes and functions of mechanics and general design considered to be possessed by the specified material.
 3. Approval of a substitution shall be obtained from the Director, Grounds Operations, before construction is begun.
 4. Approval of a substitute shall not remove the responsibility to demonstrate that the final installed sprinkler system will operate according to the intent of the originally designed and specified system.

PART 2: MATERIALS**2.01 GENERAL**

- A. All materials and accessories shall be of new (unused) material.
1. Any section of pipe found to be defective before or after installation shall be replaced with new pipe.

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2. All new sprinkler irrigation equipment shall be essentially the standard product of the manufacturer.
3. All new equipment furnished shall have in-service performance records sufficient to verify published capabilities.
4. Sprinklers shall be designed to operate efficiently at the pressure, flow, and diameter of coverage indicated on the drawings.
5. All electrical components shall be UL approved.

2.02 POLYVINYL CHLORIDE PIPE AND FITTINGS

- A. All mainlines shall be schedule 40 PVC and all lateral piping shall be Class 200 (SDR-21).
 1. All piping shall be purple pipe.
 2. All main lines shall have 12” of cover minimum but no more than 18”.
 3. All piping shall meet or exceed minimum requirements of Commercial Standards CS 256-63.
 4. All piping shall be approved by the National Sanitation Foundation.
 5. All fittings shall be of the type recommended by the pipe manufacturer.
 6. Pipe shall be snaked in the trench sufficiently to permit expansion and contraction.
 7. Mainlines shall be pressure tested at 120 psi water pressure for 24 consecutive hours. This shall be verified by Owner and conducted prior to filling any trenches.

SECTION 32 84 00 – LANDSCAPE IRRIGATION**2.03 REMOTE CONTROL VALVES**

- A. Remote control valves shall be 8200 CR Series electric valve as manufactured by WeatherMatic Sprinkler Division of Telsco Industries, or approved equal.
1. The control valves shall be electrically operated, normally closed, diaphragm type, brass valves with 24 volt, 60/50 HZ solenoids.
 2. Valves shall be slow opening and closing.
 3. Valves shall have manual flow control and manual bleed.
 4. Each valve shall also have installed a WeatherMatic PRK-24 (XPR) Pressure Regulator.
 5. Each valve shall be installed with an extra three feet (3') of coiled valve wire attached to solenoid in the valve box.
 6. King Dry Conn connectors (or equal) are to be used when connecting valve wires to each solenoid except when product specifications call for something different such as on two wire systems. Two wire specs addressed separately in this document
 7. When two-wire systems are being installed, manufacturer's recommended decoders must be used.

2.04 REMOTE CONTROL VALVE WIRE

- A. Control wire shall be of the size and type recommended by the valve manufacturer, with a minimum gauge of 14 AWG.
1. Wire shall be of the direct burial type made for the irrigation industry. The successful bidder shall submit as a shop drawing a wiring diagram showing the size and amount of wire to be used.
 2. Two spare valve wires will be placed in the trench along all mainline runs.
 3. Submersion proof connectors (3M DBR/Y – 6 or comparable) will be used at each splice of direct-burial wire and placed in a valve box of sufficient size.
 4. The common wire must be of a gauge to accommodate additional amperage should more than one section be run together in the future. This

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shall be based on the maximum flow of the mainline and the number of sections of irrigation that would accommodate.

5. When two-wire systems are being installed, manufacturer's recommended wire must be used.
6. Wiring should conform to the following color code:
 - a. Red – power or “hot” wire
 - b. White – common
 - c. Blue – 2 wires serving flow meter, part of hydrometer
 - d. Green – 2 wires serving hydrometer solenoid

SECTION 32 84 00 – LANDSCAPE IRRIGATION**2.05 ISOLATION VALVES - BALL VALVES and GATE VALVES,**

- A. Isolation gate valves shall use threaded or bolted flange attachments.
- B. An isolation valve shall be installed upstream immediately in front of each remote control valve and shall be a plastic ball valve construction.
- C. All isolation valves to isolate main lines shall be Nibco, Model F-619-RW-son or approved equal. Must be iron body gate valve with resilient seat, non-rising stem with square key on 2” and larger.
- D. Isolation valves shall be designed for a minimum water working pressure of 150 psi.
- E. Location of all isolation valves shall be approved by Owner as a part of design review process.

2.06 Backflow Prevention

- A. The Model 850 Double Check Valve Assembly (DCA) as manufactured by Febco shall be used unless site conditions require other type of backflow prevention.
 - 1. The 850 Double Check Valve Assembly may be installed under continuous pressure, and must be preceded by an isolation valve and Y strainer as required by TCEQ.
 - 2. The Double Check Valve shall be located underground with location and enclosure (valve box) sized to ensure accessibility for testing and meet all applicable codes.
 - 3. Enclosure size and installation shall be approved by Owner.
 - 4. All backflow prevention devices must be tested by Licensed Backflow Prevention Device Tester when installed.

SECTION 32 84 00 – LANDSCAPE IRRIGATION**2.07 HYDROMETER - FLOW METER and MASTER VALVE COMBINATION**

- A. Each mainline shall be equipped with an automatic metering valve as manufactured by Arad Control Valves.
1. It shall be a model IS-BM-XX Hydrometer with electric pulse transmission every 10 gallons.
 2. It shall be equipped with an electric remote control solenoid (24 VAC, normally closed) with manual override.
 3. The meter shall be installed underground and down stream from the double check assembly.
 4. It should have a valve box that allows easy access for reading meter.
 5. On Special Projects, alternate devices may be required even though the ability to monitor flow and control master valve is still required. Consult with the Director, Grounds Operations, for alternates.

2.08 QUICK COUPLERS

- A. Quick coupler valve shall be manufactured by WeatherMatic Industries or approved equal. Sizes and location shall conform to plan.
1. $\frac{3}{4}$ " MIPS x $\frac{1}{2}$ " FIPS (Model QV75L)
 2. Coupler shall be located in a valve box.
 3. Isolation valve shall be installed immediately upstream of each quick coupler valve (refer to 2.06)

SECTION 32 84 00 – LANDSCAPE IRRIGATION**2.09 VALVE BOXES**

- A. Valve boxes shall be polypropylene plastic of sufficient size to allow easy access to electric valves, isolation valves, double check valves, water meters, and quick couplers and wire splices.
 - 1. Size to be approved by Texas State University-San Marcos, Grounds Operations, during the review process.
 - 2. Valve boxes will have sufficient spacing between the box and piping holes shall be covered with plastic or a sufficient material to help prevent backfill.

2.10 SWING JOINT RISERS AND NIPPLES

- A. All swing joint nipples shall be unplasticized polyvinyl-chloride.
 - 1. Hunter Preassembled Swing Joint Assemblies or similar.
 - 2. Fittings at swing joints shall be Schedule 40 threaded elbows.

2.11 ROTARY SPRINKLER HEADS

- A. Rotary sprinkler heads shall be adjustable from 30 degrees to 360 degrees with interchangeable nozzles (full circle heads where appropriate).
 - 1. Hunter MP Rotators shall be used whenever possible.
 - 2. Alternatively, sprinklers shall be Hunter PGP series or approved equal.
 - 3. Heads shall be set 4” or more from curbs.

SECTION 32 84 00 – LANDSCAPE IRRIGATION**2.12 POP-UP LAWN HEADS**

- A. Heads shall have a ½ inch female thread inlet.
 - 1. Pop-Up Series Heads shall be Hunter Pro Series, as manufactured by the Hunter Industries Incorporated or approved equal.
 - 2. Lawn Nozzle shall be MP Rotator.
 - 3. Pop-Up Sprinkler Heads shall be installed with the underside of flange flush with the finish grade.
 - 4. Heads shall be set 4” or more from curbs and other hardscape. **NO WATER ON HARD SURFACES ALLOWED.**

2.13 SHRUB HEADS ON RISERS, POP-UPS and NOZZLES

- A. Should not be used on plantings that will outgrow height of riser under normal maintenance procedures. **Drip may be preferable.**
- B. Shrub risers shall be ½” x 12” Sch 80 nipple fitted with a LXS Weathermatic Shrub adapter with a ½ inlet.
 - 1. Shrub spray heads shall be placed on ½ inch risers in areas of groundcover or shrubs where pedestrian traffic will not come in close proximity to risers.
 - 2. Along walkways, Hunter Pro Spray 12” pop-up heads shall be used.
- C. Strip Nozzle shall be MP Rotator or approved equal.
 - 1. Shall have adjusting screw to regulate distance of throw.
- D. Shrub nozzle shall be MP Rotator or approved equal.

SECTION 32 84 00 – LANDSCAPE IRRIGATION**2.14 TREE BUBBLERS**

- A. Shall be Hunter Multi-Stream Bubblers, Model MSBN-50
- B. Shall be placed at edge of root ball.
 - 1. It shall be placed on a Hunter preassembled swing joint using a LXS Weathermatic shrub adapter with a ½” female threaded inlet

2.15 DRIP IRRIGATION

- A. Drip irrigation shall consist of Techline tubing as manufactured by Netafim or substitute approved by Owner.
 - 1. Because of water stains on buildings, use drip next to walls where feasible.
 - 2. **Emitter and line spacing shall be ~~on~~ 12 inches (TLDL4).**
 - 3. It shall be installed accordingly to manufacturer’s specifications, including electric valve, water filter, ¾” Techline pressure regulator, and poly distribution tube.
 - 4. Keep individual drip zones relatively small. A maximum of 700 feet is recommended. Tubing shall be placed in each section on 12 inch spacing and staked every 36 inches.
 - 5. All drip tubing shall have pressure compensating emitters
 - 6. Subsurface drip is encouraged in areas where runoff may occur into the street. If chemical root intrusion protection is used, an RP backflow prevention device is required.

2.16 AUTOMATIC CONTROLLER

- A. Irrigation controller shall be Baseline 3200 or Motorola (ACE IRRInet or AC IRRInet-M). *Proposed substitutions must be approved by Owner.*
 - 1. It shall be equipped with sufficient station capability depending on size of installation.

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2. It shall be mounted according to manufacturing specifications, including proper grounding of unit.
3. It shall be located as approved by Owner for ease of maintenance. Product Distributor should be engaged to ensure radio communication with Owner's central computer. Equipment includes UHF radio interface and antenna.
4. Contractor shall ensure communication is established from field unit to central computer before acceptance by Owner.
5. Water Management Accessories – Weathermatic Rain Sense or equal.
6. Ethernet connectivity required for Baseline 3200 installations.

PART 3: PERFORMANCE**3.01 GENERAL**

- A. Unless otherwise specified or shown on the drawings, the construction of sprinkler lines shall include excavation and backfill; the furnishing, installing and testing of sprinkler pipe and fittings, and electrical conductors; and the removal and/or restoration of existing improvements and all other work in accordance with the plans and specifications.

3.02 EXCAVATION, BACKFILL AND PROTECTION OF TREES

- A. All excavation shall be unclassified and is to include earth, loose rock, rock or any combination thereof, in wet or dry state.
- B. Backfill for general trenching shall be the material removed, compacted to density equal to the adjacent undisturbed soil and shall conform to the adjacent grades without dips, sunken areas, humps or other irregularities.
 1. Initial backfill on all lines shall be of a fine granular material with no foreign matter larger than ½ inch in size.
 2. If, in the opinion of the Owner, the excavated material is not satisfactory for use as backfill, the Contractor shall dispose of this unsatisfactory material.
 3. Contractor shall be responsible for any settling of trenches for work done.

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- C. Backfill for trenching behind curbs and under paved areas and driveways shall be compacted select backfill to 95% density, meeting material and installation requirements set forth.
- D. Trees and tree roots shall not be damaged. No trenching within the Critical Root Zone (CRZ) of trees without Texas State University-San Marcos approval; CRZ
- E. to be determined by Texas State University-San Marcos Director, Grounds Operations, or delegate. (See Section 01 56 39 – Temporary Tree Protection, Construction Standards.)
- F. It is understood that the piping layout is diagrammatic and piping shall be routed around trees and shrubs in such manner as to avoid damage to plantings.
- G. All lumber, rubbish, and large rocks shall be removed from the trenches and surrounding landscape.
 - 1. Pipe shall have a firm, uniform bearing for the entire length of each line to prevent uneven settlement.
 - 2. Wedging or blocking of pipe will not be permitted.
 - 3. Pad the trenches with dirt or sand, if the soil is extremely rocky.
- H. No PVC shall be laid when there is water in the trench.
 - 1. No PVC shall be laid when temperature is 45 degrees or below.
 - 2. PVC pipe will expand or contract 1 inch per 10 degrees F change in temperature.
 - 3. Therefore, pipe shall be snaked from side to side of trench bottom to allow for expansion and contraction.
- I. All foreign matter or dirt shall be removed from inside of the pipe before welding, and piping shall be kept clean by approved means during and after laying of pipe.
- J. Select fill-dirt or sand shall be used for backfill.
 - 1. No backfill with rock or large clods shall be used.
 - 2. Tamping or flooding shall be done to the satisfaction of Texas State University-San Marcos.

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3. Backfill material will be used to within 6 inches of grade and remaining 6 inches is to be topsoil approved by the Owner.
 4. Any vegetation disturbed is to be returned to its original state, i.e., resodded.
- K. Any trenches improperly backfilled, or where settlement occurs, shall be reopened to the depth required for compaction, then refilled and compacted, with the surface restored to the required grade and left in a completed surface condition as described above.
- L. All excavation and backfill shall be unclassified and covered in the basic bid.
1. No additional fee will be allowed for rock encountered.

3.03 AUTOMATIC CONTROLLER

- A. Refer to 2.16. The controller shall be mounted in a location approved by Owner.
1. All control wires above the ground shall be enclosed in conduit.
 2. All wiring shall be done in accordance with National Codes and all products used UL approved.
 3. Grounding rod or plate shall be installed per manufacturer's specifications.

3.04 PVC PIPE

- A. PVC pipe, couplings and fitting shall be handled and installed in accordance with the manufacturer's recommendations. Each pipe length shall be properly spaced in jointing to allow for expansion and contraction.
- B. Contractor shall use only Weldon 735 cement and Weldon P-68 primer. The pipe and fittings shall be thoroughly cleaned of burs, dirt, dust, and moisture before applying primer and solvent.
- C. Install concrete thrust blocks as necessary at direction changes, size changes, termination, and valves.
- D. All pipe should be purple pipe.

3.05 VALVES

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- A. Install all new valves as indicated on the plans or as may be required for the proper control of the piping systems in which they are incorporated.
1. Valves shall be buried deep enough so that the valve box lid will not protrude above grade.
 2. Isolation valves shall be set vertically.
 3. Control valves shall be set to give the correct pressure at the sprinkler head.

3.06 SPRINKLER HEADS

- A. Sprinkler heads shall be installed in plumb position at intervals not to exceed those shown and in the approximate location and configuration shown on the plans.
1. Sprinkler swing joints shall be made up as shown on the plans.
 2. All nipples shall be minimum length required to allow sprinkler head adjustment motion without inducing load in the supply pipe.
 3. Sprinkler heads in turf areas shall be installed flush with existing grade.

3.07 TESTING (PRIOR TO BACKFILLING DITCHES)

- A. Before final acceptance of the installed system, make the following tests under the supervision of the Director, Grounds Operations or delegate:
1. When the main line or sections of the main line have been installed, the system (or section) will be thoroughly flushed.
 - a. The system (or section) will then be pressurized during a 24 hour period at 120 psi to the operating pressure indicated on the drawings.
 - b. Leakage will be repaired and re-tested as outlined above.
- B. All joints and connections shall be pressure tested.

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- C. Lateral lines, from the control valve to the sprinkler head, shall be tested by opening the control valve and inspecting for leaks. Heads may be plugged or blocked to a position of throw away from the trenches during inspection.

(ANY TIME PRIOR TO FINAL ACCEPTANCE)

- D. Each section of sprinklers shall be tested for area of coverage. Test shall be made by actual measurement of the radius of spray of the sprinklers.
- E. Each section of sprinklers shall be tested for operating pressure at the sprinkler heads and compared with design specifications.
- F. All section valve circuits shall be tested by Grounds Operations for partial connections (increased ohm readings). This shall be coordinated through the Director, Grounds Operations, or delegate.

3.08 FINAL ADJUSTMENT

- A. After installation has been completed, final adjustment shall be made of the sprinkler system prior to Texas State University-San Marcos' final inspection.
- B. The system shall be completely flushed to remove any and all debris from the lines by removing the nozzle from all heads on ends of lines and turning on the system.
- C. All sprinklers shall be checked for proper operation and alignment for direction of throw.
- D. All nozzles shall be checked for proper arc of spray. Prevailing wind conditions may indicate that arc of spray should be other than as shown on the plan. In this case, nozzles shall be changed to provide correct coverage, at the Contractor's expense.

3.09 EQUIPMENT TO BE FURNISHED, OPERATING INSTRUCTIONS

- A. In addition to a comprehensive as-built drawing, the contractor shall provide as part of this contract two (2) each of any special tools required for any equipment and two (2) service manuals for all equipment used.
 - 1. Manuals may be loose leaf and should show drawings or exploded view of equipment and catalog number and prices.
 - 2. Operating instructions for all equipment shall also be furnished.

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- A. The contractor shall make final cleanup of all parts of the work and rocks left on the surface as a result of trenching before final acceptance.
 - 1. This cleanup shall include removal of all construction materials and equipment, and in general, leaving the site in an orderly and finished appearance.

END OF SECTION 32 84 00