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## **SECTION 1 - GENERAL CONDITIONS & SCOPE OF WORK**

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### **1. Objective**

It is the objective of the plans, details and specifications to ensure:

#### **a. Workmanship and Quality**

The assembly of the irrigation system for the project will be achieved in an efficient and satisfactory manner, and in accordance with the highest workmanlike standards established for irrigation system installation in order to ensure the highest quality installation, operation and efficiency upon completion.

#### **b. Complete Installation**

The finished system shall be complete in every respect and shall be ready for operation to the satisfaction of the OWNER. Accordingly, the requirements of these specifications and accompanying plans and details shall be considered as part of the contract. The chosen CONTRACTOR will follow the specifications, plans and details with due perseverance.

### **2. Definitions**

The following references shall be represented as:

**OWNER/MANAGEMENT** – POMPANO’S MUNICIPAL GOLF COURSE  
**GOLF COURSE ARCHITECT** – GREG NORMAN GOLF COURSE DESIGN  
**CONSULTANT** – AQUA TURF INTERNATIONAL  
**CONTRACTOR** – TBD

### **3. Location and Scope of Work**

The site location for the project is in Pompano Beach, Florida.

The CONTRACTOR shall install an automatic underground irrigation system as indicated on the drawings and as hereafter specified. This includes all labor, equipment, tools, permits, appliances and taxes and all other costs necessary and appropriate. No deviation from these specifications, the accompanying drawings, the contract, or other general conditions is authorized. No such deviation shall be made unless written authorization signed by the OWNER, or his duly appointed representative, has been obtained in advance. Any labor, machinery, tools and permits specifically identified either on the drawings or in the specifications that are required for or can be reasonably anticipated for completion of the irrigation system shall be furnished by the CONTRACTOR at no additional cost to the OWNER. The CONTRACTOR shall be specifically responsible for the coordination and proper integration of the work with all trades involved in the project.

#### **a. Water Source**

The water source for this project at the time of the design is reclaimed water. Water sources can change between the design and construction. The contractor is responsible for insuring that all materials installed meet any code requirement for the water to be used in the system at the time of installation.

#### **b. Special Circumstances**

THE CONTRACTOR WILL KEEP THE EXISTING **PALMS COURSE** SYSTEM PRESSURIZED TO MAINTAIN THE ABILITY TO IRRIGATE THE HOLE BY EITHER THE OLD OR NEW SYSTEM. DO NOT INSTALL MORE MAINLINE THAN WILL ALLOW THE HOLE ON THAT MAINLINE SECTION TO BE IRRIGATED. NO HOLE SHALL BE DOWN FOR MORE THAN 48 HOURS. **ANY ADDITIONAL**

**ISOLATION REQUIRED TO MEET THESE REQUIREMENTS WILL BE AT NO ADDITIONAL COST TO THE OWNER.**

**c. Scheduling**

Pines Golf Course- Per Greg Norman Golf Course Design General Conditions  
Palms Golf Course- 60 day after substantial completion date of the Pine s Course

**d. Contractor Experience**

**HDPE**

The irrigation CONTRACTOR and the project supervisor shall have one (1) projects of similar scope in the last two (2) years.

The CONTRACTOR shall have successfully installed high density polyethylene pipe in golf/turf irrigation projects. References will be required. These reference(s) must provide a satisfactory response or the experience will not be accepted.

The CONTRACTOR **and** his fusion crew personnel shall complete a 3-day school on the use of all fusion equipment to be used on the project including; manual butt fusion, hydraulic butt fusion, socket fusion, electro fusion, sidewall saddle fusion or show proof of previous attendance within the last calendar year. Trainer must be qualified in all fusion types and quality control measures. Trainer must inspect all fusion equipment for proper operation. Trainer will perform a fused joint inspection. Trainer must spend sufficient time with course superintendent and his crew for proper repair and maintenance procedures. This training will be taught by a qualified fusion trainer at the jobsite. The CONTRACTOR shall furnish a copy of the completion certificates to the CONSULTANT or OWNERS REPRESENTATIVE.

Fusion Crew Personnel- includes any employee or sub contractor involved with operating any HDPE fusion equipment or directly involved with the fusion operation.

The training will include the following:

1. Butt fusion
2. Socket fusion
3. Electro-fusion
4. Side wall fusion
5. Attachment of mechanical saddles

**CONTRACTOR Equipment Qualifications**

If the CONTRACTOR owns butt fusion equipment, the equipment must be serviced prior to use for this project. The machine must be environmental friendly and satisfactory working order. The hydraulic system must be leak free. The pressure gage and the thermometer must be checked for accuracy.

If a butt fusion machine is rented, it must be rented from company that has a fusion machine service center or centers certified by the butt fusion machine manufacturer. The machine must arrive with certification that the pressure gage and heater thermometer were accurate when shipped.

The extent of the CONTRACTOR experience shall be indicated in the Section 4.0 of the Bid Documents.

**4. Drawings**

**a. Verification of Dimensions**

The drawings show the extent and general arrangement of the irrigation system. Due to the scale of the drawings, it may not be possible to indicate all offsets, fittings and accessories that may be required. Before proceeding with the work, the CONTRACTOR shall visit the premises and carefully check and verify all dimensions and shall report all variations from those indicated on the plans to the OWNER and CONSULTANT. In addition, the CONTRACTOR shall carefully investigate the structural and site conditions and become thoroughly familiar with all details of the work and working conditions.

**b. Precedence of Drawings**

The irrigation design is essentially diagrammatic with size and location of the equipment drawn to scale whenever possible. CONTRACTOR shall make use of all data in the contract documents and shall verify this information at construction site. CONTRACTOR shall furnish and install all work called for on the drawings whether or not specifically mentioned in the specifications.

**c. Verification of Quantities**

Every effort has been made to estimate the quantities of material needed for this job. The quantities listed are to insure equitable bidding. However, the scope of work can change in construction. The selected CONTRACTOR & DISTRIBUTOR should make the CONSULTANT aware of any discrepancies found in the quantities prior to finalizing the contract. Any changes will be negotiated at that time or adjusted by unit pricing listed in the unit price list. In addition, small incidentals may not be included. The CONSULTANT will **NOT** be held responsible for the quantity of construction materials ordered. CONTRACTOR & DISTRIBUTOR to verify all quantities.

**5. Guarantee**

The workmanship included under the contract shall be guaranteed for twelve (12) months by the CONTRACTOR from the final date of acceptance by the OWNER. Labor furnished under this contract shall also be guaranteed by the CONTRACTOR for a minimum of twelve (12) months from final approval. The DISTRIBUTOR shall furnish to the OWNER all written warranties provided by the manufacturer or distributors of any equipment or materials installed under this contract. In the event of malfunction within the time specified above, all necessary repairs and/or replacements shall be made expediently by the CONTRACTOR, at no additional cost to the OWNER. The OWNER retains the right to make emergency repairs without relieving the guarantee obligations of the CONTRACTOR. The OWNER has the responsibility to maintain the irrigation system in proper working order during the warranty period. In the event the CONTRACTOR does not respond to the OWNERS request for repair work under this guarantee within a period of seventy-two (72) hours, the OWNER may make such repairs as he deems necessary at the full expense of the CONTRACTOR.

Any settling of back-filled trenches that may occur during the guarantee period shall be repaired by the CONTRACTOR at no additional cost to the OWNER, including the complete restoration of all damaged planting, paving or other improvements of any kind.

NOTE: If the OWNER takes responsibility of the leveling of the trenches any time during construction or the guarantee period it must be in writing of the scope to be performed. At that point the CONTRACTOR will be relieved of his duties to repair any settling that occurs in the area.

**6. Permits and Code**

Installation shall be as required by the National Standard Plumbing Code (NAPHCC), National Electric Code (NEC) and as specified elsewhere in the specifications. If the CONTRACTOR

observes that the drawings and specifications are at variance or in conflict with existing ordinances, regulations, or codes, he shall promptly notify the CONSULTANT in writing. Any necessary changes shall be as authorized in writing by the CONSULTANT. If the CONTRACTOR performs any work knowing it to be contrary to such laws, ordinances, etc. and without notice to the CONSULTANT, he shall bear all resulting costs, including but not limited to the change and correction thereof, so as to comply. Permits and licenses of a temporary nature necessary for the commencement of work shall be secured and paid for by the CONTRACTOR. Permits, licenses and easements for permanent structures or permanent changes in existing facilities shall be secured and paid for by the OWNER, unless otherwise specified.

## SECTION 2 - CONSTRUCTION GUIDELINES

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### 1. Irrigation General Conditions

Installation of the irrigation system shall proceed in the following general manner:

- a. OWNER will purchase the material.
- b. CONTRACTOR responsible for ordering of material, handling, storage, all quantities, and security.
- c. **Pines Course: Complete Irrigation Replacement (Holes: 1-18).** Golf course will be closed for the duration of construction.
- d. **Palms Course: Partial Irrigation Replacement (Holes: 2-7, 8-Part, 12-17 Complete Irrigation Replacement) (Holes: 1, 8-Part, 9, 10, 11, 18 & Practice Range New Sprinklers and Control System “Only)** Golf course will remain open for the duration of the constructions period. One (1) hole will be closed at a time for irrigation installation. Contractor is responsible to keep the existing **Palms Course** irrigation operational by means of the new or old system. No one (1) hole shall be down for more than 48 hours.
- e. CONTRACTOR must submit a material specification booklet prior to installation to be approved by CONSULTANT.
- f. The pump station – Existing (RECLAIMED WATER) Location at Water Treatment Plant.
- g. Installation of mainline pipe, fittings, valves and power wire starting will commence or terminate at the 12” Ductile Iron pipe located on hole #16 of the Pines Course. *(Two-Way-Cable System shall start at the central computer location If Needed)*
- h. Installation of lateral pipe, wire, fittings, swing joints and isolation valves with flushing of lateral piping and valves, upon completion of flushing of connecting mainline sections.
- i. CONTRACTOR responsible for all existing pipe tie-in to complete the system.
- j. CONTRACTOR will remove all existing sprinkler and satellites after new irrigation is installed, and approved by the OWNER’S REPRESENTATIVE or CONSULTANT.
- k. The CONTRACTOR will remove, cap and repair damaged areas on all existing above ground and exposed below ground irrigation components.
- l. CONTRACTOR will be responsible to repair all existing pipe, power wire and hydraulic tubes to maintain existing irrigation system.
- m. Cut out any exposed abandoned hydraulic tubes.
- n. The CONTRACTOR will remove, cap and repair damaged areas on all existing above ground and exposed below ground irrigation components.
- o. CONTRACTOR is responsible for ALL underground utilities.
- p. Mainline trenches 4” and larger shall be trenched method.
- q. All pipe trenches 2” and 3” shall be trenchless method. (PALMS COURSE ONLY)
- r. CONTRACTOR is responsible for backfill and compact mainline and lateral trenches.
- s. CONTRACTOR is responsible for sod cut with clean edge, compact and replace. Includes all open trenches outside the TURF DISTURBED AREAS defined by the Golf Course Architect.
- t. Installation of field satellites or Decoder/ICS system.
- u. Delivery, installation of central computer.
- v. Installation of sprinklers to grade after flushing lateral lines.
- w. Cleanup and final back-filling of trenches.
- x. Cart path repair.
- y. GROUNDING tested (by: Material Distributor’s Representative).
- z. Clean-up staging area.

- aa. Re-setting of sprinklers, valves boxes, etc. to grade after grassing shall be guaranteed for twelve (12) months by the CONTRACTOR from the final date of acceptance by the OWNER.
- bb. HDPE distributor must make three (3) site visits to the site during construction to inspect CONTRACTOR workmanship.
- cc. The CONTRACTOR shall provide a DISTRIBUTOR representative from their company to make monthly site visits during construction and at the conclusion of construction for a period of six months and report the findings to the CONSULTANT and OWNER. At the conclusion of the project the DISTRIBUTOR will be responsible for testing the grounding, sprinklers and central control system to verify that it is installed and operating per the specifications. The CONSULTANT will communicate these findings as well as the other compliance with the specifications to the OWNER during the final walkthrough. The DISTRIBUTOR will continue to monitor the operation of the system for a six month period to insure the system is fully operational.

2. **Contractor's Understanding**

By submitting a bid proposal, it is understood and agreed by the CONTRACTOR that he has, by careful examination of the site, satisfied himself as to the nature and location of the work, the conformity of the ground, the character, quality and quantity of materials to be used, the character of the equipment and facilities incidental to the completion of the work, the general and local conditions, and other matters that may in any way affect the work under this contract. The contract shall not be affected or modified nor shall any of its terms or obligations be affected or modified by verbal agreement or conversation with any officer, agent, or employees of the OWNER, either before, during, or after the execution of this contract.

3. **Safety**

The CONTRACTOR shall follow all standard construction methods and complete all aspects of work in a professional manner. All methods should comply with current OSHA standards. The CONTRACTOR shall provide for proper worker safety at all times.

4. **Supervision and Workmanship**

a. **Supervisor**

The CONTRACTOR shall keep on the project, during its progress, a qualified supervisor and any necessary assistants, all satisfactory to the OWNER and CONSULTANT. The supervisor shall represent the CONTRACTOR, in his absence, and all directions given to him shall be as binding as if given to the CONTRACTOR. The irrigation supervisor shall be approved by the CONSULTANT and the approved supervisor will be maintained throughout the job unless prior approved by the CONSULTANT. The name of the supervisor must be included in Section 4.0 of the Bid Documents.

b. **Workmanship**

Every facet of the work described herein shall be executed in strict accordance with the contract documents in the most workmanlike and substantial manner. All workmanship shall be the best of its kind. All labor, tools, and equipment and shall be furnished in ample quantities to facilitate the proper and expeditious execution of the work. All materials shall be new, except such materials as may be expressly provided in the contract documents to be otherwise.

**5. Existing Facilities and Structures**

The plans may show the location and nature of existing facilities, structures and utilities. However, neither the OWNER nor CONSULTANT assumes any responsibility for the correctness or completeness of this information. The CONTRACTOR shall request such information from the OWNER, appropriate agency or utility, sufficiently in advance of construction to preclude damage to the same.

The CONTRACTOR shall exercise the utmost of care in protecting all existing buildings, equipment, piping, pipe coverings, utilities, roads, sidewalks, landscaping or other structures of any kind. The CONTRACTOR shall be liable for any damage to any of the OWNER'S property.

Any damage from leaks in the piping system being installed by the CONTRACTOR or his agents, employees, or sub-contractors during the course of his work, whether through negligence or otherwise, shall be replaced or repaired by the CONTRACTOR at his own expense in a manner satisfactory to the CONSULTANT. Such repair or replacement shall be a condition precedent to the OWNER'S obligation to make final payment under the contract.

The CONTRACTOR shall perform all cutting, patching and fitting of his work required to match to the work of others or existing irrigation system, structures or utilities either shown on the plans, implied in the specifications or necessary to complete the installation and to make the parts of his work whole. The CONTRACTOR shall take all necessary and reasonable precautions to prevent any damage to existing turf, trees, foliage, plant material, wetlands, native areas, archeological areas or other property of the OWNER. Any such areas disturbed by the CONTRACTOR, his employees, agents or sub-contractors shall be restored to their original condition by, and at the CONTRACTOR'S expense. No native or environmentally sensitive areas shall be disturbed in the slightest degree. The CONTRACTOR must impress his organization with this sense of importance and responsibility to preserve the delicate nature of such areas. Hunting, exploring, camping, recreation or other activities not related to the performance of work by the CONTRACTOR is prohibited on the OWNER'S property. Employees in violation of this request shall be subject to dismissal.

**6. Materials**

1. All materials to be paid by the OWNER shall be new, and the best procurable without defects, and as required by the plans, specifications and special provisions.
2. The Contractor shall furnish all labor, supervision, tools, equipment, personnel and warehouse facilities required to perform the work in an orderly and efficient manner.
3. It shall be the Contractor's responsibility to inventory, transport and store all items obtained from City of Pompano Beach.
4. The Contractor shall obtain the materials from City of Pompano Beach as directed by City of Pompano Beach's Representative. The Contractor shall account for all materials in his possession. Any unused materials remaining after the work completion shall be returned to City of Pompano Beach.
5. All materials required to complete the construction with the exception of irrigation materials provided by the City shall be furnished by the Contractor at his own expense. Materials furnished by the Contractor shall be new and of good quality.
6. The Contractor shall bear the responsibility of repairing or replacing any materials or equipment supplied by City of Pompano Beach which are damaged or lost by the Contractor while in his possession.

**a. Submittals**

The CONTRACTOR shall submit with his bid a list of labor & equipment used to be installed. Submittals shall be listed in Section 9.0 of the Bid Documents and shall include the following materials (pipe, wire, fittings, swing joints, sprinklers, satellites, all valves including air relief and drain valves) *If necessary*.

**b. Approval**

No material shall be installed before on-site inspection and approval of the material by the CONSULTANT or the OWNER'S REPRESENTATIVE.

**c. Delivery**

The CONTRACTOR shall coordinate the delivery of all materials and equipment to avoid delay of the project. The CONTRACTOR is responsible for providing any and all means including equipment, labor, etc. for the complete delivery and proper unloading of all materials from suppliers.

**d. Substitutions**

All materials and installation shall be as specified and approved by the CONSULTANT or OWNER'S REPRESENTATIVE. If materials have no reference of "or accepted equivalent", contractor shall bid on specified materials. No changes to plans or specifications will be made prior to bidding unless contractors have received a written addendum.

**e. Storage**

The OWNER shall provide a specified location in which all materials to be used on the project shall be stored when not in use. Provision of the land is for the purpose of keeping the property neat and orderly and in no way waives any requirements of the CONTRACTOR to protect his equipment and materials from damage by the elements or from theft or vandalism. Facilities of adequate size and water-tight, with floors raised above ground level, shall be provided for all types of materials that are liable to damage from exposure to weather. Other materials shall be stored on blocks off the ground and covered.

Materials shall be located as to allow easy access for inspection and identification. All materials shall be carefully stacked and stored on site, and all work shall be performed in strict conformity with local laws regarding the same. The storage location shall be supplied with adequate security to the satisfaction of the CONSULTANT, in order to protect the materials stored therein. The OWNER or CONSULTANT may enter the material storage area for inspection, inventory, or any other purpose as he deems necessary. Any material that has become damaged, weathered, deteriorated or otherwise become unfit for use shall not be used in the project.

Upon completion of all work, or when directed by the CONSULTANT or OWNER'S REPRESENTATIVE, the CONTRACTOR shall remove the storage facility promptly from the construction site.

**f. Materials Furnished by the OWNER**

The OWNER will provide all the irrigation materials needed to complete the project. The OWNER will provide the primary power and electrical power disconnects for the satellite power sources as noted on the plans. The CONTRACTOR shall make all connections and provide labor and materials to make connections to the irrigation system control system power wiring from the OWNER supplied disconnect panels. Where

necessary, the CONTRACTOR will provide and install all voltage regulating/stabilizer units at required electrical supply points. All connections to the meters/hook-ups/disconnects at any location shall be made by a licensed electrical contractor per all applicable codes.

**g. Additional Equipment**

NA

**h. Handling**

The CONTRACTOR shall be responsible for correct procedures in loading, unloading, stacking, transporting and handling all materials to be used in the system. The CONTRACTOR shall avoid rough handling that could affect the useful life of equipment. Pipe and other materials shall be handled in accordance with the manufacturer's recommendations on loading, unloading and storage.

**7. Clean-Up**

The CONTRACTOR shall remove waste materials from the site during the entire term of the project, as is necessary to maintain the premises in a clean and orderly fashion. Upon completion of the work, the CONTRACTOR shall promptly remove from the site all temporary structures, field office, debris and waste incidental to his operation and shall clean and prepare all fixtures and surfaces relative to the contract. Failure to perform a clean-up function within seventy-two (72) hours of notification by the OWNER may result in this work performed by others in a manner he deems expedient. The cost therein shall be charged to the CONTRACTOR and deducted from moneys due under this contract.

**8. Programming and Training**

The irrigation computer shall be completely programmed to include all database entries such as station numbers, sprinkler type, radius and flow. The flow management of the software will be programmed to ensure the most efficient operation to include pump capacity and mainline hydraulic flow zones. The irrigation schedules and programs will be created. The as-built digital file will be converted into the appropriate .shp files and the database information will be combined with the mapping software for the selected irrigation manufacturer. Programming for the computer central system is to be provided by a qualified Irrigation Consultant and shall be part of the CONTRACTORS lump sum price. The an Irrigation Consultant shall be regularly engaged and qualified in the business of Golf Course Irrigation Design for the preceding five years and shall have satisfactorily completed at least five eighteen-hole golf course central control database and maps or the equivalent. The Irrigation Consultant will coordinate the loading of the data and map in the irrigation computer as well as superintendent training with the local distributor.

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## SECTION 3 - STAKING AND CONSTRUCTION RECORDS

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### 1. **General**

The flagging of the golf course irrigation components will be performed by an Irrigation Consultant to determine the locations of the mainline, sprinklers, valves and quick couplers prior to installation.

The CONTRACTOR may be required to make field adjustments from the initial design in order to effectively irrigate the course as a result of adjustments before or during construction. These minor adjustments will not be compensated. However, significant changes in quantities or routings will be compensated as per the Unit Prices.

The CONTRACTOR may change the pipe routing or depth of trench in order to compensate for rock or other obstacles with the prior approval of the Irrigation Consultant or OWNERS REPRESENTATIVE. Field changes of this minor extent will in no way affect the contract price except where changes alter the quantity of materials or increase the depth of trench and backfill required. The routing of the pipe should otherwise generally follow the irrigation plan. Any changes require the prior approval of the Irrigation Consultant.

### 2. **Flagging and Staking**

Flagging services are to be provided by an Irrigation Consultant and shall be part of the CONTRACTORS lump sum price. The Irrigation Consultant conduct up to (8) site visits, (1) for a pre-construction meeting to review the irrigation plan and staking procedure, (6) for flagging of all irrigation components, material and installation inspections and (1) final walk through. The Irrigation Consultant will initially review the entire sprinkler layout and strategy with the CONTRACTOR. The Irrigation Consultant shall be regularly engaged and qualified in the business of Golf Course Irrigation Design for the preceding five years and shall have satisfactorily completed at least ten eighteen-hole golf course staking projects or the equivalent. Staking by CONTRACTOR, manufacture, distributor is not allowed.

Prior to staking, the following items should be met in order to advance the process:

- A. Holes to be staked shall be prior approved by the Irrigation Consultant.
- B. Drainage shall be completed on all holes to be staked.
- C. All boundary lines, grassing limits, cart paths and landing areas shall be located.
- D. All greens shall be cored and final approved for drainage.

A minimum of (3) hole shall be ready for staking at the time of the staking visit by the Irrigation Consultant. If less than (3) holes are ready, the CONTRACTOR can pay for an additional site visit and expedited travel expenses to be negotiated with the Irrigation Consultant. Also, a minimum of (5) day's advance notice shall be given that holes will be ready. If less than (5) days notice is given, the CONTRACTOR may be required to pay an expedition fee and travel expenses to be negotiated with the Irrigation Consultant. Additional staking fees may also be applicable if the total number of visits is exceeded. Eight (8) site visits are included. If additional visits are required the CONTRACTOR will negotiated fees and travel expenses with the Irrigation Consultant.

The locations of the sprinklers and valves on the plans are essentially diagrammatic. In no instance shall the spacing of sprinklers exceed the distances as shown on the drawings. All flags for staking will be provided by the CONSULTANT.

**The flags will be immediately replaced by the CONTRACTOR with stakes and clearly marked in order to clearly designate the equipment to be installed at each location.**

Stakes/hubs shall be placed accurately and components shall be located within one (1) foot of the indicated/flagged position. Any offset from the base position shall be clearly indicated to insure accurate installation. The CONTRACTOR shall maintain this staking, and have the Irrigation Consultant replace any disturbed stakes to the correct position (at the CONTRACTOR'S expense), until the equipment is installed and indicated by the contractor on the revised "As-Staked Drawings."

Approximately three days after completion of each staking visit, the Irrigation Consultant shall provide the CONTRACTOR a set of reproducible "As Staked Drawings" via the email, FTP site, mail or the Contractor can pay for overnight delivery fees. The drawings will include the sprinkler locations with sprinkler addresses. The CONTRACTOR shall immediately verify the drawings in comparison to the staking and immediately notify the Irrigation Consultant of any variances. These as-staked drawings shall be the basis for the Final Construction Record Drawings. ATI shall be notified by the CONTRACTOR if the sprinkler addresses are changed from those supplied at the time of installation. The next staking visit will not be made until the previous sprinkler addresses are verified. The purpose for this is to allow for accurate and expeditious as-built development as well as programming of the central computer by the Irrigation Consultant. If the sprinkler addresses are changed without notification to the Irrigation Consultant prior to programming the CONTRACTOR will be billed extra per hour for the time required to revise the as-built drawing and irrigation program.

**3. Construction Record Drawings**

The GPS As-Built shall account for all irrigation components to include sprinklers, valves, pipe routing, pipe size, wire routing, wire size, wire splices, satellites and quick couplers installed on the project. This will be accomplished using SUB CENTIMETER accuracy Trimble GPS survey equipment or accepted equivalent in combination with timely and accurate field notes. The CONTRACTOR shall stake all in-ground irrigation fittings, wire splices, valves, capped lateral lines, plugged service tees, and other buried components with a 3/4" x 3' PVC stake or accepted equivalent to provide for GPS Sub-meter mapping by the Irrigation Consultant. The CONTRACTOR shall maintain this staking, and replace any disturbed stakes to the correct position until the as-built is finalized. The GPS As-Built is to be provided by an Irrigation Consultant and shall be part of the CONTRACTORS lump sum price. The Irrigation Consultant shall be regularly engaged and qualified in the business of Golf Course GPS AS-Built for the preceding five years and shall have satisfactorily completed at least ten eighteen-hole golf course As-Built maps or the equivalent. All as-builts must be performed on AutoCAD 2007 provided in color with clear adequate interpretation of the construction record drawings with a backup file on disk.

The CONTRACTOR shall neatly maintain updated irrigation "as-built" field notes. The notes for each hole shall be provided to the Irrigation Consultant within (1) week after installation of the hole. The CONTRACTOR shall maintain a copy of the field notes for their records.

Information included on the irrigation field notes shall include, but is not limited to:

- a. Person responsible for drawings and date of preparation.
- b. Pipe routing and size, mainline fitting angles.
- c. Indication of all sprinkler types and nozzles.
- d. Location of all water sources and electrical supply points.
- e. Station and satellite assignment of sprinklers.
- f. Wire trench locations and **all wire splices**.
- g. Measurements to all valves and wire splices.

- h. Notes of any unique installation conditions or equipment.

The CONTRACTOR shall keep a qualified person on the job during the entire project to update and coordinate the on-going “as-built drawing/CRD”.

The Irrigation Consultant will provide drawings of the final “as-built/CRD” of the irrigation system from these notes and the GPS data. The irrigation as-built data will be provided to the OWNER, by Irrigation Consultant in a .dwg format and one (1) set of 1”=100’ color plots including: irrigation system, golf course features and drainage inlet locations. Laminated plots of each hole will be provided to the OWNER of the irrigation system in (1) one bound book per course. (1) One 1”=100’ or (size to fit), color hatch rendering Wall Map on high gloss paper.

**4. Construction Record Photography**

Construction Record Photography will be taken by the CONTRACTOR to meet the following criteria:

- a. Photograph the work in progress from vantage points which will show principal activity since previously photographed.
- b. Photography shall include mainline & wire installation to include depth of cover and compaction techniques; fitting, valve, splices and grounding installation. Lateral pipe and sprinkler installation.
- c. Adequate quantity of photography shall be provided by hole to adequately depict the installation, approx. Twenty (20) photos per hole.
- d. Submit progress construction photographs monthly with payment requests. Photographic images shall be provided in digital images in standard .jpeg or .tiff formats. Record date image was made as part of digital file.
- e. All images of work in progress shall be made at “standard mode” (640 x 480 pixels) at a minimum. Images of the final product shall be made at “high quality” resolution (1,280 x 960 pixels).

Submit copies to the CONSULTANT and OWNER in CD format with a text file identifying all images.

**5. Improper Location of Equipment**

If at any time prior to final acceptance of the irrigation system it is found that the CONTRACTOR has improperly located equipment, he shall remove the improperly located equipment and install such equipment in the locations satisfactory to the CONSULTANT. The relocation of the improperly located equipment shall be at the CONTRACTOR’S expense.

## SECTION 4 - EXCAVATION

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### 1. **Excavation**

Prior to trenching outside the TURF DISTURBED areas all mainlines & laterals the CONTRACTOR will mark lines on the turf showing the layout of pipe. The existing sod shall be cut and placed to the side for replacement over the backfilled trench by CONTRACTOR. The sod shall be immediately replaced to avoid desiccation and shall be watered as needed. Irrigation of the sod after it is laid is the responsibility of the CONTRACTOR. If water is not available from the existing irrigation system the CONTRACTOR is responsible to provide a water truck to irrigate the sod. The OWNER will be responsible for the sod after each golf hole is completed.

HDPE Pipe shall be installed per manufactures' recommendations. This includes the bedding of the pipe in the bottom of the trench.

All trenches shall be neatly aligned with trench bottoms as level as possible. Trenches shall be of adequate width to allow installation of wires as detailed in the drawings.

During excavation existing pipe may be encountered. Any pipe that is encountered during trenching shall be removed outside the width of the trench prior to installation of the new piping.

Irrigation mainline pipe shall have a minimum of thirty (30") and a maximum of thirty-six inches (36") of cover on the pipe. All lateral lines shall have a minimum of eighteen inches (18") and a maximum of twenty-four inches (24") of cover on the pipe. The bottom of the trench shall be free of rocks, clods, debris and other sharp edges.

Width of Trenches:

Mainline: 18" width

Laterals: 10" width

The CONTRACTOR shall exercise reasonable care to avoid causing damage to any and all underground utilities or structures. The OWNER shall advise the CONTRACTOR of any underground utilities or structures of which he is aware. Utility locating services shall be called upon to pinpoint the location of any underground utilities on the site of the project. It is the responsibility of the CONTRACTOR to assure that this procedure is carried out.

Trenching shall be avoided within the drip lines of existing trees. The CONTRACTOR shall provide proper root pruning to meet arboricultural standards or as directed by the OWNER or CONSULTANT. No trenching shall be done within twelve (12") inches of proposed or existing streets, walks, drives or structures unless prior approval has been received in writing from the OWNER or CONSULTANT.

### 2. **Rock Excavation**

All excavation shall be unclassified and shall include all materials encountered except materials that cannot be excavated by "normally employed mechanical means". Such exceptions shall be brought to the attention of the CONSULTANT or OWNER'S REPRESENTATIVE and an adjustment in price based on the unit price per foot and shall be agreed upon before excavation of these areas proceeds. Such price adjustments and agreement shall include responsibility for

the disposal of the unsuitable materials removed from the trench and the acquiring of additional backfill materials.

For the purpose of these specifications “normally employed mechanical means” shall include the use of all power equipment normally used in the construction of golf course irrigation systems, including chain trenchers with small back hoe units and track hoe units equipped with buckets up to and including 30” wide. Equipment beyond this including blasting equipment, jack hammers, larger back hoes than described above, back hoe type machines equipped with jack hammer units, “rock saws”, or the like shall be considered as being beyond “normally employed mechanical means”.

**3. Backfill**

Irrigation CONTRACTOR shall thoroughly compact all trenches in lifts not to exceed twelve inches (12") with a Vermeer trench compaction machine or equivalent and the last layer shall tie smoothly into existing grade. Final acceptance of trench backfill shall rest with OWNER’S REPRESENTATIVE or CONSULTANT. Backfill material shall be free of rocks or other material potentially harmful to the pipe. All excavated materials that in the opinion of the CONSULTANT or OWNER are suitable for backfill, base or cover material shall be kept separate from the general excavation material. Acceptable bedding material, fill dirt, pea gravel or sand shall be used to extend six inches (6”) above the pipe. Acceptable bedding material, around swing joints, fittings and sprinklers shall be sand. The remainder of the backfill shall contain no lumps or rocks larger than three inches (3”), except the top six (6”) inches that shall be free of rocks over one inch (1”). All material not suitable for backfill or reuse shall be disposed of by the CONTRACTOR and hauled away onsite to designated locations marked by OWNER’S REPRESENTATIVE.

**Bedding of Pipe in Rock Excavation Areas**

It may be necessary to bed the pipe in sand to cover exposed rock or other hazardous soil conditions. In this instance, the CONTRACTOR shall excavate the trench an additional three inches (3”) in depth and then provide a minimum of three inches (3”) of coarse clean sand or suitable clean backfill material for bedding of the pipe. The CONTRACTOR shall be paid by invoicing by the linear foot of trench.

**4. Street Crossings**

Directional boring- The CONTRACTOR will arrange and pay for any directional boring as needed across existing streets. The CONTRACTOR will be required to install all wire through sleeves. Materials used for road crossings shall meet or exceed the following specifications and detail drawings must be prior approved by the CONSULTANT.

Open Cuts (*If Necessary*) – Open cuts require specific approval of the City of Pompano Beach. Where open cuts are allowed in street paving, plans shall call for steel plate covers to be installed and maintained over the cut during periods when CONTRACTOR is not actively engaged in work at the site. Streets that are open cut shall be "saw cut" prior to pavement removal. Saw cut shall be a minimum of four inches (4") deep.

Proper barricading and signage shall be required on all projects. Adequate signage for vehicular and pedestrian traffic shall be installed. A traffic control plan shall be submitted to City of Pompano Beach and approved by City of Pompano Beach for all streets open to travel by the public.

All open cut installations under existing or proposed streets shall be backfilled with cement stabilized sand.

**5. Cart Paths**

If trenching is necessitated through existing cart paths, the CONTRACTOR shall cut the pavement in a straight line to the width of the trench prior to trenching. Where possible, cart paths damaged due to installation shall be replaced in 4' sections at the expansion joints. Removal of cut pavement and replacement with new pavement shall be the responsibility of the CONTRACTOR. The trenches in the pavement shall be backfilled to grade, adequately compacted and maintained until new pavement is replaced. All cart path repair cost shall be included in the CONTRACTOR'S lump sum price.

## SECTION 5 - PIPING AND CONNECTIONS

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### 1. **Handling**

Pipe shall be delivered to the project shipped on equipment proper for shipping HDPE products and to meet industry standards. The CONTRACTOR shall exhibit extreme care and caution at all times in the handling, loading and unloading, storing and installation of all pipe, fittings and related components. No pipe shall be dropped from cars or trucks, or allowed to roll down slides without proper retaining ropes. Any pipe damaged in any way shall be discarded and removed from the site immediately to avoid future use.

During transportation pipe shall rest on suitable pads, strips, skids or blocks securely wedged or tied in place. Pipe shall be transported around the project on a trailer or vehicle with a bed long enough to allow the complete length of pipe to be supported. The bed and supports or braces of the trailer shall be covered so that no sharp edges can damage the pipe in any way. Any pipe damaged shall be replaced. **Transporting of pipe by means of a back-hoe with forks will not be allowed.**

### 2. **Mainline and Lateral Pipe Materials and Installation**

#### a. **Pipe Materials (MARKED FOR EFFLUENT WATER) "PURPLE STRIP"**

All HDPE pipe shall be new and manufactured domestically. All piping on the project of a similar type shall be of one manufacturer and installed as called for in the specifications and as called for by the manufacturer recommendations. All pipes shall be as indicated on the drawings and meet the following criteria:

Mainline: 10" & Above -HDPE PE4710 - SDR 13.5 (161psi WPR)

Laterals: 2" - 8" -HDPE PE4710 - SDR 17.0 (126psi WPR)

Electrical 4" - Conduit "Grey" "***Marked for Electric***" (Two-Way Cable or Power Wire)

3/4" - Conduit "Grey" "***Marked for Electric***" (#10 Bare Copper)

#### b. **HDPE Pipe Materials**

Pipe shall be manufactured from a PE PE4710 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material will meet the specifications of ASTM D3350-05 with a cell classification of PE 445474C or higher. Pipe shall be manufactured to the dimensions and requirements of ASTM F714. All 2" - 8" pipe shall be SDR 17.0 (126psi WPR). All 10" pipe and above shall be SDR 13.5 (161psi WPR) The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All HDPE pipe shall be in straight lengths OR (2", 3" and 4" HDPE pipe can be in coils if CONTRACTOR straighten and re-rounds pipe with a (Line Tamer Machine-Recommended). All pipes shall be marked for effluent water "purple stripe".

The DISTRIBUTOR of the HDPE pipe and fittings must comply with the following requirements:

1. The DISTRIBUTOR must be capable of supplying both the pipe and fittings.
2. The DISTRIBUTOR must be capable of supplying special fittings within its own manufacturing facility.

3. The supplier must have the capability to train the CONTRACTOR'S employees in butt fusion, electro-fusion and socket fusion of HDPE pipe and fittings.
4. The supplier must be capable of providing a "Hot Line "phone number to assist in fusion and fusion equipment questions.
5. The supplier must be capable of providing a trained representative on site upon the request of the CONTRACTOR, OWNER or CONSULTANT to address any problems that are encountered during the installation.
6. The supplier must be capable to rent, sell and service fusion equipment.
7. The supplier must have access to fusion equipment for rent, sell and service.
8. The supplier must furnish a written 10 year limited Warranty for HDPE pipe, valves and fittings golf and turf irrigation applications as provided.
9. 2" HDPE to PVC transition fitting.
10. 2"-10" HDPE to Ductile Iron transition fitting.

**c. HDPE Pipe Installation**

The polyethylene pipe shall be joined into continuous lengths. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 425 (+/- 15) degrees Fahrenheit, alignment, and an interfacial fusion pressure of 75 PSI. The fusion equipment used shall be manufactured by McElroy Manufacturing or approved equal. The butt fusion joining will produce joint weld strength equal to or greater than the tensile strength of the pipe itself. Thrust blocks will not be required with the fused HDPE pipe. Fused connection shall be used as shown on the plans and details or where butt fusion cannot be used (socket or Electro-fusion) is approved.

The CONTRACTOR and his fusion crew personnel shall complete a 3-day school on the use of all fusion equipment to be used on the project including; manual butt fusion, hydraulic butt fusion, socket fusion, electro fusion, sidewall saddle fusion or show proof of previous attendance within the last calendar year. Trainer must be qualified in all fusion types and quality control measures. Trainer must inspect all fusion equipment for proper operation. Trainer will perform a fused joint inspection. Trainer must spend sufficient time with course superintendent and his crew for proper repair and maintenance procedures. This training will be taught by a qualified fusion trainer at the jobsite. HDPE Trainer/Consultant must have a minimum of 5 years onsite HDPE training and support in golf/turf/commercial irrigation projects. The CONTRACTOR shall furnish a copy of the completion certificate for each Fusion Crew Personnel to the CONSULTANT or OWNERS REPRESENTATIVE.

Prior to HDPE pipe being installed in the trench, after the CONTRACTOR has begun butt fusion of the pipe, the CONSULTANT and/or the OWNERS REPRESENTATIVE reserve the right to select at random two butt fusion joints (with a minimum of 18" of pipe on each side of the joint). These samples shall be sent to the HDPE supplier for hydrostatic testing at the CONTRACTOR'S expense. The testing procedure shall be to Factory Mutual Standards. In no case will the failure be in the butt fusion joint. The test will be recorded and sent to the CONTRACTOR and CONSULTANT. Upon failure of any butt fusion weld; CONTRACTOR will be required to cut and re-weld all questionable butt fusion joints as directed by the CONSULTANT at no cost to the OWNER.

**d. On-Site Warranty**

Pipe seller or manufacture warrants that, for a period of ten (10) years from the date of shipment it will provide continuing support and training through the warranty period. Seller warrants that it will replace any section of HDPE pipe product that is defective in materials or workmanship, provided that Buyer, upon discovery of a defect, promptly notifies Seller of the defect and, as instructed by Seller at such time, either returns the product to Seller for inspection or allows Seller to inspect at the place of installation. If Seller determines the product to be defective, Seller will provide new product of the same specification and same quantity as the defective

Product and Seller will bear the expense of freight to deliver the replacement product to the jobsite

CONTRACTOR warrants that, for a period of five (5) years from the date of installation, it will re-fuse or repair a fusion connection that is defective in workmanship, provided that Buyer, upon discovery of a defect, promptly notifies Contractor of the defect and, allows the CONTRACTOR to inspect at the place of installation. If it is determined the fused connection to be defective, CONTRACTOR will re-fuse or repair the connection at the jobsite. CONTRACTOR does not warrant the product itself, only the fused connection.

**e. Sleeves, Bridge and Stream Crossings**

When the irrigation pipe or wire must be installed across a paved road, the CONTRACTOR shall contact and obtain the necessary permission of the agency or persons having jurisdiction. The CONTRACTOR shall install pipe and sleeved wire sleeves across the area in accordance with the governing agency's guidelines. A sleeve of sufficient size to pass the electrical conduit wire sleeves shall be installed with separate sleeves for all 115 V.A.C. and 24-volt control wiring installed. Ductile iron pipe may be used in lieu of sleeves for water pipe at road crossings. Any method employed, however, must satisfy the governing agency's requirements. The CONTRACTOR shall pay for all costs incurred including permits and road surface replacement or repair if pavement is removed or damaged by this operation.

Wire sleeves of sufficient size consisting of PVC electrical conduit with enough separate sleeves to provide for separation of 115 V.A.C. and 24 volt wiring shall be provided and individually supported or securely strapped for support if needed.

**f. HDPE Fusion**

1. Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground, whenever possible. The joining method shall be the butt fusion and or socket fusion method and shall be performed in strict accordance with the pipe supplier's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe supplier, including, but not limited to, temperature requirements of 425 +/- 15 degrees Fahrenheit, alignment, and an interfacial fusion pressure of 75 +/- 15 psi for hydraulic . The fusion equipment used shall be manufactured by McElroy Manufacturing, or equal. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself.
2. Electrofusion or socket fusion (500°F +/-25 may be used where the butt fusion method cannot be used. Electrofusion couplings and fittings shall be PE 4710 with a minimum cell classification of PE 445474C. Electro-fusion couplings or fittings shall have a manufacturing standard of ASTM F1055. Couplings and fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans.

3. Mechanical connection to other types of pipe shall be made by one of the following methods:
  - a. Flange, using HDPE flange adapter with HDPE stubs, ductile iron back up ring, and zinc-plated bolt pack. All bolts to be installed to manufacturer's torque specifications.
  - b. Mechanical joint, using HDPE Mechanical Joint (MJ) adapter kit with HDPE stubs.
  - c. Bell MJ adapter with kit (4"- 24")
4. INSPECTION: Inspect the pipe for defects before installation and fusion. Pipe shall not exhibit scratches or gouges greater than Defective, damaged or unsound pipe will be rejected.
  - i. TESTING if pressure testing is required testing shall be done hydrostatically. All fused taps on HDPE pipe shall be made using Electrofusion branch saddles with 2" IPS HDPE outlet or sidewall branch saddles. The pressure rating shall be equal to or greater than 100 PSI Central Plastics PE 4710 or approved equal.

**g. Mainline HDPE Pipe 4" - 24" Installation**

All HDPE pipe shall be installed per the following:

1. Pipe shall be installed in accordance with ASAE S376.
2. Irrigation mainline pipe shall have a minimum of thirty (30") and a maximum of thirty-six inches (36") of cover on the pipe.
3. Any repairs to the main line during construction shall require the use of HDPE fittings.
4. Extreme care shall be taken at all times to prevent contamination of the pipe with debris and dirt during storage, transport and installation. The open ends of the pipe shall be sealed at all times when installation is not in progress.
5. Piping shall be flushed completely prior to connection to lateral lines.
6. All mainline trenches shall be sod cut and replaced, backfilled and compacted as specified.

**h. Lateral Pipe Installation**

Lateral pipe may be installed by trenching or plow methods only. All lateral pipe to be installed by trenching and laying of pipe, backfilling and compacting as installed per the following requirements:

1. Trench depth shall be a minimum of eighteen (18") and a maximum of twenty-four inches (24") from the top of the pipe to the surface of the trench.
2. Bottom of the trench shall be free from sharp debris and rocks.
3. Installation of pipe shall be installed in accordance with ASAE S376.
4. Backfill will be compacted from 90%-95% compaction.
5. Piping shall be flushed completely prior to installation of sprinklers.
6. Extreme care shall be taken at all times to prevent contamination of the pipe with debris and dirt during storage, transport and installation. The open ends of the pipe shall be sealed at all times when installation is not in progress.

**i. 2" and 3" Lateral Pipe Installation (Trenchless) (Palms Course)**

Lateral pipe to be installed by trenchless methods on Palms Course. All lateral pipes to be installed by trenchless methods shall be installed per the following requirements:

1. 2"-3" plowing depth shall be a minimum of eighteen inches (18") and a maximum of (24") maintained from the top of the pipe to the surface of the trench.
2. 1½" plowing depth shall be a minimum of sixteen inches (16") and a maximum of (22") maintained from the top of the pipe to the surface of the trench.

3. Bottom of the trench shall be free from sharp debris and rocks.
4. Installation of pipe shall be installed in accordance with ASAE S376.
5. Backfill will be compacted from 90%-95% compaction.
6. Piping shall be flushed completely prior to installation of sprinklers.
7. Extreme care shall be taken at all times to prevent contamination of the pipe with debris and dirt during storage, transport and installation. The open ends of the pipe shall be sealed at all times when installation is not in progress.

### 3. **Fittings and Valves**

All fittings shall be HDPE DR11. Fittings and valves shall be line sized as called for in the plans unless stated elsewhere in the plans or specifications. Fittings and valves shall be used that are compatible with the pipe utilized on the project. All fittings and valves of a similar style and type shall be purchased from the same manufacturer.

#### **Fittings**

All fittings shall meet the following requirements

1. All sprinklers shall be mounted on LASCO PVC 364-251 or equal, 2" x 1½" Tap't Saddle w/ACME Threads, ID #P inlet elbow adaptor and 1-½" swing joints.
2. The swing joint shall be adapted at the swing joint outlet to match the size of the sprinkler inlet.  
1-1/2" Sprinkler inlet - Use LASCO G3PO-212 Swing Joint or equal  
1-1/4" Sprinkler inlet - Use LASCO G3PA-212 Swing Joint or equal  
1" Sprinkler inlet - Use LASCO G3PC-212 Swing Joint or equal  
1-1/2" Quick Coupler inlet - Use LASCO G3PS-212 Swing Joint (quick couplers) or equal

NOTE: Toro & Rain Bird swing joints are accepted only with a five year warranty for both swing joints and sprinklers.

3. All rotors shall be installed on 12" standard lay length LASCO or equal, factory assembled, adjustable swing joints as indicated on the details. Swing joints shall utilize PR315 or Schedule 80 components and contractor shall follow manufacturer's installation recommendations.
4. Sprinklers & Quick Couplers at dead ends shall be installed on **LASCO P330-251 2"** or equal Tap't Hybrid Coupling, fuses onto 2" HDPE lateral pipe. All swing joints must come with a minimum 5 year warranty. NOTE: Toro and Rain Bird swing joints are accepted only with a five year warranty for both swing joints and sprinklers.
5. All golf sprinkler swing joint and sprinkler threads shall be ACME.

#### **HDPE Fittings**

Butt Fusion Fittings - Fittings shall be PE4710 HDPE, Cell Classification of 445474C as determined by ASTM D3350-02. Butt Fusion Fittings shall have a manufacturing standard of ASTM D3261. Molded & fabricated fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans. Fabricated fittings are to be manufactured using a Data Logger. Reference to the Data Logger Quality Control records should be referenced from an indented stamp in each fusion bead of each fitting. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the quality control records. All fittings 8" and smaller shall be molded. All fittings above 8" shall be fabricated. Flanged and Mechanical Joint Adapters - Flanged and Mechanical Joint Adapters shall be PE 4710 resin with a minimum cell classification of PE 445474C. Flange adapters and Mechanical Joint Adapters shall have the same pressure rating as the pipe unless otherwise specified on the plans. All fused taps on HDPE pipe shall be made using

“fused connection” socket or electro-fusion service saddles as shown on the plans and details. They shall be PE4710 HDPE, Cell Classification of 445474C as determined by ASTM D3350-02, shall have a manufacturing standard of ASTM F1055, and have the same pressure rating of the pipe. Where required “fused connection”, socket or electro-fusion couplings will be used as shown on the plans and details. They shall be PE 4710, Cell Classification of 445474C as determined by ASTM D3350-02, shall have a manufacturing standard of ASTM F 1055, and have the same pressure rating of the pipe.

HDPE IPS dead end cap DR11 (2” – 8”).

#### **Mainline Gate Valves (4” & Above)**

Main Line isolation valves 4”-24” shall be line size American AVK Resilient Ductile Iron Gate Valve or equal, 250 PSI, tested to AWWA C515, ASTM A536, flanged ends with HDPE SDR 11 fusible ends. HDPE- D.I. covered with a “heat activated shrink tube” to prevent corrosion. Hydraulic tested to AWA C515, Bonnet Bolts of stainless steel-316 or approved equal. Coating Electro-statically applied fusion-bonded epoxy-resin, meets or exceeds AWWA C550. Assembly shall be installed in a 10” round valve box with a 4” PVC sleeve around valve skirt or as noted in the plan. Must carry a ten (10) year warranty or approved equal. (3” lateral feed to green complex)

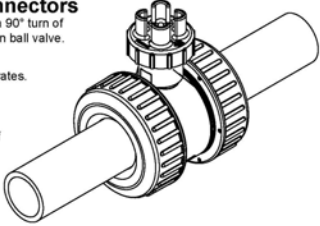
#### **Lateral Ball Valves**

- **2” Lateral Isolation Valve to be used with 2” lateral HDPE pipe (Tees & Fairways)**
- **3” Lateral Isolation Valve to be used with 3” lateral HDPE pipe (Greens)**

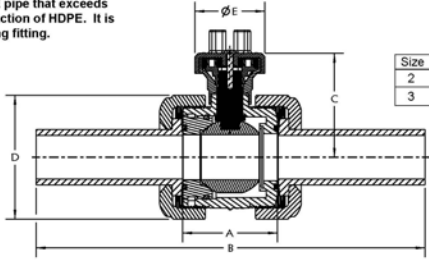
Lateral isolation valves shall be a (2” or 3”) SLO-CLOSE full block true union ball valves with HDPE 3408 Spigot DR11 end connections, as manufactured by LASCO V20101HD-SC or equal. They are to be joined to HDPE pipe using standard butt fusion equipment, 2” or 3”IPS socket coupling or electro-fusion couplings, following equipment manufacture’s recommendations. The valve assembly shall be attached to mainline 4” and above beginning with a two inch (2” or 3”) FRIALEN or CENTRAL electro-fusion or side wall branch saddle by mainline size followed by a (2” or 3”) FRIALEN or CENTRAL socket or electro-fusion coupling (if needed), followed, (2” or 3”) HDPE pipe length required to raise the assembly to the specified lateral pipe depth (if needed), followed by a (2” or 3”) IPS molded HDPE 90 degree elbow, the (2” or 3”) SLO CLOSE Valve butt fused to the (2” or 3”) lateral pipe or (2” or 3”) IPS socket coupling. Assembly shall be installed in a 10” round valve box with a 4” PVC plastic sleeve around valve skirt. SLO-CLOSE valves must be installed following the flow arrow located on the side of the valve. (See Detail Below)

**Submittal Drawing: HD-SC Series Thermoplastic True Union Ball Valve with HDPE End Connectors**  
Designed for turf irrigation, and many other applications. Patented gear drive thermoplastic handle mechanism allows for a 360° rotation of the handle to achieve a 90° turn of the ball. This gradual open/close actuation greatly reduces the opportunity for shock or hammer experienced by the sudden open/closure of a standard quarter-turn ball valve.

- Handle features a cross to accept standard sprinkler key wrench for buried service actuation.
- Replaces brass or bronze gate valves for irrigation uses.
- Thermoplastic construction eliminates process and atmospheric corrosion.
- True Union End Connectors allow for easy and quick removal from line.
- Follow published guidelines to de-rate pressure for elevated process temperature. Avoid prolonged exposure to direct sunlight during installation.
- Slo-Close valves are for Open or Closed operation. Do not attempt to meter or throttle by leaving valve in partially open/closed position.
- Spigot ends are to be joined to HDPE electro-fusion fittings, or compression adapters, following equipment manufacturers' recommendations. **This valve is not suitable for butt fusion in a section of HDPE pipe that exceeds 24" in length due to thermal expansion and contraction of HDPE. It is designed to be connected to a directional-changing fitting.**
- End connectors are HDPE spigot ends meeting DR11 dimensions.
- Full port design - same I.D. as Sch 80 pipe minimizes turbulence at high flow rates.
- Floating ball design for positive seal.
- Dual Stem o-rings for extra protection against leaks.
- Repairable: A complete inventory of repair parts is readily available.
- Valves should be installed such that the center-line of the pipe is a minimum of 18" below grade. We recommend a double valve box allowing access to the union nuts to facilitate simple future maintenance or repair.



Dimensions (Inches):	2"	3"
A	4.19	5.56
B	16.10	17.47
C	5.54	6.40
D	5.30	5.68
E	2.88	2.88

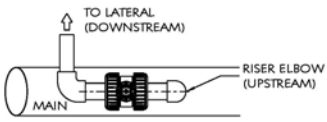


Size	Model	Material	Pressure Rating
2	V20101HD-SC	PVC/EPDM PTFE Seats	160 psi, non-shock water at 73° F.
3	V30101HD-SC	PVC/EPDM PTFE Seats	150 psi, non-shock water at 73° F.

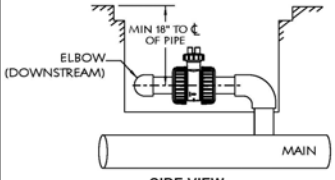
[Also see Colonial Full Block® True Union Ball Valve 101N Series for a complete size range of standard quarter-turn valves, manual or automated.]

❖ 360° turn clockwise to close.

**Recommended Installation Layout**



**Recommended Burial Depth**



**Sample Engineering Specifications:**  
True Union Ball Valves shall be produced of PVC Type I, cell classification 12454 material. Valve handle shall have a gear-mechanism allowing for a 360° rotation of the handle to achieve a 90° turn of the ball and shall be activated manually by hand or by use of a standard sprinkler key wrench. Valve o-rings shall be made of EPDM material. Valve stem shall have two o-rings. Valve seats shall be produced of Teflon® material. End connectors shall be of ASTM 3408 material and DR11 dimensions. Colonial HD-SC Series® TUBV.

SLO-OPEN / SLO-CLOSE TRUE UNION BALL VALVE (HDPE ENDS)		Colonial ENGINEERING INC.	
MODEL	MB	SIZE	B
REV	EJL	DATE	1 OF 1
REV	MB	DATE	-
DATE	12-2-09	UNITS	INCH
			<b>K29003</b>

### Drain Valves

A two inch (2") SLO-CLOSE full block true union ball valves with HDPE 3408 Spigot DR11 end connections, as manufactured by LASCO V20101HD-SC or equal shall be installed on any low points in mainline isolation sections to allow for water to be quickly removed from the system for maintenance. The valves shall be mounted on a two inch (2") FRIALEN or CENTRAL electro-fusion or side wall branch saddle by mainline size on the bottom of the pipe followed by a 2" FRIALEN or CENTRAL electro-fusion coupling or socket (if needed), followed by a 2" IPS molded HDPE 90 degree elbow, the 2" SLO CLOSE Valve butt fused to the 2" lateral pipe or 2" IPS socket coupling. Assembly shall be installed in a 10" round valve box with a 4" PVC sleeve around valve skirt. Drain valve assemblies shall be installed for maintenance on any low points in mainline isolation sections to allow for water to be quickly removed from the system with 2" pipe installed to the nearest lake, creek, drain or point of relief. The relative location is indicated on the irrigation plans, but should be field adjusted to the lowest point.

### Air Release Valves

A two inch (2") Plastic Bermad 02-ARC-P or equal air release valve shall be installed on any high inflection points in long runs (100' or greater) of piping without sprinkler head outlets. The relative location is indicated on the irrigation plans, but should be field adjusted to the highest point. The valves shall be mounted on a two inch (2") FRIALEN or CENTRAL electro-fusion or side wall branch saddle by mainline size followed by a 2" PVC SCH80 nipple, length required to service the assembly, a two inch (2") Standard threaded ball valve, a two 2" x 4" SCH80 nipple terminating at the air release valve. This assembly shall be installed in a 14" by 23" minimum valve box with lid mounted at grade level to allow for access and maintenance.

**4. Valve Boxes**

The CONTRACTOR shall install all gate valves, isolation valves, remote control valves, drain valves, air relief valves, ground rods, electrical splices, etc. in high impact plastic valve boxes per the details on the plans to provide easy access to the installed component. Valve boxes shall be manufactured by Carson, Ametek, Brooks, and be of the following size:

- Mainline and Lateral Valves - 10" Round, Marked "Irrigation" *Purple in color, locking cover*
- Quick Couplers- 6" Circular, Marked "Irrigation" *Purple in color, locking cover*
- Ground Rods @ two-way cables on mainline- 10" Circular, Marked "Electrical", locking lid
- Switches - 10" Circular, Marked "Electrical", locking lid
- Two-Way-Cable Spice - 10" Circular, Marked "Electrical", locking lid
- Elec. Splices – 10" Circular, Marked "Electrical", locking lid
- Multi-Pack Decoder Boxes - 12" Rectangular (minimum), Marked "Electrical", locking lid
- Air Release – 14" x 23" Rectangular (minimum), Marked "Irrigation" *Green in Color*
- Drain Valve - 10" Circular, Marked "Irrigation" *Purple in color, locking cover*

Valve boxes shall be installed with the appropriate extensions per the manufacturer to bring the valve box level with existing grade. Pea gravel shall be installed in the floor of each automatic valve box. Valve box lids in turf areas shall be green and those in native soil, bark or mulch shall be tan.

**5. Flushing**

Extreme care shall be used at all times during flushing and pressurization. Mainlines shall be flushed as each section is added to the system and a gate valve installed. Lateral lines should not be connected to the mainline prior to flushing of the mainline. Laterals must be flushed prior to installation and operation of the sprinklers. Any flushing through the sprinklers may result in the replacement of the sprinkler subjected to flushing with a new sprinkler and the CONTRACTOR will be responsible for all labor and materials necessary in the replacement.

**6. Inspection**

The CONSULTANT, ARCHITECT and OWNER reserve the right and access to inspections of the installation whenever necessary. The CONTRACTOR shall provide any labor and equipment required to successfully test and inspect the work. Inspections include, but may not be limited to, the following:

- a. Inspection of materials to be used on the project.
- b. General inspection of installation by the CONSULTANT, ARCHITECT and OWNER'S REPRESENTATIVE.
- c. Installation inspections in regards to scheduling, materials, pipe depth, compaction, wiring and splices, grounding, cleanup and as-built field notes.
- d. Proper sprinkler location, coverage patterns and performance.
- e. Leakage test of the piping system and all valves.
- f. Inspection for trench settlement, proper grading and compaction of trenches, sprinklers, valve boxes and all components upon completion of the installation.
- g. Inspection for satisfactory repair, as a result of installation, of any damage to asphalt surfaces, blacktop, roadways, landscape, etc.
- h. Testing of the automatic operation of all irrigation equipment.
- i. Acquire construction record photography from the contractor and combine with other site visit photography.

**7. HDPE Pipe Testing**

The mainline and lateral piping system is to be fused to withstand Bend Back testing as determined by ASTM F2620-06. Testing shall occur at a minimum once per operator, per diameter, per week. At any time a new operator is fusing pipe, a Bend Back test is required. At any time during the fusion process the CONSULTANT or OWNER's REPRESENTATIVE has the right at any time to have a Back Bend test administered at their discretion. Fusing Operator must document with a silver sharpie pen, each test specimen by marking date of fusion, operator's full name, diameter of pipe tested and must mark as "pass or fail" and store in one place for proof of compliance. Back Bend test procedures as followed but may not be limited to:

**Butt Fusion Qualification:**

- a. Prepare a sample joint. Sample lengths should be at least 6" or 15 times the minimum wall thickness.
- b. Observe the fusion process and verify the recommended procedure for butt fusion is being followed.
- c. Visually inspect the sample joint for quality.
- d. Allow the joint to cool completely (minimum of one hour).
- e. The sample should be cut lengthwise into at least three longitudinal strip with a minimum of 1" or 1.5 times the wall thickness in width.
- f. Visually inspect the cut joint for any indications of voids, gaps, misalignment or surfaces that have not been properly bonded.
- g. Bend each sample at the weld with the inside of the pipe facing out until the ends touch. The inside bend radius should be less than the minimum wall thickness of the pipe. In order to successfully complete the bend back, a vise may be needed. For thick wall pipe, a hydraulic assist may be required.
- h. The sample must be free of cracks and separations within the weld location. If failure does occur at the weld in any of the samples, then the fusion procedure should be reviewed and corrected. After correction, another sample weld should be made per the new procedure and re-tested.

**Saddle Fusion Qualification:**

- a. Prepare at least two sample joints. The main pipe length should be a minimum of 2' or seven times the maximum saddle fitting base dimension, whichever is greater.
- b. Observe the fusion process and verify the recommended procedure for saddle fusion is being followed.
- c. Visually inspect the sample joint for quality.
- d. Allow the joint to cool completely (minimum of one hour). The main should not be tapped for this qualification process.
- e. Cut the joint lengthwise along the main pipe and through the saddle fitting.
- f. Visually inspect the joint for any voids, gaps, misalignment or surfaces that have not been properly bonded.
- g. Bend each test strip 180 degree with the inside facing out.
- h. The fusion joint must be free of cracks, voids, gaps and separations.
- i. Test the other sample joint by impact against the saddle fitting. The failure must occur by either tearing the fitting, bending the fitting at least 45degrees or by removing a section of the pipe. Failure at the fusion is not acceptable. This test is a federal requirement for qualification of fusion procedures, but is not a requirement for individual qualification.
- j. If failure does occur at the weld in any of the samples, then the fusion procedure should be reviewed and corrected. After correction, another sample weld should be made per the new procedure and re-tested.

**8. Balance and Adjustment**

The CONTRACTOR shall balance and adjust the various components of the sprinkler system so that the over-all operation of the system is most efficient. This includes a synchronization of the controllers, adjustments to pressure regulators, pressure relief valves, part circle sprinkler heads and individual station adjustments on the controllers. The CONTRACTOR may request the MANUFACTURER or OWNER'S REPRESENTATIVE to assist in the balancing and adjustment of the system as it relates to its function and operation.

**9. Notice of Completion**

When the CONTRACTOR is satisfied that the system is operating properly, that it is balanced and adjusted and that all work and clean up is completed, he shall issue the notice of completion to the CONSULTANT. The notice of completion shall include the request for final inspection with date and time given. The inspection shall occur upon final completion of the installation but prior to the re-setting of the sprinklers after the settling process.

**10. Final Inspection with OWNER'S REPRESENTATIVE**

The CONSULTANT or ARCHITECT will respond to the notice of completion by the CONTRACTOR and shall appear at the given time for a tour of the project with the purpose of making it the final inspection. Any inconsistencies in regard to the specifications shall be noted by the CONSULTANT and OWNER'S REPRESENTATIVE and a written copy of correction shall be given the CONTRACTOR.

## SECTION 6 - SPRINKLERS AND IRRIGATION VALVES

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**1. Sprinklers**

The installation of sprinklers shall include the furnishing of all equipment and components necessary to completely install the sprinkler and shall include, but not be limited to, excavation and backfill, swing joint risers assembly, sprinklers, wire and restoration to grade in accordance with these plans and specifications.

**a. Large Turf Sprinkler Materials**

Sprinklers shall be of the types, nozzles and sizes indicated on the plans and capable of producing the radius of throw, flow, pressure and any other designations as indicated on the drawings. Sprinklers shall meet the following requirements:

- a. All V-I-H sprinklers shall be electric actuation.
- b. Each sprinkler shall include an Integrated Control System or Toro Decoder sprinkler (If Applicable).
- c. Pressure regulated with a pre-set pressure of **80 PSI MAX.**
- d. Sprinkler tops to be marked “lavender” (**Effluent Model**)
- e. Cases shall be constructed of high impact molded plastic.
- f. Sprinkler internal and valve shall be serviceable through the top of the sprinkler.
- g. Carry a minimum three year unconditional warranty.
- h. ACME inlet threads are required on V-I-H sprinklers.
- i. Manufacturer may be required to supply a replacement nozzle for each sprinkler at no additional charge.
- j. Acceptable models: Toro-DT, Rain Bird, Rain Bird- ICM body or Hunter

<b>Legend</b>	<b><u>Toro</u></b>	<b><u>Rain Bird</u></b>	<b><u>Hunter</u></b>
75’ Spacing Full Circle V-I-H-H	DT54-55	900E-52	G880E-33P8S
65’ Spacing Full Circle V-I-H-H	DT54-53	700E-40	G870E-23P8S
75’ Spacing Part Circle V-I-H-H	DT55-55	950E-22C	G995E-48P8S
65’ Spacing Part Circle V-I-H-H	DT55-33	751E-40	G875E-23P8S

**b. Sprinkler Installation (Satellite System)**

The CONTRACTOR will remove all existing sprinklers on the site during construction. Part circle sprinklers staked along cart paths shall be installed at a 1’ offset from the pavement. The CONTRACTOR must coordinate the location of the finished pavement to insure that the sprinklers are located within 1’ of the pavement.

Sprinklers shall be installed at grade upon initial installation. Two (2) months after completion of the installation, the CONTRACTOR will be required to return to the project and reset any sprinklers that have settled. All sprinklers shall be backfilled and hand tamped to 95% compaction to avoid future settling. Swing joint installation shall be consistent throughout the project with the sprinklers laying away from the green and to the right side of the pipe. Extreme care shall be taken to prohibit trash from entering the piping and swing joints during installation of the sprinklers. Sprinklers in areas of excessive slope shall be adjusted level for maximum sprinkler performance without exposing the sprinkler case to damage from mowers or other equipment. The CONTRACTOR shall install a small coil of tubing at each valve-in-head sprinkler to

allow for maintenance. A wire shall be run from the satellite to each sprinkler. Three (3) spare wires shall be installed to the quick coupler at each green. The location of the spare wires shall be marked on the contractor's field notes and "as-built". The CONTRACTOR shall be responsible for all adjustments necessary to insure the proper coverage and operation. All adjustable part circle sprinklers shall also be properly adjusted by the CONTRACTOR prior to final checkout of the system. All sprinklers having adjustable pin nozzles shall have such pin adjusted for proper distribution prior to planting and final checkout of the system.

**c. Sprinkler Installation**

The CONTRACTOR will remove all existing sprinklers on the site during construction. Part circle sprinklers staked along cart paths shall be installed at a 1' offset from the pavement. The CONTRACTOR must coordinate the location of the finished pavement to insure that the sprinklers are located within 1' of the pavement.

Sprinklers shall be installed at grade upon initial installation. Two (2) months after completion of the installation, the CONTRACTOR will be required to return to the project and reset any sprinklers that have settled. All sprinklers shall be backfilled and hand tamped to 95% compaction to avoid future settling. Swing joint installation shall be consistent throughout the project with the sprinklers lying away from the green and to the right side of the pipe. Extreme care shall be taken to prohibit trash from entering the piping and swing joints during installation of the sprinklers. Sprinklers in areas of excessive slope shall be adjusted level for maximum sprinkler performance without exposing the sprinkler case to damage from mowers or other equipment. The CONTRACTOR shall install a small coil (18" minimum) of two-way-cable at each valve-in-head sprinkler to allow for maintenance. Three way wire splices shall be installed at a valve box or sprinkler only. The location of the ground assemblies and splices shall be marked on the CONTRACTOR'S "as-built" field notes. The CONTRACTOR shall be responsible for all nozzle adjustments necessary to insure the proper coverage and operation. All adjustable part circle sprinklers shall also be properly adjusted by the CONTRACTOR prior to final checkout of the system. All sprinklers having adjustable pin nozzles shall have such pin adjusted for proper distribution prior to planting and final checkout of the system.

**2. Quick Coupling Valves**

Quick coupling valves shall be installed each green complex and where indicated on the plans for rough areas and meet the following requirements:

- a. One-piece brass construction with **1 1/2"** inlet thread minimum.
- b. Install utilizing a LEEMCO, HARCO or LASCO stabilizing anchor.
- c. Lasco 1 1/2" ACME threaded inlet 1 1/2" NPT threaded outlet 12" swing joint.
- d. Non-potable, purple Cap w/ 6" valve box.

Material supplier shall supply two (2) quick coupler valve keys compatible with the valves installed. All keys shall be fitted with hose swivels to accommodate one-inch (1-1/2") hose.

## **SECTION 7 - AUTOMATIC SATELLITE CONTROL & ELECTRICAL**

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### **1. Central Controller**

The central control system shall be a wireless Toro Linx with T-Map, Rain Bird Nimbus II, Hunter Surveyor with all necessary antennas shall be installed at the maintenance building. The Rain Bird Nimbus II shall include the following modules:

- Weather software
- Freedom System
- Map Utilities
- Station Layers-Map Options

The irrigation computer shall be installed prior to commencement of **project**. The irrigation central controller shall be a IBM compatible computer based package of the latest model as specified by the irrigation software manufacturer and shall include the CPU, software, printer, monitor, modem, cables, antennas, irrigation interface units, surge suppression, programming and training manuals as specified herein and any other items necessary to insure complete operation of the irrigation system. Central controller shall be fully compatible with the satellite controllers used in the system.

A hand held wireless portable radio system for irrigation control must be installed to include all antennas, surge suppression devices, cabling and three (3) hand held radios. All frequencies required for any radio equipment are the responsibility of the CONTRACTOR. The CONTRACTOR shall coordinate a site survey with the irrigation material supplier to perform a site survey, preferably prior to submitting a bid. In either instance, any additional antennas required to make each satellite fully functional to the central computer located at the maintenance building is the responsibility of the CONTRACTOR.

The CONTRACTOR shall be responsible for the installation of all central computer components and certify communication to all field components. Location of the central controller shall be in the maintenance building and installed per the following specifications and any manufacturer's recommendations

#### **a. Irrigation Software**

Irrigation system software shall be of the latest release version and include a 5-year complete warranty and service program. The manufacturer shall agree to provide any software releases for a period of twelve (12) months following **final acceptance** of the system by the OWNER.

#### **b. Irrigation Computer**

The irrigation computer shall be latest model approved by the irrigation manufacturer and meet the following minimum requirements:

- a. Intel Pentium 4 micro-processor, 3 GHz Core 2 Duo Processor, 2 GB MHz DDR2 RAM, Mini Tower.
- b. 160 GB hard drive, 32MB video card, sound card, speakers, keyboard and PS2 mouse. Additional serial port for expansion.
- c. **Remote Access: NSN Connect, Team Viewer, PC Anywhere or accepted equivalent.**
- d. Must have internet connection capabilities.
- e. 4 Integrated USB drive ports.
- f. DVD/CD-RW Combo Drive.

- g. 24" SVGA Color Monitor.
- h. Adequate ports to connect to all peripherals and a Weather Station.
- i. Surge protection for all electrical and telephone connections.
- j. Five (5) Year Warranty.
- k. Printer shall be a high-speed color Inkjet model HP DeskJet for Windows or approved equal, or as recommended by the irrigation system controls manufacturer.
- l. The control system manufacturer must have the capability to supply twenty-four (24) hour replacement of all central computer components in the event of failure.

## 2. **Field Satellite Controllers**

The field satellite controllers shall be wireless and compatible with the central computer. The concrete pads, satellites shall be installed per the manufacturer's recommendations. Controllers shall be as located and installed as shown on the plans and details. Each satellite shall be installed to allow for expansion of (4) stations per hole per location. Each satellite shall be fully surge protected as specified in the plans and details or as recommended by the manufacturer for 240VAC power. Satellites shall be supplied with the following features:

- a. Housed in a heavy-duty temperature and chemical resistant high impact plastic pedestals.
- b. UL Listed.
- c. Electric actuation
- d. Removable access panels for ease of installation and maintenance.
- e. Include all necessary cabling and connections. Capable of providing a minimum of 24 stations.
- f. Acceptable Models:
  - Toro – E-Series OSMAC
  - Toro – E-Series OSMAC Hydraulic to Electric Conversion Kit
  - Rain Bird – Par Plus-ES Link
  - Hunter: VSX Field Controllers

## 3. **Weather Station –Wireless**

A weather station shall be installed as located on the irrigation plans per the irrigation manufacturer's recommendations. The weather station shall be fully surge protected as recommended by the manufacturer for 120VAC power. The weather station and software shall be supplied with the following features:

- a. Communication shall be wireless.
- b. Mounted on an aluminum pole and an outdoor environmental enclosure.
- c. Provide remote sensors to monitor air temperature, wind speed, solar radiation, wind direction, relative humidity, and rainfall.
- d. All software required to allow automatic download and Evapotranspiration (ET) calculation from the weather sensors.
- e. Allow automatic rain shut-off of the central irrigation system  
Communicate to and allow monitoring from the irrigation central computer via direct connection.

## 4. **Wiring**

**The CONTRACTOR shall insure that all wiring shall be in accordance with all local codes and manufacturer's specifications. The CONTRACTOR shall verify prior to installation that conduit is not required.** Wiring shall be as manufactured by PAIGE electric or approved equal. Upon receiving materials, all wire shall be inspected by the OWNER'S REPRESENTATIVE prior to installation. The OWNER will provide all properly sized and fused electrical disconnects and panels for the irrigation system. The CONTRACTOR shall

provide all wiring, conduit, labor, equipment and any other items necessary to connect field wiring to these power sources.

All wiring where feasible shall be installed in a continuous manner without splicing. Any splices that must occur other than in satellites pedestals shall be located in plastic valve boxes with locking covers and marked as "Electrical" per the details in the plans. All splices shall be located on the revised "As-Stacked Drawings." Wire shall be checked immediately upon installation for resistance and continuity. Grounding shall be completed simultaneously with the satellite installation. All grounding shall be installed in accordance with the plans, specifications and manufacturer's specifications prior to connection of the 240VAC power to the satellites.

**a. Power Wire Materials**

All power cables are type Tray Cable to be UL listed for direct burial, and rated at 600 volts approved for underground direct burial and meet the following requirements:

1. The cable shall include three conductors, which are to be colored per wire industry standard or numbered as 1, 2, and 3.
2. The size of the "hot" and "common" conductors are to be as shown on the irrigation plans, and the size of the "ground" conductor as required by the National Electrical Code, or larger.
3. The inner copper conductors shall be covered with high dielectric PVC and Nylon. The outer jacket will be black PVC and is to be sunlight resistant.
4. All wire shall be furnished in 2,500 ft. reels where possible, or 1,000 ft. reels as a minimum.
5. All power wire shall be supplied by the same manufacturer.
6. Approved power cable shall be Paige Electric Co., LP specification number P7266D for 10 AWG and smaller and specification number P7267D for 8 AWG and larger or equal.

**b. Power Wire Installation**

The CONTRACTOR shall install all 240 VAC power wire as per the installation specifications of the irrigation control system manufacturer as well as the plans, specifications and to meet the follow requirements:

1. All wiring shall be installed in accordance with all applicable electric codes.
2. All wire shall be installed in 2" conduit with pull boxes installed at a minimum of 300' or at changes in pipe direction **(only if applicable per building code)**.
3. Any mainline trench that does not include power wire should have a blue 24-volt tracer wire installed to the nearest satellite. Blue should not be used for any other purpose. No mainline trench should be installed without a wire available for tracing.
4. Wiring shall be installed in mainline trenches adjacent to and two (2") inches below the top of piping.
5. Install with a minimum of twenty-six inch (26") cover.
6. All field satellites are to be grounded in accordance with all ASIC, local code and the manufacturer's recommendations.
7. All splices shall be made with Scotchcast epoxy splice kits #82-A, #82-A1, #82-A2, #82-A3, or wye splice #82-B1, #90-B1, or approved equal.
8. All above ground wiring shall be installed in conduit per applicable codes.

**c. 24-Volt Wire**

Wires connecting the remote control valves to the irrigation controller are single conductors, type PE. Its construction incorporates a solid copper conductor and polyethylene (PE) insulation with a minimum thickness of 0.045 inches. The wires shall be UL listed for direct burial in irrigation systems and be rated at a minimum of

30 VAC. Approved wire is Paige Electric Co., LP specification number P7079D or equal. All common wires shall be sized as #12 and all hot wire as #14

All 24-volt wire splices and connections to sprinkler wires shall be made in DBY watertight connectors. Wires shall be affixed with numbered labels in the satellite. Three (3) spare hot and one (1) common should be supplied to the green and tee quick coupler assembly for each hole. The spare wires should also be differentiated by color. Blue should only be used for mainline tracer wires.

A separate wire shall be run from each sprinkler to the satellite. All sprinklers shall be wired for individual operation. If pairing of sprinklers is deemed to be required by the OWNER, all approach, tee, and green sprinklers may be wired for individual operation. Adjacent part circle sprinklers other than greens or tees may be paired if they are set at the same arc. Pair sprinklers on separate pipelines where possible. Pairing of sprinkler wires where approved shall be done in the satellite and not in the field. Each wire shall be clearly numbered with an adhesive label in the pedestal for easy identification.

## 5. Grounding

All satellite power sources, the central controller and irrigation satellite locations shall be grounded to meet the manufacturers' specifications.

It is the responsibility of the CONTRACTOR to provide surge protection for all electrical equipment installed by him in relation to the irrigation contract. Said protection shall include but not necessarily be limited to the items described above and in the following paragraphs. The CONTRACTOR shall place a good grounding conductor system at each automatic controller (or control group) location to meet the ASIC grounding standards in the detail drawings and in the specifications below. The installed grounding system should have a reading of no more than 10 ohms resistance to the ground in which it is placed. Resistance to the grounding electrode shall be measured by using a MEGGER direct reading Earth Resistance Testing instrument as manufactured by James G. Biddle Co. of Plymouth Meeting, Pennsylvania or a similar type of measuring instrument.

### NOTE:

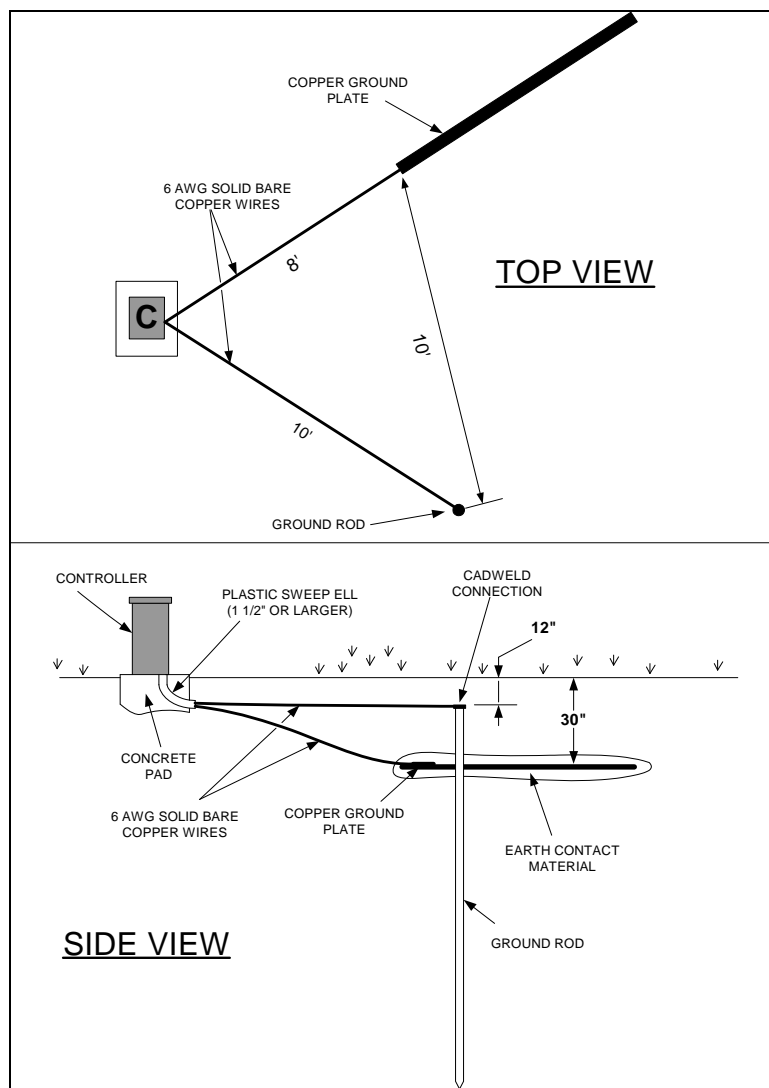
- 0- 5 Ohms—Excellent Grounding Protection
- 5 - 10 Ohms—Good Grounding Protection
- Above 10 ohms—Resistance is considered a poor ground and steps must be taken to improve the grounding conditions.

The CONTRACTOR shall have the right to seek assistance from the manufacturer or its local representative in the testing of any grounds. A minimum of 10 ohms resistance to ground is to be achieved. The CONTRACTOR shall install all grounding equipment described above and as described in the control system manufacturer's literature in an attempt to reach this level.

Where specified methods do not reach required levels, the CONTRACTOR may be asked to install additional grounding equipment as dictated by local conditions. The CONTRACTOR will be compensated for this additional wiring and equipment installation as negotiated by the CONSULTANT for the OWNER.

**a. EARTH GROUNDING**

It is the responsibility of the installer to connect all electronic irrigation equipment for which he is responsible to earth ground in accordance with Article 250 of the National Electrical Code (NEC.) Grounding components will include the items described in the following paragraphs, at a minimum. Use grounding electrodes that are UL listed or manufactured to meet the minimum requirements of Article 250-52 of the 1999 NEC. At the very minimum, the grounding circuit will include a copper clad steel ground rod, a solid copper ground plate and 100 pounds of PowerSet® earth contact material, as defined below and per the following detail.



Ground rods are to have a minimum diameter of 5/8” and a minimum length of 10 feet. These are to be driven into the ground in a vertical position or an oblique angle not to exceed 45 degrees at a location 10 feet from the electronic equipment, the ground plate, or the wires and

cables connected to said equipment, as shown in the detail above. The rod is to be stamped with the UL logo, Paige Electric part number 182007 or equal. A 6 AWG solid bare copper wire (about 12 feet long) shall be connected to the ground rod by the installer using a Cadweld Plus Control Unit welding kit, Paige Electric part number 1820037 or equal. This wire shall be connected to the electronic equipment ground lug as shown in the detail above. The copper grounding plate assemblies must meet the minimum requirements of Article 250-52(d) of the 1999 NEC, Paige Electric part number 182199L or equal. They are to be made of a copper alloy intended for grounding applications and will have minimum dimensions of 4" x 96" x 0.0625". A 25-foot continuous length (no splices allowed unless using exothermic welding process) of 6 AWG solid bare copper wire is to be attached to the plate by the manufacturer using an approved welding process. This wire is to be connected to the electronic equipment ground lug as shown in the detail of page 1. The ground plate is to be installed to a minimum depth of 30", or below the frost line if it is lower than 30", at a location 8 feet from the electronic equipment and underground wires and cables. Two 50-pound bags of PowerSet<sup>®</sup>, Paige Electric part number 1820058 or equal, earth contact material must be spread so that it surrounds the copper plate evenly along its length within a 6" wide trench. Salts, fertilizers, bentonite clay, cement, coke, carbon, and other chemicals are not to be used to improve soil conductivity because these materials are corrosive and will cause the copper electrodes to erode and become less effective with time.

Install all grounding circuit components in straight lines. When necessary to make bends, do not make sharp turns. To prevent the electrode-discharged energy from re-entering the underground wires and cables, all electrodes shall be installed away from said wires and cables. The spacing between any two electrodes shall be so that they don't compete for the same soil.

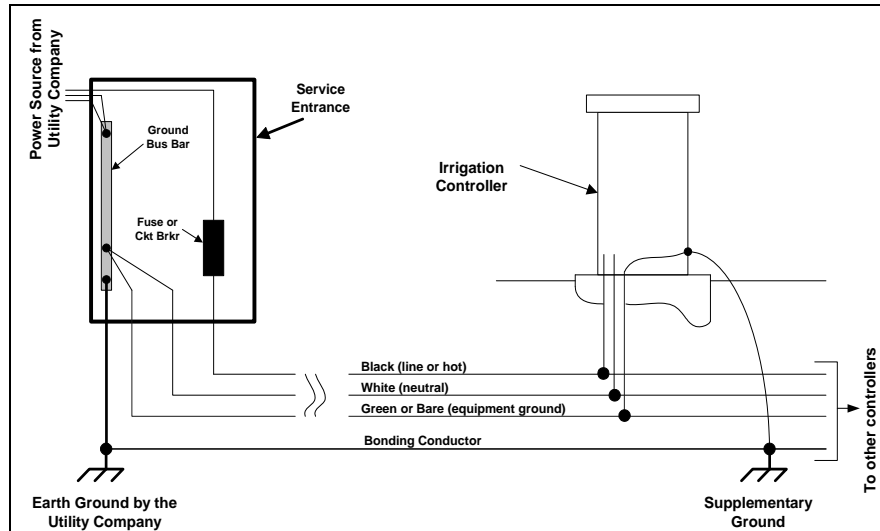
The earth-to-ground resistance of this circuit is to be measured using a Megger<sup>®</sup>, or other similar instrument, and the reading is to be no more than 10 ohms. If the resistance is more than 10 ohms, additional ground plates and PowerSet<sup>®</sup> are to be installed in the direction of an irrigated area at a distance of 10', 12', 14', etc. It is required that the soil surrounding copper electrodes be kept at a minimum moisture level of 15% at all times by dedicating an irrigation station at each controller location. The irrigated area should include a circle with a 10-foot radius around the ground rod and a rectangle measuring 1-foot X 24-feet around the plate.

All underground circuit connections are to be made using an exothermic welding process by utilizing products such as the Cadweld "Plus" color coated container kits. Solder or "One Shot" shall not be allowed to make connections. In order to ensure proper ignition of the "Plus System", the Cadweld Color Coated Containers must be utilized by the size identification ring color chart used by Cadweld "Plus" grounding applications. The 6 AWG bare copper wires are to be installed in as straight a line as possible, and if it is necessary to make a turn or a bend it shall be done in a sweeping curve with a minimum radius of 8" and a minimum included angle of 90°. Mechanical clamps shall be permitted temporarily during the resistance test process, but are to be replaced with Cadweld "Plus" color coated container kits immediately thereafter.

**b. BONDING**

The above grounding circuit is referred-to as "supplementary grounding" in the NEC. And for safety reasons, the NEC requires that all supplementary grounds be "bonded" to each other and to the service entrance ground (power source) as shown below. This is also "recommended

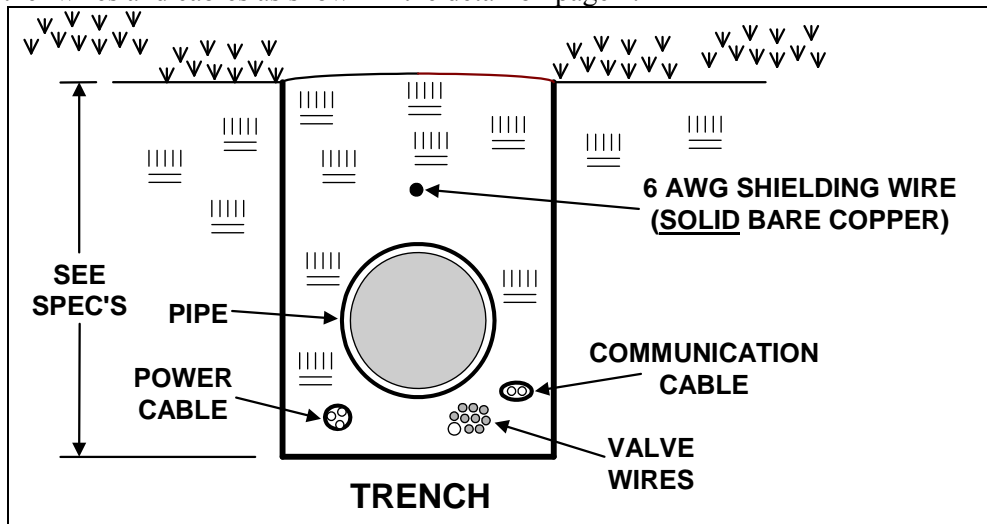
practice" of IEEE Standard 1100-1999. Note that this is in addition to the equipment ground, which is commonly referred-to as "the green wire." The Black, White and Green wires must always be kept together in a trench/conduit/tray/etc.



The bonding conductors are to be 6 AWG solid bare copper unless the system power conductors are larger than 1/0 AWG, in which case they are to be 4 AWG solid bare copper. All splices to the bonding conductors shall be made using a Cadweld Plus Control Unit kit.

**c. SHIELDING**

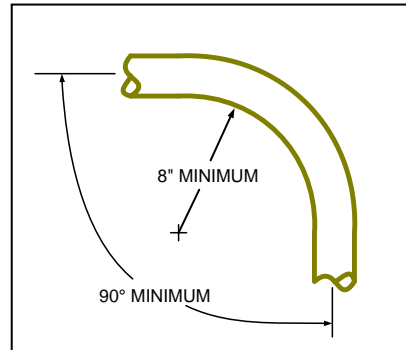
The bonding conductors are to be installed in such a way so that they also act as shielding conductors. This becomes a network of solid bare copper wire over all the main bundles of other wires and cables as shown in the detail on page 4.



The bare copper wire is to be installed as close to the surface as possible, yet being sufficiently below the ground level as to prevent damage from maintenance equipment such as aerators. And it must be placed above all other valve/power/communication wires and cables, per detail, and installed in all trenches as shown on the electrical plan drawings. It is not necessary to install this conductor over short wire runs (less than 150 feet) away from the main wire

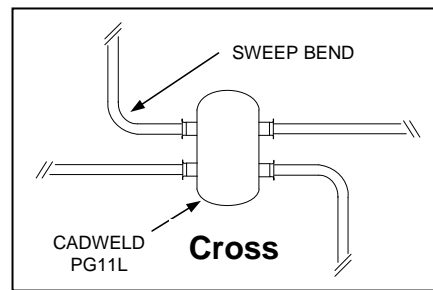
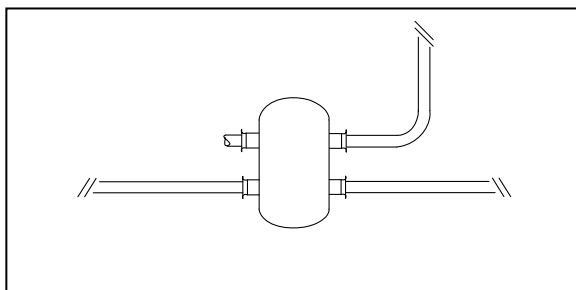
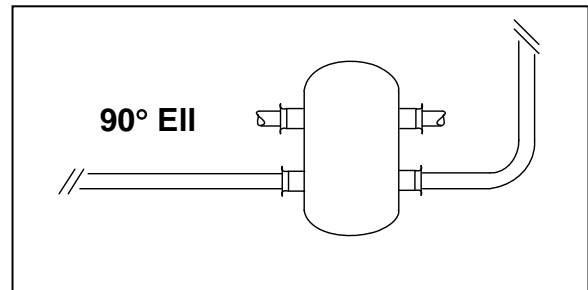
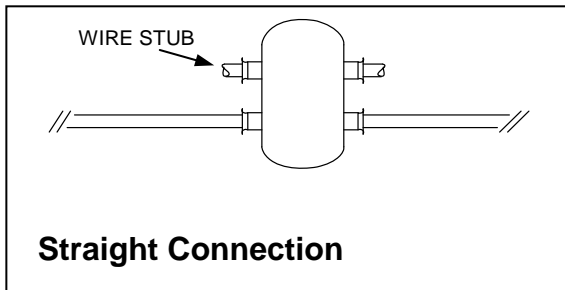
bundles. The conductor is laid in as straight a line as possible, and when necessary to make bends, do so in a sweeping motion using the following detail as a guideline.

Note: When connecting bare copper wires to the ground lug of electronic equipment, feed it through a dedicated 1 1/2" plastic sweep ell to automatically meet the requirements of the "sweep bend" shown here.



The shield network is to be connected to the service entrance earth ground, to all electronic equipment ground lugs, and all equipment supplementary grounding electrodes. One such network is necessary for each power source. Do not interconnect the equipment ground wires from different power sources.

When joining bare copper wires, do so using an Cadweld Plus Control Unit t kit as shown in the details below, Paige Electric part number 1820074 or equal.



## **SECTION 8 – TWO-WAY-CABLE CONTROL AND ELECTRICAL**

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### **1. Central Controller**

The central control system shall be a wireless Toro Linx with T-Map or Rain Bird Nimbus II with all necessary antennas shall be installed at the maintenance building. The Rain Bird Nimbus II shall include the following modules:

- Weather software
- Freedom System
- Map Utilities
- Station Layers-Map Options

The irrigation computer shall be installed prior to commencement of **project**. The irrigation central controller shall be a IBM compatible computer based package of the latest model as specified by the irrigation software manufacturer and shall include the CPU, software, printer, monitor, modem, cables, antennas, irrigation interface units, surge suppression, programming and training manuals as specified herein and any other items necessary to insure complete operation of the irrigation system. Central controller shall be fully compatible with the Decoder/ICS used in the system.

A hand held wireless portable radio system for irrigation control must be installed to include all antennas, surge suppression devices, cabling and three (3) hand held radios, plus one (1) for the CONTRACTOR. All frequencies required for any radio equipment are the responsibility of the CONTRACTOR. The CONTRACTOR shall coordinate a site survey with the irrigation material supplier to perform a site survey, preferably prior to submitting a bid. In either instance, any additional antennas required to make future Decoder/ICS remote radio modules fully functional to the central computer located at the maintenance building is the responsibility of the CONTRACTOR.

The CONTRACTOR shall be responsible for the installation of all central computer components, grounding and certify communication to all field components. Location of the central controller shall be in the pump station building and installed per the following specifications and manufacturer's recommendations.

#### **a. Irrigation Software**

Irrigation system software shall be of the latest release version and include a 5-year complete warranty and service program. The manufacturer shall agree to provide any software releases for a period of twelve (12) months following **final acceptance** of the system by the OWNER.

#### **b. Irrigation Computer**

The irrigation computer shall be latest model approved by the irrigation manufacturer and meet the following minimum requirements:

- a. Intel Pentium 4 micro-processor, 3 GHz Core 2 Duo Processor, 2 GB MHz DDR2 RAM, Mini Tower.
- b. 160 GB hard drive, 32MB video card, sound card, speakers, keyboard and PS2 mouse. Additional serial port for expansion.
- c. **Remote Access: NSN Connect, Team Viewer, PC Anywhere or accepted equivalent.**
- d. Must have internet connection capabilities.
- e. 4 Integrated USB drive ports.

- f. DVD/CD-RW Combo Drive.
- g. 24" SVGA Color Monitor.
- h. Adequate ports to connect to all peripherals and a Weather Station.
- i. Surge protection for all electrical and telephone connections.
- j. Five (5) Year Warranty.
- k. Printer shall be a high-speed color Inkjet model HP DeskJet for Windows or approved equal, or as recommended by the irrigation system controls manufacturer.
- l. The control system manufacturer must have the capability to supply twenty-four (24) hour replacement of all central computer components in the event of failure.

## **2. Field Two-Way-Cable Decoder/ICS:**

### **General Decoder/ICS Conditions**

Installation of a Decoder/ICS system shall proceed in the following general manner:

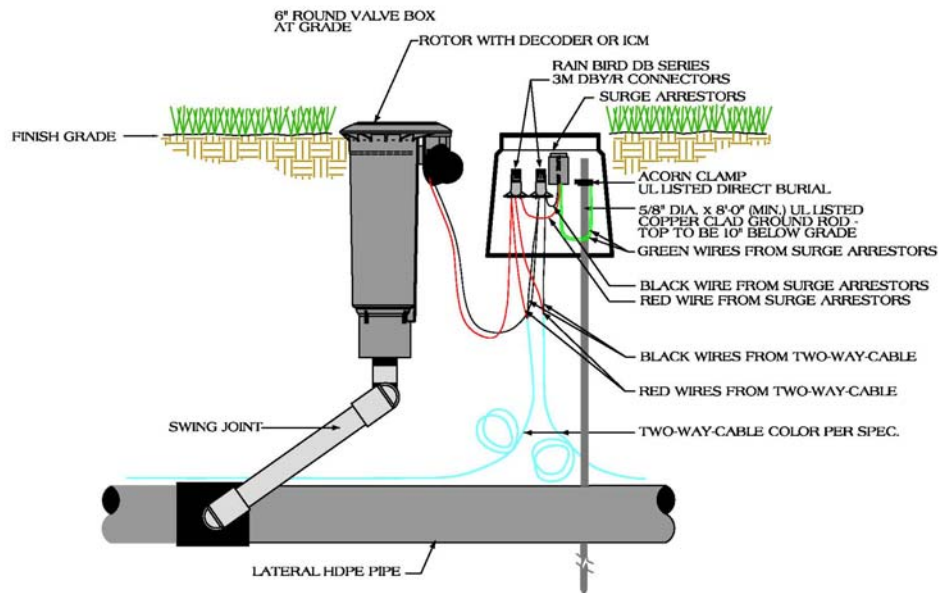
- a. The OWNER or CONSULTANT has the right to alter two-way-cable path quantities as deemed necessary before or after awarding the contract after selecting a manufacture.
- b. The CONTRACTOR shall follow manufacture specifications & installation guidelines for Toro- Integrated Decoder or Toro- GDC Decoder, Rain Bird ICS or Rain Bird Decoder and the recommended manufacturers grounding requirements at all times.
- c. Central computer to be fully operational with proper ground and remote internet service prior to commencement of the project.
- d. Field two-way-cable Decoder/ICS system does not require satellites.
- e. Start of installation to begin at the central computer location.
- f. Install and connect all grounding and surge protection as the system is installed including central control equipment ground grid and field ground rods/ plates.
- g. Two-way-cable paths must be connected to the central computer to be able to operate the irrigation system.
- h. Two-way-cable paths shall be installed in the same trench as the irrigation pipe.
- i. Two-way-cable paths shall outer jacket shall be color coated for each Two-way-cable path (Group) per manufacture specifications.
- j. #14 AWG two-way-cable path wire to be used in a star configuration. DO NOT LOOP two-way-cable paths.
- k. Individual sprinkler control shall be met at all times.
- l. Single Station Design- Decoder/ ICM per sprinkler for all green, fairways, roughs and tees.(DESIGN-A)
- m. Multi Station Design- multi pack Decoders to be used for all green, fairways, roughs and tees. (DESIGN-B)
- n. Multi Pack Decoders shall be wired one solenoid to each of the four (4) or two (2) outputs.
- o. Maximum 250 Decoders and 500 addresses on a wire path (Group). If this exceeded contact the CONSULTANT.
- p. Maximum distance with secondary wire (Paige Electric Decoder –to-Solenoid (DTS) Cables) or equal between Decoder and solenoids shall not exceed 400' when using #14 AWG. For distances up to 700' use #12AWG wire for the two-way-cable paths.
- q. Decoder to solenoid wiring shall be sized for maximum resistance of 2 Ohms.
- r. Maximum resistance in Two-way-cable paths 33 Ohms.
- s. Each Decoder/ICM valve-in-head sprinkler and electric valve shall have its own unique address/code.
- t. A minimum of 45 OHMS or less is required for the ground resistance to assure the surge arrestors being effective.

- u. All splices to be made at a sprinkler or in a separate valve box (not in mainline, lateral, drain, or air valves). In the case where a sprinkler is not available they must be placed in a 10" round valve box marked "electric".
- v. All wire splices shall have a minimum of 18" of extra wire on each side of the splice above the surface of the ground to allow the splice to be easily serviced in future.
- w. Decoder Cable Fuse Device (DCFD) must be installed along the two-way-cable path for troubleshooting per plan, installed in a valve box.
- x. Grounding to be placed every 500' (OR PER MANUFACTURE REQUIREMENTS) Ground assemblies to be placed along the mainline, at each green valve location, long run dead ends along the two-way-cable **main** path or where marked on the plan. Each ground shall be placed near the closest lateral valve with a 10" round valve box marked "electric".
- y. Grounding rods are acceptable method of grounding, if rods do not meet minimum ground resistance of **45 OHMS or less**, additional grounding rods or grounding plates must be used.
- z. Surge arrestor must be installed at each grounding location spliced with two-way-cable **main** path.
- aa. All two-way-cable paths along the mainline and laterals must have a #10 AWG bare cooper wire shield tied into each ground along the main two-way path and #6 AWG bare cooper or plates to be used to ground the central.
- bb. The 3M DBY/R, DBY-6, DBR-6 or Rain Bird DB Series are listed as "UL 486D-Direct Burial" and must be used for all splices.
- cc. Handheld radio system shall be installed to provide complete electric control of the system from any location on the golf course. Radios shall be capable of activating any station through a keypad on the radio.
- dd. CONTRACTORS are responsible to keep record of each Decoder/ICM address/code with each sprinkler, splices and ground locations on the "CRD" to be provided to the CONSULTANT **after every hole**.
- ee. The Irrigation DISTRIBUTOR & MANUFACTURE shall provide a Decoder/ICS representative from there company to make monthly site visits during construction. At the conclusion of the project the DISTRIBUTOR will be responsible for testing the grounding, sprinklers and central control system to verify that it is installed and operating per the specifications. The CONSULTANT will communicate these findings as well as the other compliance with the specifications to the OWNER during the final walkthrough. The DISTRIBUTOR will continue to monitor the operation of the system for a one year period after installation to insure the system is fully operational.
- ff. The CONTRACTOR and his wire crew personnel shall complete a 2-day onsite training on the techniques to be used on the project including; splicing, grounding, surge arrestors, wire pulling, splice tags, decoder switches, troubleshooting, shielding bond wire splices and the general use of a radio to test the system. Trainer must be qualified to issue certificate of training. Trainer must spend sufficient time with course superintendent and his crew for proper troubleshooting and maintenance procedures. The CONTRACTOR shall furnish a copy of the completion certificate to the CONSULTANT or OWNERS REPRESENTATIVE.

**3. Integrated Decoder/ICM Installation (Single Station Design)**

The Toro (Integrated Decoder) and Rain Bird (ICM) installation instructions shall be followed at all times. Two-way-cable communication wire sized at #14AWG shall be installed from the central computer location to the Decoder/ICM on that two-way-cable path (GROUP). Where the number of Integrated Decoder/ICM in each path (GROUP) exceeds the designed quantities, care must be taken not to exceed the recommended number of Integrated Decoder/ICM per wire path as recommended by the manufacturers.

All sprinklers and valves shall be controlled individually by a Integrated Decoder/ICM. A single Integrated Decoder/ICM is required for each valve-in-head sprinkler and valve, that is to operate individually and that is installed in a lateral piping system, down each hole or other locations on the course, where individual operation of the Valve-in-Head sprinkler is desired (see detail below).



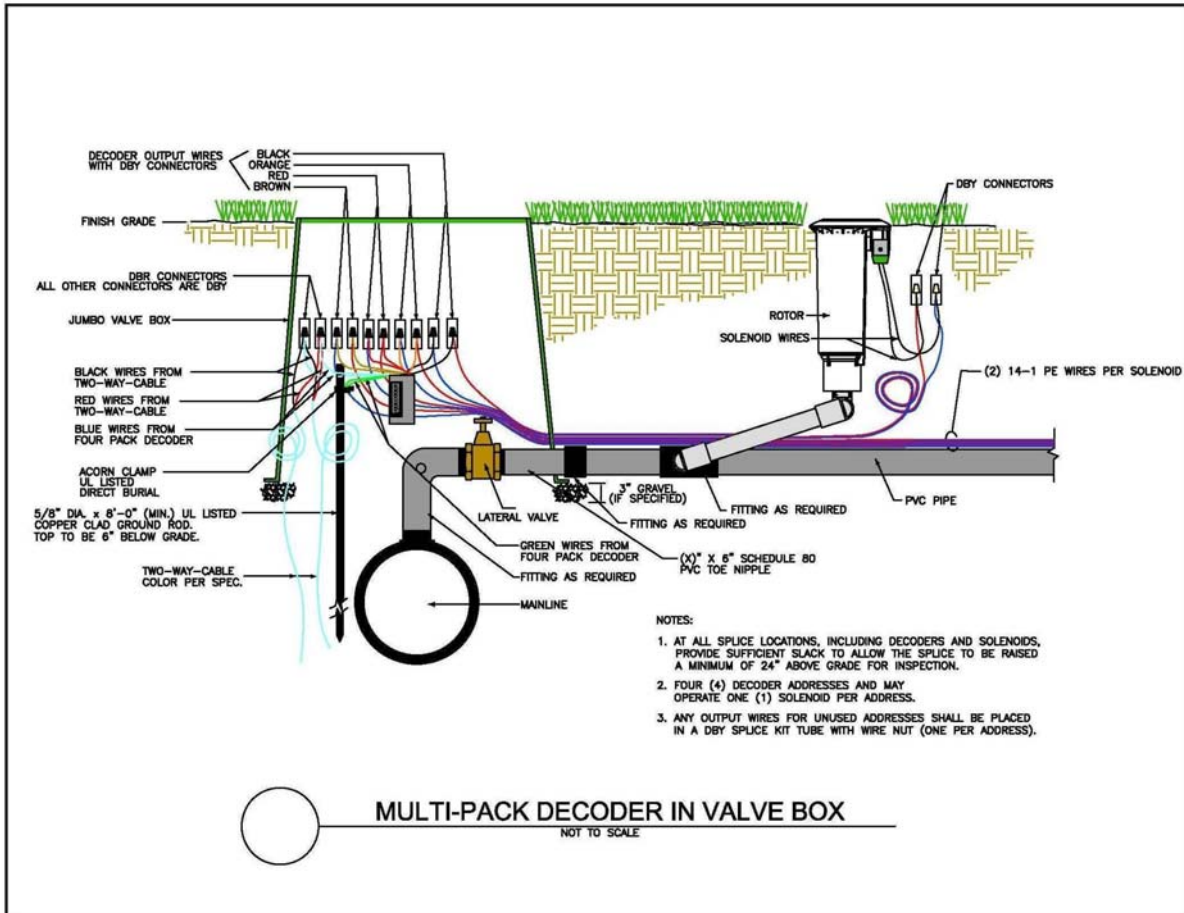
NOTE:  
1. AT ALL SPLICE LOCATIONS, PROVIDE SUFFICIENT SLACK TO ALLOW THE SPLICE TO BE RAISED A MINIMUM OF 24" ABOVE GRADE FOR INSPECTION.

 **LATERAL SPRINKLER GROUND ASSEMBLY**  
NOT TO SCALE

**Multi Pack Decoder Installation (Multi Station Design)**

The Toro GDC Decoder (Multi Pack) or Rain Bird (Multi Pack) Decoder installation instructions shall be followed at all times. Two-way-cable communication wire sized at #14AWG shall be installed from the central computer location to the Decoders on that two-way-cable path (GROUP). Where the number of Multi Pack Decoders in each path (GROUP) exceeds the designed quantities, care must be taken not to exceed the recommended number of Multi Pack Decoders per two-way-cable path as recommended by the manufacturers. 2 or 4 Multi Pack Decoders shall be installed in the 12" rectangle valve box near each Green, fairway and tee lateral valve. An adequate number of Multi Pack Decoders shall be installed at each location to provide individual control of each V-I-H sprinkler on that lateral feed. Only 4 station Multi Pack Decoders with 2 and 4 addresses and built in surge protection may be used to control the sprinklers at each location. From each Multi Pack Decoders #14 AWG, Decoder-to-Solenoid (DTS) cable wire shall be installed. The distance to any sprinkler from the Multi Pack Decoders shall not exceed

400' when using #14 AWG. For distances up to 700' use #12AWG wire for the two-way-cable paths (see detail below).



**a. Making The Wire Splice**

When making an inline wire splice use a linesman's pliers to gently twist one of the red insulated conductors to the other red insulated conductor and one of the black insulated conductors to the other black insulated conductor. Place no more than three or four twists in the wire. Twisting the wires in excess can fracture the conductors. **DO NOT** twist two-way-cable wire in the same jacket together. This will cause a fault in the central and may shut down the entire system.

**b. Location of The Splices**

The Decoder/ICM splices will be directly buried beside the Valve-in-Head sprinkler instead of in a valve box. It is important that the **LOCATION OF THE SPLICES REMAIN CONSISTENT** throughout the entire course. It is recommended that the splice assembly be buried directly below the manual valve actuator. **DO NOT TAPE** the splice assembly to the valve-in-head sprinkler, as this would prevent removal of the sprinkler head from the riser without first digging down and un-taping the assembly. All wire splices shall have a minimum of 18" of extra wire on each side of the splice above the surface of the ground to allow the splice to be easily serviced in future. Orient the DBY/R, DBR-6, DBY-6 or Rain Bird DB Series above the wires. In this way they will serve to protect the wires from being nicked, by alerting you that you're close to the wires if any digging is required in this area in the future (See detail above).

**c. Decoder/ IC Module Address**

At the time of installation the contractor shall note the location and Decoder/IC Module address for all rotors and valves and record it on a construction drawing or other permanent recording document. Removable self-adhesive address label shall be removed from each Decoder/IC Module and affixed to a construction drawing or other permanent record for future reference if applicable. On the record drawing, each label shall be correctly identified with the location of the appropriate valve or sprinkler on the drawing. It shall be the responsibility of the contractor to be able to reference the location of every address as well as the location of all surge devices.

**4. Wiring**

The CONTRACTOR shall insure that all wiring shall be in accordance with all local codes and manufacturer's specifications. Wiring shall be as manufactured by PAIGE electric or approved equal. Upon receiving materials, all wire shall be inspected by the CONSULTANT or OWNERS REPRESENTATIVE prior to installation. The OWNER will provide all properly sized and fused electrical disconnects and panels for the irrigation system. The CONTRACTOR shall provide all wiring, conduit, labor, equipment and any other items necessary to connect field wiring.

All wire where feasible shall be installed in a continuous manner without splicing. Any splices that must occur other than noted on the plan, tagged in the field along the mainline located in plastic valve boxes with locking covers and marked as "Electrical" per the specifications, details in the plans. All splices made at the sprinkler can be direct buried. All splices made shall be tagged and placed inside the valve box for easy access. All splices shall be located on the "As-Stamped Drawings." Wire shall be checked immediately upon installation for resistance and continuity. Grounding shall be completed simultaneously with each hole installation. All grounding shall be installed in accordance with the plans, specifications and manufacturer's specifications prior to connection of the Central Computer.

Each Decoder/ICM valve-in-head sprinkler or Multi Pack Decoder shall have its own unique address/code. All sprinklers shall be wired for individual operation. If pairing of sprinklers is deemed to be required by the OWNER, all approach, tee, and green sprinklers may be wired for individual operation. Adjacent part circle sprinklers other than greens or tees may be paired if they are set at the same arc. Pair sprinklers on separate pipelines where possible.

**a. Decoder/ICS Two-Way-Cable**

There are many types of Decoder/ICS cables, as requires by the manufacture of "2-wire" Decoder/ICS Systems. The basic differences are in the color of the inner wires (to match the color of the Decoder/ICM wires) and the colors of the outer jackets (to distinguish the various groups connected to the central computer and in the trench). These colors are indicated on the plan for easy identification in future. Recommended jacket colors: must follow manufacture specifications. Each two-way-cable path shall maintain the same color of wire jacket throughout the length of the two-way-cable path, regardless of the size or length of wire run. Different two-way-cable paths cannot be looped together.

**Toro Systems**

The CONTRACTOR shall refer to the Toro GDC Product Guide for specifications & installation guidelines for Toro- Integrated Decoder at all times.

Wire shall be PAIGE Electric P7350D 14 AWG, Solid Copper, 2-Conductor or equal and meet the following specifications. This is a cable with 2 twisted wires, so that they stay together during the installation process and offer some opposition to electrical flow during lightning strikes. This cable is specifically designed for the harsh conditions of landscape projects where chemicals such as fertilizers, herbicides, pesticides, and fungicides are frequently applied.

This Specification covers a jacketed cable containing two UL listed Sprinkler Systems Wires, single conductor, suitable for direct burial, for operation up to 600 volts, and temperatures up to 60°C.

#### Construction

Inner Conductors: Soft drawn bare copper meeting the requirements of ASTM specification B-3 or B-8. Insulation shall be low density high molecular weight polyethylene and a thickness of 0.045", per Paige Electric specification P7079D. The two conductors (black and white) shall be twisted with a minimum lay of 4".

#### Overall jacket

Red, high density polyethylene with a thickness of 0.035". Available with optional identification stripe colors as listed in the table below. Stripe to be integrally extruded into and through the complete wall of the jacket with an approximate width of 1/8".

The jacket shall be sufficiently round, and loose, to facilitate its removal when being stripped.

#### Inner Conductors Color Coding

Black, White

#### Jacket Color

Color coding of jacket shall be of one solid color. Standard colors: red, green, yellow, and black.

#### Surface Print

Inner Conductors – "Paige Electric P7079D 14 AWG PE UL Number 600V Sprinkler System Wire Direct Burial" or equal

Outer Jacket – "Paige Electric, P7350D, 14 AWG PE UL Number 600V Sprinkler System Wire Direct Burial Only for Toro Decoder Systems RoHS" or equal

#### TEMPERATURE RATING

Color Code:

-55°C to +60°C

#### SPLICING RECOMMENDATIONS

Underground splices shall be made in accordance with National Electrical Code® Articles 300.5 (Underground Installations) and 110.14 (Electrical Connections) using 3M DBY/R, DBY-6 or DBR-6 connectors, which are UL listed under "UL 486D-Direct Burial", for wet or damp

locations, 600 volts. Connectors that are not listed at all, or listed under UL Standard UL 486C as "Compression Connectors", shall not be allowed.

PAIGE PART NO. JACKET STRIPE OUTER DIAMETER SHIPPING WEIGHT  
(Pounds/1000')

170800 None.378" ± .020"65  
170800BK Black  
170800YL Yellow  
170800GN Green

**Rain Bird Systems**

The CONTRACTOR shall follow Rain Bird IC Design Guide July 2009 specifications & installation guidelines for IC System and grounding at all times.

Wire shall be PAIGE Electric P7072D-Rev 12 or equal and meet the following specifications.

SIZES: 14AWG, 2 CONDUCTOR

This specification covers construction requirements for a 2/C control cable design to operate ICM consisting of tin coated copper conductors, insulated with PVC and having a high density polyethylene direct burial jacket. Conductors are UL approved Type UF.

**CONSTRUCTION**

STRAND	INS. WALL (MILLS)	JACKET WALL (MILLS)	O.D.	WEIGHT LBS/M
1	60	45	.280"x.470'	83
1	60	45	.300"x.505"	105
1	60	60	.350"x.575"	147
1	80	60	.420"x.715"	205

**Conductor**

Soft annealed tin coated copper conforming to ASTM B-33.

**Insulation**

Polyvinyl Chloride conforming to UL Standard 493 for TYPE UF rated 60°C.

**Cable Assembly**

Insulated conductors are laid parallel.

**Outer Jacket**

Pressure Extruded High Density PE conforming to ICEA S-61-402, and NEMA WC5 Jacket Thickness 3/64" minimum jacket material to completely fill interstices between the two insulated conductors.

**Color Coding**

Black, Red

**Jacket Color**

Color coding of jacket shall be of one solid color. Standard colors: red, blue, green, yellow, black, pink, purple, brown and orange.

**Surface Print**

"Paige Electric P7072D or equal Size 600V Sunlight Resistant Direct Burial For Maxi Control Systems"

**SPLICING RECOMMENDATIONS**

Underground splices shall be made in accordance with National Electrical Code® Articles 300.5 (Underground Installations) and 110.14 (Electrical Connections) using 3M DBY/R, DBY-6 DBR-6 connectors, or RB DB Series which are UL listed under "UL 486D-Direct Burial", for wet or damp locations, 600 volts. Connectors that are not listed at all, or listed under UL Standard UL 486C as "Compression Connectors", shall not be allowed.

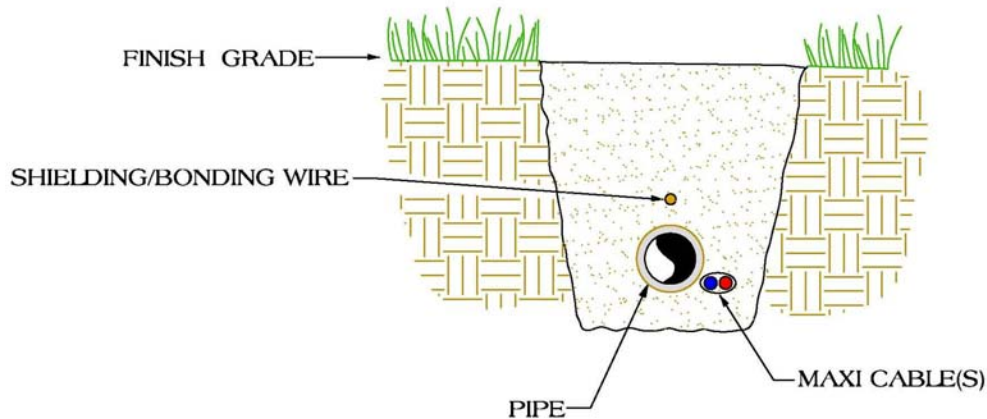
**b. Decoder-To-Solenoid (DTS) Cables**

Wires connecting the Decoder to the irrigation sprinkler are 14AWG, solid copper, 2-conductor. This specification covers a cable containing two wires laid parallel with a web joining them, UL listed as Sprinkler System Wire, suitable for direct burial, for operation up to 600 volts and temperatures up to 60 Degrees Celsius. Conductors: soft drawn bare copper meeting the requirements of ASTM specification B-3 or B-8. Insulation: low density high molecular weight polyethylene and a thickness of 0.045". One leg raised ridges for polarity. Testing: After scoring the web between the conductors with a knife, the conductors must be able to be separated without showing copper and must meet the minimum wall thickness of .045" everywhere along the insulation wall. Approved wire is Paige Electric Co., DTS specification number P7351D or equal. Color: The wiring inside a valve box can be very complicated. DTSTM cable color can be chosen to match the colors the Decoder output wires (addresses) to untangle the confusion. Recommended jacket colors: Red, Blue, Green, Orange, Yellow, Purple, Brown, Grey and Purple must follow manufacture specifications.

All DTS wire splices and connections to sprinkler wires shall be made in accordance with National Electric Code (NEC) Articles 300.5 (Underground Installations) and 110.14 (Electrical Connections) using 3M DBY-6 or DBR-6 connectors, which are UL listed under "UL 486D-Direct Burial", for wet or damp locations, 600 volts. Connectors that are not listed at all, or listed under UL Standard UL 486C as "Compression Connectors", shall not be allowed.

**c. Two-Way-Cable Installation on Mainline Trench**

When two-way-cable is being installed at the same time as new mainline piping, it shall be laid at the bottom of the trench away from the pipe. The shielding/bonding wire shall be laid at the top of the 6" layer of clean back fill that covers the pipe. In rocky conditions the trench shall have a 6" layer of clean sand on the bottom of the trench before backfilling is started. If rocky back-fill is being used (which is NOT recommended), the two-way-cable shall have a 6" layer of sand on top of it, before backfilling is started. The two-way-cable shall have a minimum of 18" cover on it after backfilling is completed. It is necessary to maintain consistency as to which side of the trench the cable is laid. By so doing you reduce the risk of damaging the cable, should it be necessary to dig in the area to repair a pipeline leak or break. For example; looking down a golf hole from the tee to the green, always lay the two-way-cable on the right side of the trench (See detail below).



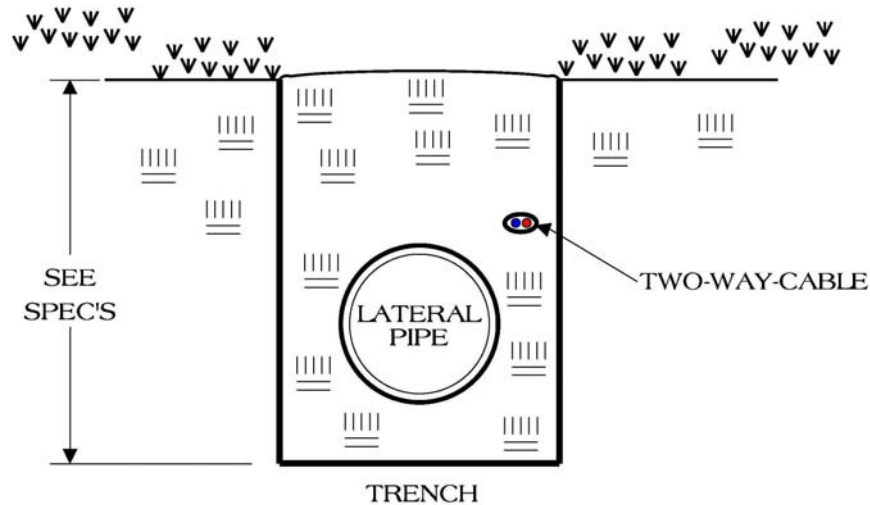
1. THE SHIELD/BOND WIRE SHALL BE A #10 AWG SOLID CORE BARE COPPER WIRE.
2. THE SHIELD/BOND WIRE SHALL BE LAID IN THE TRENCH AS STRAIGHT AS POSSIBLE AND POSITIONED APPROXIMATELY FOUR INCHES (4") ABOVE THE PIPE AND TWELVE TO EIGHTEEN INCHES (12" TO 18") BELOW GRADE.
3. ALL BENDS SHALL BE MADE AS A GENTLE SWEEP THEREBY REDUCING IMPEDANCE. THE SHIELD/BOND WIRE SHALL BE CONNECTED TO ALL LSP-1 SURGE PROTECTORS USING A DBY-R OR RAIN BIRD DB SERIES SPLICE KIT. CONNECTIONS TO A GROUND ROD SHALL BE MADE WITH A UL LISTED ACORN CLAMP.
4. GROUND RODS OR GROUND PLATES SHALL BE INSTALLED PER RAIN BIRD RECOMMENDATIONS OF ONE (1) ROD OR PLATE EVERY 500 FEET OR PER PLAN WITH 50 OHMS OR LESS OF GROUND RESISTANCE.



Where two-way-cable passes under roadways, sidewalks, walls, or any other paved areas, it shall be installed in a minimum of a 2" size pipe conduit "marked electric" or a conduit that meets local codes.

**d. Two-Way-Cable Installation on Lateral Trenchless**

All two-way-cable to be trenched or lain with a vibratory plough (but not pulled). Install with a minimum of fourteen inch (14") cover and a maximum depth of twenty-two inch (22"). CONTRACTOR is responsible to follow manufactures' specification and meet the 2005 Edition of the National Electrical Code, Article 300-5. (NOTE: Decoder-to-Solenoid (DTS) cable also applies to these specifications and detail.



 TWO-WAY-CABLE LATERAL TRENCH DETAIL  
NOT TO SCALE

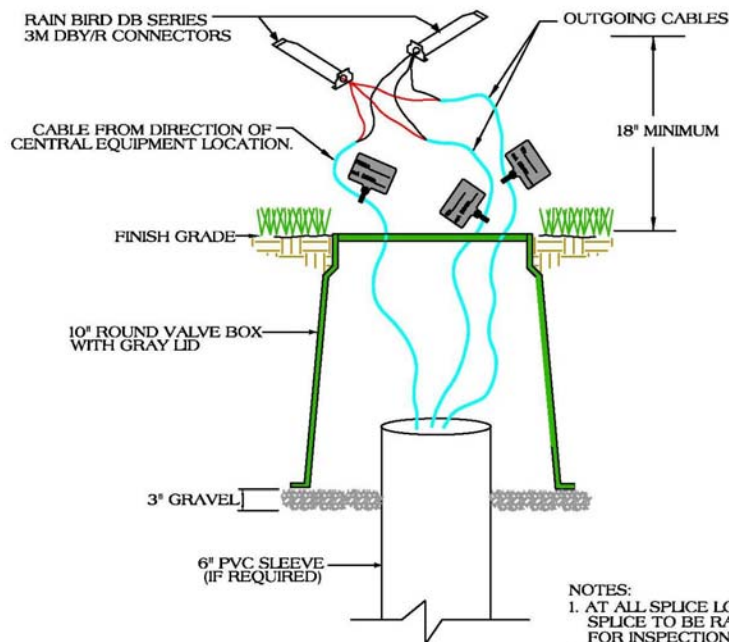
**e. Splices In Two-Way-Cable**

In order for the wire connections to comply with the 2005 edition of National Electric Code Articles 300.5 (under grounding installations) and 110.14 (Electrical Connections), in wet or damp locations, the connector must be listed under specifications “UL 486D” if installed in a valve box. It must be listed under specification “UL 486D-Direct Burial”. It must be listed under specification “UL 486D-Direct Burial” if buried in dirt. This requirement applies to all electrical connections in wet or damp locations, regardless of voltage. The 3M DBY/R, DBY-6, DBr-6 or RB DB Series and are listed as “UL 486D-Direct Burial” and meet these requirements for all underground installations. Solder shall never be used in making connections as it melts during a lightning discharge.

**In all splicing locations of the two-way-cable path, all wires shall be clearly marked with permanent type marking TAGS or wire label kits. The two-way-cable path should be marked to indicate the trunk wire coming from the central, the trunk wire continuing out from the splice location and the branch wire off of the trunk wire as per the detail below.**

Wherever splices are made in the two-way-cable path or Decoder/ICM wiring, they shall be placed in a valve box. **NO exception.** This means that ALL main trunk line splices and ALL branch take-off connections MUST be placed in a valve box. Valve box shall be a 10” round valve box marked “electric”, except at a sprinkler location or with the lateral valve box. All wire splices shall have a minimum of 18” of extra wire on each side of the splice above the surface of the ground to allow the splice to be easily serviced in future.

NOTE: All three way splices made on the mainline shall be in a 10” round valve box marked “electric”. All other splices to be buried at the nearest sprinkler or valve box and marked on the CONTRACTOR CRD field notes. Do not install any splice with a mainline or lateral valve.

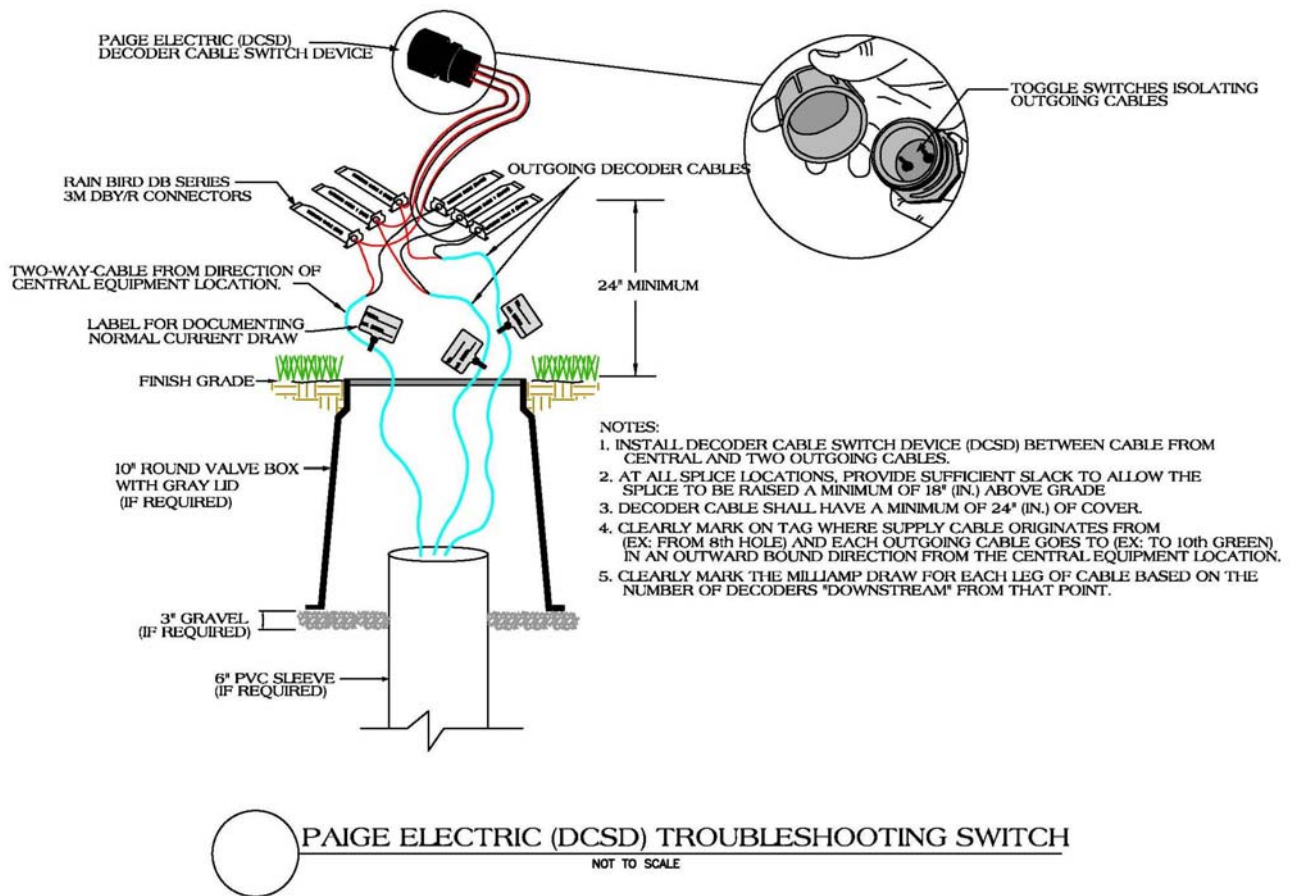


NOTES:

1. AT ALL SPLICE LOCATIONS, PROVIDE SUFFICIENT SLACK TO ALLOW THE SPLICE TO BE RAISED A MINIMUM OF 18" (IN.) ABOVE GRADE FOR INSPECTION.
2. TWO-WAY-CABLE SHALL HAVE A MINIMUM OF 18" (IN.) OF COVER.
3. CLEARLY MARK ON TAG WHERE SUPPLY CABLE ORIGINATES FROM (EX: FROM 8th HOLE) AND EACH OUTGOING CABLE GOES TO (EX: TO 10th GREEN) IN AN OUTWARD BOUND DIRECTION FROM THE CENTRAL EQUIPMENT LOCATION.
4. CLEARLY MARK THE MILLIAMP DRAW FOR EACH LEG OF CABLE BASED ON THE NUMBER OF DECODERS "DOWNSTREAM" FROM THAT POINT.
5. CALCULATE THE MILLIAMP DRAW BASED ON THE FORMULA:  
0.5 mA PER SINGLE DECODER MULTIPLIED BY QUANTITY OF DECODERS  
1.0 mA PER DECODER MULTIPLIED BY QUANTITY OF DECODERS



- f. **Decoder Cable Fuse Devices (DCFD)**- Manufactured by Paige Electric (Part # 270DCFD or #270DCFD3) or approved equal by CONSULTANT. The Paige electric DCFD disconnect splitter shall be installed at location along the main two-way-cable paths such that it can isolate certain sections of cables for purpose of troubleshooting (see plan for locations). The DCFD shall be installed inside and irrigation valve box as per installation detail. The splices for all connections shall be made using a 3M DBY/R, DBY-6 DBR-6 or RB DB Series. Quick disconnect splitter- Splits the incoming signal from the central computer into two or three directions. By flipping a switch, the Decoder cables can be disconnected in order to isolate sections of the system while troubleshooting. Water tight, O-ring seal, ACME thread installed in a waterproof valve box for easy access. Each DCFD is supplied with 36" leads to allow the assembly to be brought above grade when accessing switches for troubleshooting.



## 5. Grounding

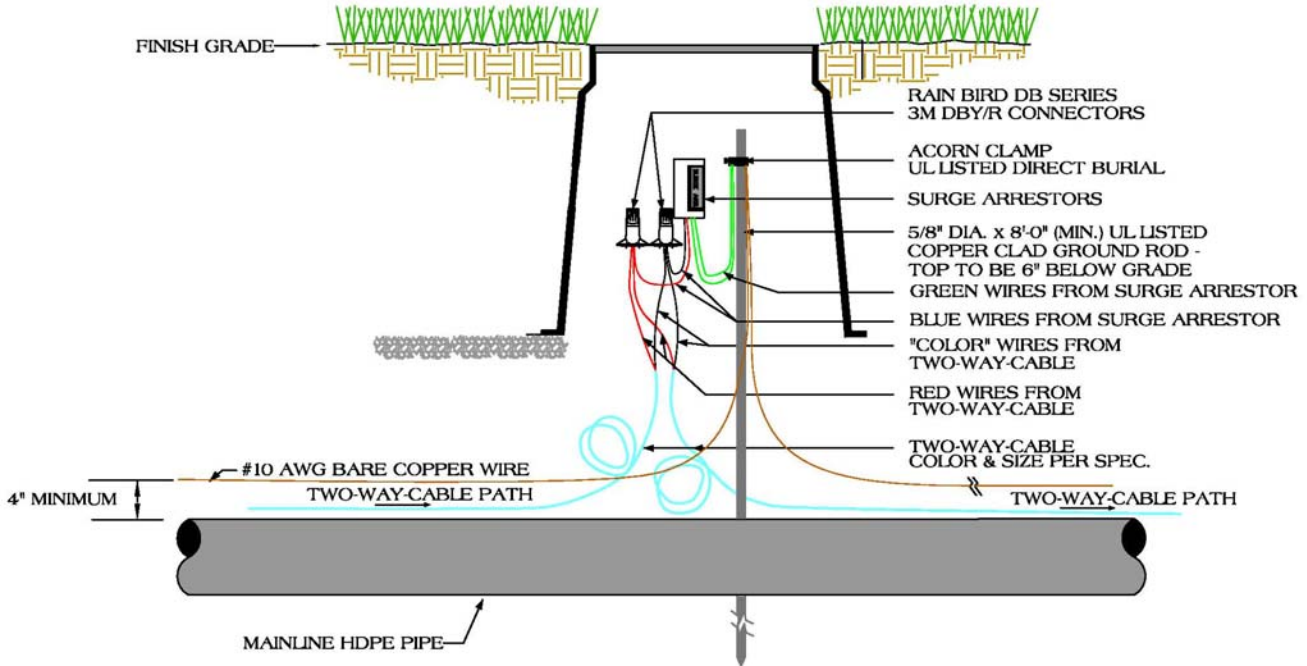
All groundings marked on the plan including the central controller shall be grounded to meet the MANUFACTURERS' specifications.

It is the responsibility of the CONTRACTOR to provide surge protection for all electrical equipment installed by him in relation to the irrigation contract. Said protection shall include but not necessarily be limited to the items described above and in the following paragraphs. The CONTRACTOR shall place a good grounding conductor system at each location marked on the plan to meet the ASIC grounding standards in the detail drawings and in the specifications below.

The installed grounding system should have a reading of no more than 45 ohms resistance to the ground in which it is placed. Resistance to the grounding electrode shall be measured by using a MEGGER direct reading Earth Resistance Testing instrument as manufactured by James G. Biddle Co. of Plymouth Meeting, Pennsylvania or a similar type of measuring instrument.

The CONTRACTOR shall have the right to seek assistance from the manufacturer or its local DISTRIBUTOR in the testing of any grounds. A minimum of 45 ohms resistance to ground is to

be achieved. The CONTRACTOR shall install all grounding equipment described above and as described in the control system manufacturer's literature in an attempt to reach this level. Where specified methods do not reach required levels, the CONTRACTOR may be asked to install additional grounding equipment as dictated by local conditions. The CONTRACTOR will be compensated for this additional wiring and equipment installation as negotiated by the CONSULTANT for the OWNER.



- NOTE:
1. AT ALL SPLICE LOCATIONS, INCLUDING DECODERS AND SOLENOIDS, PROVIDE SUFFICIENT SLACK TO ALLOW THE SPLICE TO BE RAISED A MINIMUM OF 18" ABOVE GRADE FOR INSPECTION.
  2. AN EXTRA TWELVE (12") PIECES OF #10AWG BARE COPPER WIRE TWISTED TOGETHER WITH INCOMING BOND WIRE IS NEEDED WHEN USING A CADWELD PLUS ONE SHOT CONTROL UNIT WELDING KIT.

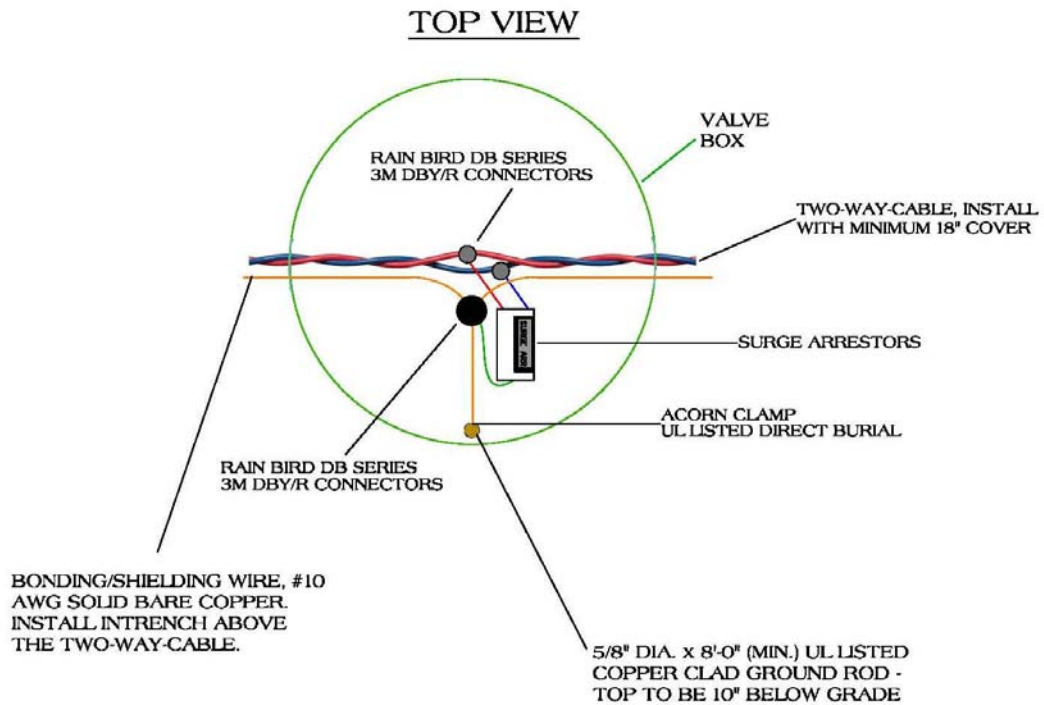


**a. Earth Grounding**

The CONTRACTOR shall follow manufacture specifications & installation guidelines for Toro- Integrated Decoder, GDC, Rain Bird- ICS, Decoder and grounding at all times. It is the responsibility of the CONTRACTOR to connect all electronic irrigation equipment for which he is responsible to earth ground in accordance with Article 250 of the National Electrical Code (NEC.) Grounding components will include the items described in the following paragraphs, at a minimum. Use grounding electrodes that are UL listed or manufactured to meet the minimum requirements of Article 250-52 of the 1999 NEC. At the very minimum, the grounding circuit will include a solid copper ground plate and 100 pounds of PowerSet® earth contact material or copper clad steel ground rod as defined below and per the following specifications.

Where additional grounding is required to meet minimum resistance readings, a U.L. listed ground rod shall be installed 20 feet away from an existing ground rod. Use U.L. listed acorn clamps to connect 6/1 bare, solid, copper wire between the two rods or use ground plates as specified below.

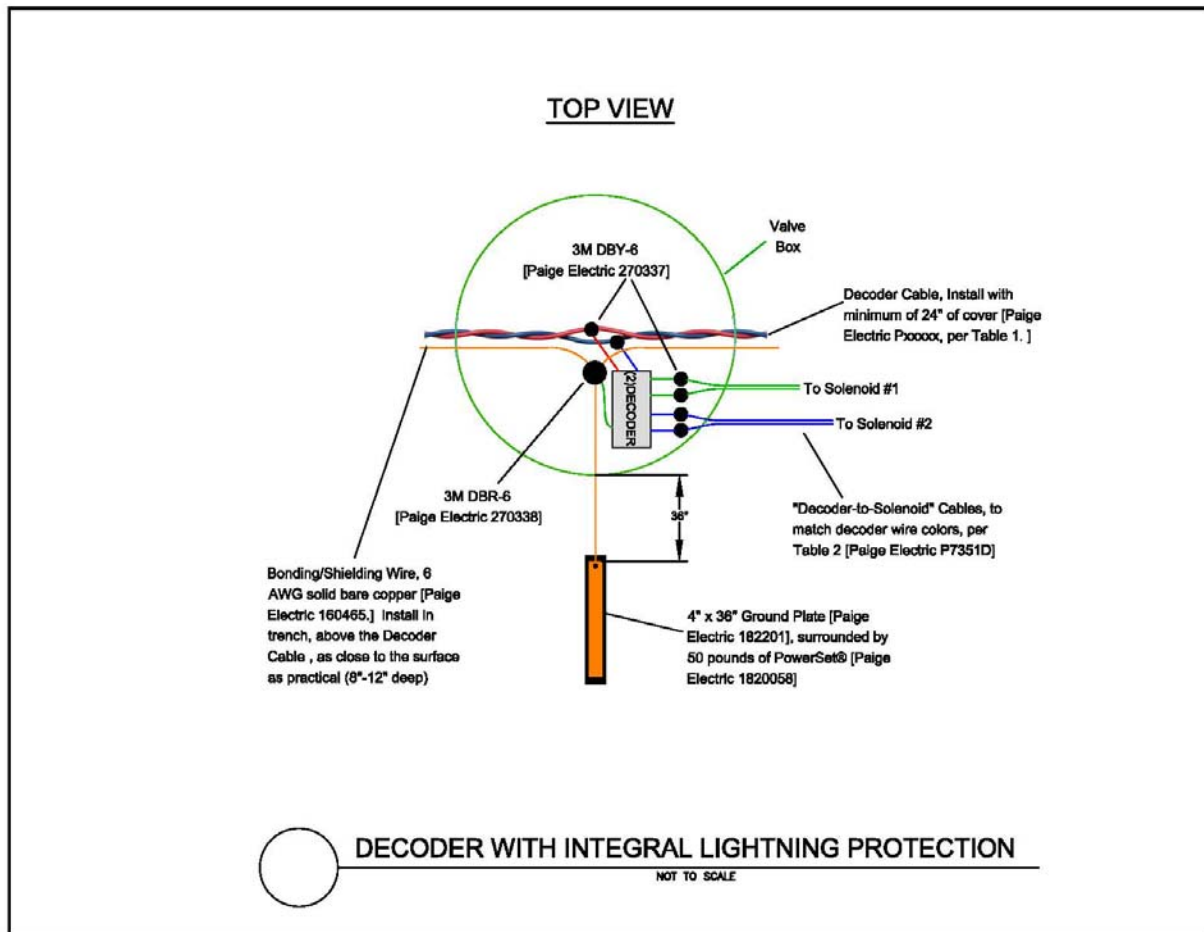
It is highly recommended to test the ground grid at a very minimum to test it at least once a year. In the more lightning prone areas, it would be prudent to check the grounds several times a year at minimum.



**b. Ground Rods**

Ground rods are to have a minimum diameter of 5/8" a minimum length of 8 feet and a minimum of 6" below grade. These are to be driven into the ground in a vertical position or an oblique angle not to exceed 45 degrees at the manufactures specifications. The rod is to be stamped with the UL logo, Paige Electric part number 182007 or equal. Grounding clamps should be used to connect grounding conductors to ground rods on a temporary basis. Once satisfactory results are achieved, the clamps shall be replaced by permanent welded connection or copper acorn clamps. Solder shall never be used in making connections as it melts during a lightning discharge. Connections to the ground rod shall be installed using a U.L. listed copper acorn clamp or Cadweld Plus One Shot Control Unit welding kit, Paige Electric part number 1820037 or equal. An extra twelve (12") pieces of

#10AWG bare copper wire twisted together with incoming bond wire is needed when using a Cadweld Plus One Shot Control Unit welding kit.



**c. Ground Plates**

The copper grounding plate assemblies must meet the minimum requirements of Article 250-52(d) of the 1999 NEC, Paige Electric part number 182199L or equal. They are to be made of a copper alloy intended for grounding applications and will have minimum dimensions of 4" x 36" x 0.060". Grounding conductors shall be attached to the plate using a welding process. Splices made to the grounding conductor shall be made using a welding process. Dissimilar metals and solder connections shall not be allowed. The ground plate is to be installed to a minimum depth of 30", or below the frost line if it is lower than 30", installed in a horizontal position flat on the bottom of the trench. Ground plates shall be surrounded by a 50-pound bag of PowerSet®, Paige Electric part number 1820058 or equal, earth contact material must be spread so that it surrounds the copper plate evenly along its length within a 6" wide trench. Salts, fertilizers, bentonite clay, cement, coke, carbon, and other chemicals are not to be used to improve soil conductivity because these materials are corrosive and will cause the copper electrodes to erode and become less effective with time. Install all grounding circuit components in straight lines. When necessary to make bends, do not make sharp turns. To prevent the electrode-discharged energy from re-entering the underground wires and cables, all electrodes shall be installed away from said wires and cables.

The earth-to-ground resistance of this circuit is to be measured using a Megger<sup>®</sup>, or other similar instrument, and the reading is to be no more than 45 ohms. If the resistance is more than 45 ohms, additional ground plates and PowerSet<sup>®</sup> are to be installed in the direction of an irrigated area at a distance of 10', 12', 14', etc. It is required that the soil surrounding copper electrodes be kept at a minimum moisture level of 15% at all times.

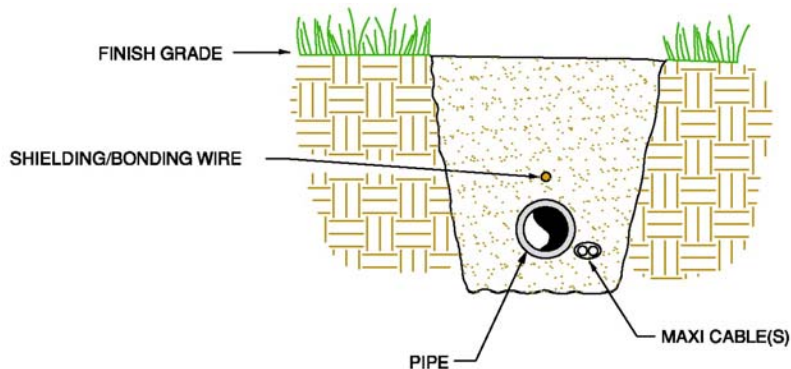
All underground circuit connections are to be made using an exothermic welding process by utilizing products such as the Cadweld "Plus" color coated container kits. Solder or "One Shot" shall not be allowed to make connections. In order to ensure proper ignition of the "Plus System", the Cadweld Color Coated Containers must be utilized by the size identification ring color chart used by Cadweld "Plus" grounding applications. The 6 AWG bare copper wires are to be installed in as straight a line as possible, and if it is necessary to make a turn or a bend it shall be done in a sweeping curve with a minimum radius of 8" and a minimum included angle of 90°. Mechanical clamps shall be permitted temporarily during the resistance test process, but are to be replaced with Cadweld "Plus" color coated container kits immediately thereafter.

**d. Bonding**

The above grounding circuit is referred-to as "supplementary grounding" in the NEC. And for safety reasons, the NEC requires that all supplementary grounds be "bonded" to each other and to the service entrance ground (power source) as shown below. This is also "recommended practice" of IEEE Standard 1100-1999. Note that this is in addition to the equipment ground, which is commonly referred-to as "the green wire." The Black, White and Green wires must always be kept together in a trench/conduit/tray/etc.

**e. Shielding**

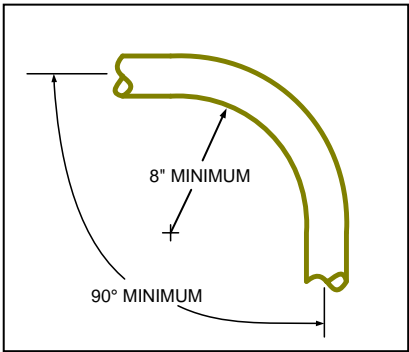
#10 AWG bare copper shielding/ bonding wire to be installed along the mainline critical paths only and tied to each ground. The bonding conductors are to be installed in such a way so that they also act as shielding conductors. This becomes a network of solid bare copper wire over all the main bundles of other wires and cables as shown in the detail below.



1. THE SHIELD/BOND WIRE SHALL BE A #10 AWG SOLID CORE BARE COPPER WIRE.
2. THE SHIELD/BOND WIRE SHALL BE LAID IN THE TRENCH AS STRAIGHT AS POSSIBLE AND POSITIONED APPROXIMATELY FOUR INCHES (4") ABOVE THE PIPE AND TWELVE TO EIGHTEEN INCHES (12" TO 18") BELOW GRADE.

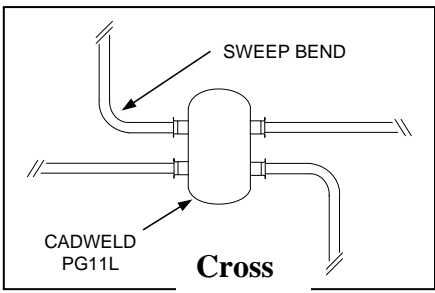
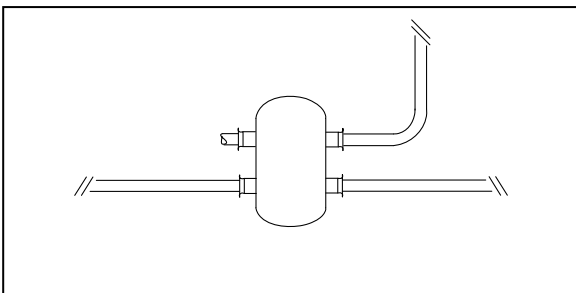
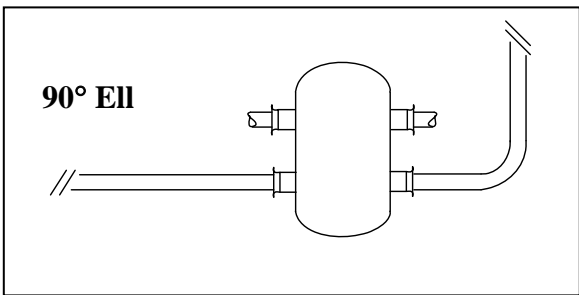
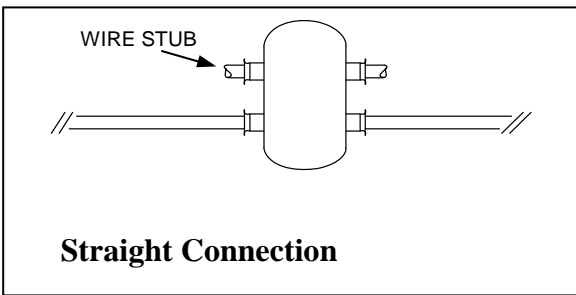
The bare copper wire is to be installed approximately 6" above the pipe and 12" to 18" inches below grade. It shall be placed above all other valve/power/communication wires and cables, per detail, and installed in all trenches as shown on the electrical plan drawings. The bonding/shielding wire shall be connected to all surge devices using the specified splice kit. The wire shall be connected to all ground rods or plates using a U.L. listed copper acorn clamp or permanent welded connection. It is not necessary to install this conductor over short wire runs. The conductor is laid in as straight a line as possible, and when necessary to make bends, do so in a sweeping motion using the following detail as a guideline.

Note: When connecting bare copper wires to the ground lug of electronic equipment, feed it through a dedicated 1 1/2" plastic sweep ell to automatically meet the requirements of the "sweep bend" shown here.



The shield network is to be connected to the service entrance earth ground, to all electronic equipment ground lugs, and all equipment supplementary grounding electrodes. One such network is necessary for each power source. Do not interconnect the equipment ground wires from different power sources.

When joining bare copper wires, do so using a U.L. listed copper acorn clamp or Cadweld Plus One Shot Control Unit kit as shown in the details below, Paige Electric part number 1820074 or equal.



6. **Surge Arrestors**

Surge arrestors or surge suppression device shall be attached to a ground rod, Decoders without built in surge arrestors and shielding/bonding wire to ensure good earth ground. A maximum resistance of 45 OHMS shall be achieved and lower readings are highly desirable. In some instances it may take three rods in a triangular pattern, tied together below grade with #10 AWG bare copper ground wire to obtain 45 OHMS or less resistance. It is absolutely necessary to obtain and maintain a ground resistance of 45 OHMS or less if the surge arrestor is to be effective. Surge arrestor shall be connected to the ground plate or ground rod, or one of the rods by a permanent welded connection or copper acorn clamps. Don not attach both wires in the same clamp. It is difficult to get the wires to tightly secure to the rod, by using one clamp, and also the two wires are much more prone to come loose when using one clamp for two wires. The effectiveness of the ground is greatly diminished or lost altogether.

a. **Locations**

Follow manufacture specification for surge arrestors and grounding installation instructions at all times. All ground locations will be marked clearly on the plan.

**Notation of the Decoder/ICS addresses, location and grounding location on the field notes is the responsibility of the CONTRACTOR. All Toro, Rain Bird Decoder/ICS installation instructions shall be followed.**

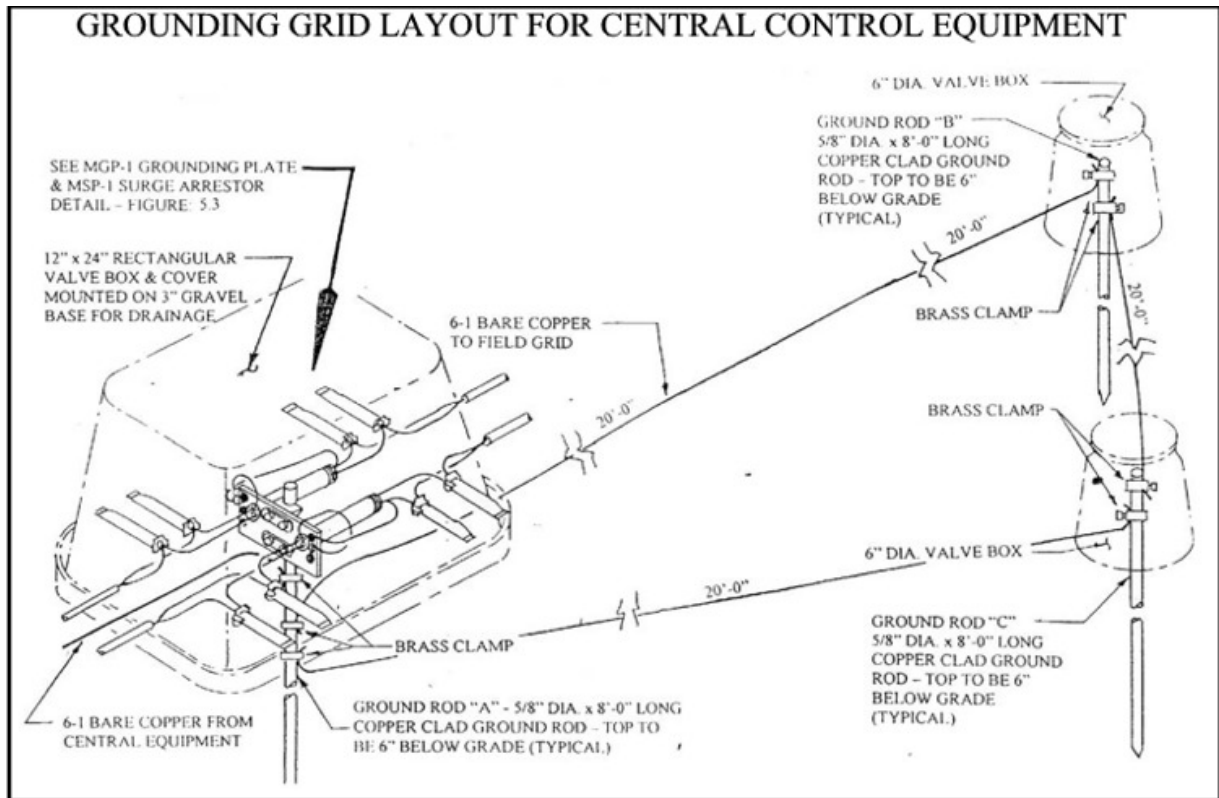
7. **Central Control Equipment Grounding Network**

The CONTRACTOR shall follow manufacture specifications & installation guidelines for Toro- GDC, Rain Bird ICS central control grounding at all times. Before any of the central control equipment is installed and particularly before it is connected to the field wiring, it is necessary to install a ground grid consisting of four (4) 5/8" dia. x 8'-0" long, copper clad ground rods. Refer to FIGURE: 4.2 shown below. The purpose of this grid is to provide a path to ground for any electrical surges that may try to enter the central equipment. The grounding grid resistance must not exceed 15Ω (Ohms) or it will not be effective in providing the necessary path to earth ground. The most effective ground grid protecting central equipment should have a resistance of 5Ω (Ohms) or less, if at all possible. This resistance level will not be obtained when the grid is first installed but is the objective after a period of time and when the central equipment is ready to be installed and/or connected to the field. Upon initial installation the ground rods will not have had a chance to make good contact with the earth. Therefore, we recommend that the grid be installed ASAP prior to the central equipment being connected to the field. While nothing can protect against a direct lightning strike, grounding effectiveness goes down as resistance goes up. Just prior to connecting of the central equipment to the field, it is recommended to test the ground grid and then at a very minimum to test it at least once a year. In the more lightning prone areas, it would be prudent to check the grounds several times a year at minimum.

a. **THE CENTRAL GROUNDING GRID LAYOUT:**

Directly below the point at which your field wiring or communication cable will enter the building, excavate an 18" x 24" opening 15" deep, in which a jumbo rectangular valve box will be set on a 3" minimum layer of gravel (to provide drainage). If at all possible the Freedom GT27141C Page 62 November 2003 System antenna should also be mounted above the point at which the field wiring or communication cable will enter the building. In this way the same grounding grid can be used for grounding of the antenna and the coaxial cable surge arrestor. Orient this opening with the 18" side closest to the building.

In the center of this opening, drive a ground rod so that the top is 6" below the finish grade (this will be ground rod "A" as shown below).



When working with the #6 or larger ground wire, take care not to make any sharp bends or kinks in the wire at any point of its routing as this will increase its RESISTANCE to ground – thereby decreasing the effectiveness of your ground grid. All bends shall be long, smooth radii of as large a radius as possible. Using a measuring tape, mark a point at least 20'-0" away from the rod you have driven closest to the building. This is the point at which ground rod "B" shall be driven. From this ground rod "B", carefully lay out a 20'-0" equilateral triangle to form the ground grid. If possible, locate these rods in a wetted area away from nearby trees. It may be necessary to go further than 20'-0" but that is acceptable. Refer to detail shown above.

**SECTION 9 - PUMP STATION**

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- 1. Pump Station**  
Existing

## SECTION 10 - APPENDIX

### Specification Outline

_Category	Description
Sprinkler Spacing	75', 65' V-I-H <b>Electric</b>
Quick Couplers	Greens (1)
Control System Level	Toro Linx with T-Map, Nimbus II, Surveyor
Satellites	Toro: E-Series OSMAC, Rain Bird: Par Plus-ES Link, Hunter: VSX Field Controllers
Satellite-Communication	Wireless
Decoder/ICS	Toro- Integrated Decoder or GDC, Rain Bird ICS or Decoder
Decoders/ICS-Communication	Decoder/ICS Two-Way-Cable System or with DTS Cable
Central Control Location	Maintenance Building
Sprinkler Wiring	Individual Wire Per Sprinkler, Individual Sprinkler Control 3 spare wires to Green QC's
Power Sources/Wire	(1) Location (Maintenance Building), 220/240V Power
Satellite-Grounding	Standard- 10 Ohms or less
Decoders/ICS-Grounding	Standard- 45 Ohms or less
Pedestals	Plastic
Mainline Routing	Independent looped
Mainline Gate Valves	American AVK Resilient Ductile Iron Gate Valve w/ PE ends or equal
Lateral Taps	Herringbone Style LASCO Slo-Close Valve or equal
Fittings	LASCO or equal Tap't Saddles, All Swing Joints Arms to be 1-1/2", HDPE DR11
Swing Joints	Standard Swing Joints-ACME, -1-1/2" Inlet and Arm, Match to Sprinkler at Outlet, NPT (Quick Coupler)
Replace Sod Trenches	YES-Backfill, Compact, Sod-Cut and replace, (Mainline & Lateral lines)
Pump Stations	Existing
Mainline Taps	IPS HDPE Tees
Sprinkler Setting	At Grade Upon installation, re-set after (2) month settling
Handheld Radio	YES (3)
Handheld Pocket PC	NO
Weather Station	Yes
R. B. Weather Station Module	Yes
R. B. Freedom System Module	Yes
R. B. Map Utilities Module	Yes
R. B. Station Layers Module	Yes