SECTION 02619 HORIZONTAL DIRECTIONAL DRILLING

PART 1 GENERAL

1.01 SCOPE

The Contractor shall furnish all labor, materials, equipment and incidentals required to install all pipe, fittings and appurtenances as shown on the Drawings and specified in the Contract Documents by Horizontal Directional Drilling (HDD).

1.02 GENERAL

A. All existing structures, pipelines, storm drains, utilities, driveways, sidewalks, signs, mail boxes, fences, trees, landscaping, and any other improvement or facility in the construction area that the Contractor disturbs for his own construction purposes shall be replaced to original condition at no additional cost to the County.

B. For “Navigable Waters of the U.S.” reference 33 of the Code of Federal Regulations, Part 329.

C. For “Waters of the U.S.” reference 33 of the Code of Federal Regulations, Part 323.

D. For “Waters of the State” reference Section 62-301 of the Florida Administrative Code.

1.03 TESTING

A. In place soil compaction tests shall be performed by a qualified testing laboratory.

B. Compaction tests shall be taken at every excavation, except in the road crossings or road shoulders; tests are to be taken according to current FDOT Standards.

C. All pipe shall be tested in accordance with the appropriate material specifications.

D. Reference Standards: American Society for Testing and Materials (ASTM), D1557, Moisture-Density Relations of Soils Using 10-lb. Rammer and 18-in. Drop.

E. The density of soil in place shall be a minimum of 95 percent in accordance with ASTM test 1557-70T, Method A or C.

1.04 QUALIFICATIONS

A. Pipe Manufacturer: All pipe and fittings shall be furnished by a single manufacturer who is fully experienced, reputable and qualified in the manufacture of the items to be furnished.

B. Drilling Supervisor: The Contractor shall provide a competent boring specialist who shall remain on the project site during the entirety of the directional boring operation. This includes, but is not limited to, drilling fluid preparation, seaming, boring and pulling. The boring specialist shall have a minimum of five years of experience in supervising directional bores of similar nature, diameter, materials and lengths.

C. Pipe Fusion: All boring and fusing equipment shall be certified for operation. The Contractor responsible for thermal butt fusing pipe and fittings shall have manufacturer certification for performing such work or a minimum of five years of experience performing this type of work. If no certification is available, written documentation of the required work experience shall be submitted for approval.

D. Drilling Fluid Specialist: The personnel responsible for supervising the supply, mixing, monitoring fluid quality, pumping and re-circulation system proposed for the drilling fluid shall have a written certification issued by the Drilling Fluid manufacturer for performing such work or a minimum of five years of experience performing this type of work. If no certification is available, written documentation of the required work experience for the proposed personnel shall be submitted for review and approval.

1.05 SUBMITTALS

A. Detailed description including specifications and catalog cuts for:

1. Shop drawings and catalog data for all HDD equipment.
2. The pipe manufacturer's maximum degree of radial bending allowed for the pipe when full and when empty and pullback force recommended setting.
3. Steering and tracking devices including specific tracer wire.
4. Drilling fluids; the drilling fluid submittal shall include the ratio of mixture to water, including any additives, based on the Contractor’s field observations prior to construction, knowledge and experience with drilling in similar conditions, and any soil data provided in the Contract Documents, which shall be verified by the fluid specialist.
5. Shop drawings for the breakaway swivel, including the method of setting the swivels’ break point and set point to be used.
6. Shop drawings for sizing of the mandrel for pull through testing
7. Pipe assembly procedure, details of support devices, and staging area layout including methods to avoid interference with local streets, driveways, and sidewalks.
8. Details of pipe fusion procedures and copies of the fusion technician qualification certification or documentation.
9. Drilling fluid technician qualification certification or documentation

B. Bore Plan: For all contiguous piping installations over 300 feet in length or any installations for piping larger than 4” in diameter, the Contractor shall submit a Bore Plan that includes the following at least 21 days prior to beginning work:

1. Contact information and experience for the drilling fluid specialist.
2. The number of passes the bore will include to get the product pipe installed.
3. The pilot bore and all reaming bore sizes including the final pullback with the product pipe.
4. Drilling rod length in feet.
5. The pilot bore, pre-ream bores (if any) and pullback production rate in minutes per (drilling) rod to maintain adequate mud flow.
6. Details of the entry and exit pit locations along with entry and exit angles for the bore, drawn to scale, depicting the position of all required equipment, access points, existing facilities to remain in place, existing traffic lanes to be maintained in operation, office trailers and storage sites.

7. The method of fusing or joining pipe of adjacent bores to ensure that the joint is on grade with the installed pipe.

C. If the Contractor is planning on deviating from the bid document Profile, then the Contractor is required to submit detailed calculations supporting the modifications. The calculations shall consist of the following:

1. Predicted and allowable pulling loads and bending stress, and the minimum allowable bending radius (Provide an estimate of the pulling loads and bending stress at characteristic points along the drill path when the curvature of the drill path changes).
2. Calculations for safety factors against ring collapse of the pipe during pullback and confirm ring deflection is within limits.
3. Graphical representation of evaluation of frac-out risks, showing maximum allowable and minimum required pressures at all critical locations along the bore alignment. The calculations shall be conducted by or under the direct supervision of a Professional Engineer licensed in the State of Florida, who shall stamp and seal the calculations.
4. The deviation drawings shall include a HDD Profile, plan view and cross-section. The Contractor is also recommended to submit deviation drawings for larger bores for site layout plans (Rig and Product Pipe Layout site) and pipeline stringing area (rollers).

D. Bore Schedule: For all contiguous piping installations over 300 feet in length or any installations for piping larger than 4" in diameter, the Contractor shall submit a detailed schedule for the HDD installation at least fifteen days prior to mobilization. The detail schedule shall identify all major construction activities and durations, with beginning and completion dates shown. The detail schedule shall be updated at least every two weeks or more frequently, as directed by the Engineer, and shall include but not limited to the following items:

1. Pre-construction walk over and inspection
2. Regular Mobilization and set-up
3. Pilot bore
4. Pre-reaming and reaming
5. Layout and thermal butt fusing of pipe
6. Pressure Testing of pipe prior to pullback when practical or as directed by the Engineer.
7. Final reaming and pullback of product pipe.
8. Annulus grouting after installation (optional).
9. Mandrel/pig test to confirm deformations of product pipe are within allowable tolerances.
10. Cleanup, surface restoration, and demobilization.

E. Prepare a Frac-out and Surface Spill Contingency Plan. Submit the plan to the Engineer prior to construction. Submit a letter of intent signed by an authorized representative of Contractor, confirming that the plan will be followed. The contingency plan for inadvertent returns/hydrofracture shall address all potential pathways for release of drilling fluid, and shall address containment, cleanup, and mitigation measures as well as inspection and reporting procedures and points of contact for regulatory and permitting agencies. The Plan

shall address releases to the ground surface and controlled releases at any relief wells installed by the Contractor. Describe the location, installation, monitoring, and abandonment procedures for any relief wells. Provide stand-by equipment on-site to recover fluids via vacuum. Describe equipment and procedures to private residence yard areas to inspect for and clean up fluid releases.

F. The Contractor shall submit an as-built profile of the pilot bore within twenty-four (24) hours of completion of the pilot bore to the Engineer and County Representative. Contractor shall receive written approval from either party in order to continue with the proposed profile alignment.

G. Furnish a Bore Path Report to the County within seven days of the completion of each bore path. Data collected by the County Representative does not relieve the Contractor from the responsibility of recording his own data. Include the following in the report:

1. Location of project, project name and number
2. Name of person collecting data, including title, position and company name
3. Investigation site location (Contract plans station number or reference to a permanent structure within the project right-of-way)
4. Driller's Log & identification of the detection method used
5. Elevations and offset dimensions of installed pipe as referenced to the drawings
6. Data log of pullback force during product pipe installation
7. All failed bores. Include length of pipe left in place and explanation of failed installation.

PART 2 PRODUCTS

2.01 MATERIALS

A. Incidental materials that may or may not be used to install the product depending on field requirements are not paid for separately and will be included in the cost of the installed product.

B. Drilling Fluids shall use a mixture of bentonite clay or other approved stabilizing agent mixed with potable water with a pH of 8.5 to 10.0 to create the drilling fluid for lubrication and soil stabilization. Vary the fluid viscosity to best fit the soil conditions encountered. Contractor shall have appropriate additives for drilling fluid available for different soil conditions that may be encountered. Do not use any other chemicals or polymer surfactants in the drilling fluid without written consent from the County. Certify to the County in writing that any chemicals to be added are environmentally safe and not harmful or corrosive to the product pipe.

C. For drilling operations that will be below waters of the State of Florida, ~~only bentonite free drilling fluids shall be used~~. additives to drilling fluid such as drill soap, polymers, etc. shall be "environmentally safe" and be approved for such usage. No diesel fuel will be used. (Addendum No.3) Acceptable products are BioMax, manufactured by M-I Swaco, Inc., P.O. Box 2216, Laurel, Mississippi 39440, Phone: (800) 731-7331 or Bio-Bore, manufactured by Baroid Drilling Fluids, Inc., P.O. Box 1675, Houston, Texas 77251, Phone: (731) 987-5900 or approved equal.

D. Identify the source of water for mixing the drilling fluid. Approvals and permits are required for obtaining water from such sources as streams, rivers, ponds or fire hydrants. Any water source used other than potable water may require a pH test.

E. Directional Drilling/Boring pipeline construction shall require the installation of minimum No. 10 AWG Copper Clad, Extra High Strength Steel tracer wire with minimum 1,940 psi break load, with a minimum 45 mil HDPE insulation thickness. Refer to Section 02800 of the Specifications for tracer wire details.

~~F. Breakaway connectors shall be supplied by DCD Design & Manufacturing, Condux International, Inc. or approved equal.~~ (Addendum No. 3)

PART 3 EXECUTION

3.01 SITE CONDITIONS

A. Carry out excavation for entry, exit, recovery pits, slurry sump pits, or any other excavation as specified in the Contract documents. Sump pits are required to contain drilling fluids if vacuum devices are not operated throughout the drilling operation, unless approved by the County.

B. Within 48 hours of completing installation of the boring product, clean the work site of all excess slurry or spoils. Take responsibility for the removal and final disposition of excess slurry or spoils. Ensure that the work site is restored to pre-construction conditions or as identified on the plans.

C. Exposure of product pipe to sunlight shall be limited to 14 consecutive days unless approved by the County. If after 14 days, the product pipe is still stored on site then it shall be fully covered to avoid UV degradation of the pipe material.

D. The pipe shall be supported at intervals along its length with rollers or Teflon pads to minimize frictional forces when being pulled, and to hold the pipe above the ground. Surface cuts or scratches greater than or equal to the maximum defect depth in 3.08 E are not acceptable.

3.02 DAMAGE RESTORATION & REMEDIATION

A. The Contractor shall take responsibility for restoration for any damage caused by heaving, settlement, separation of pavement, escaping drilling fluid (frac-out), or the directional drilling operation, at no cost to the County.

B. When required by the County, provide detailed plans which show how damage to any roadway facility will be remedied. These details will become part of the Record Drawings Package. Remediation Plans must follow the same guidelines for development and presentation of the Record Drawings. When remediation plans are required, they must be approved by the County before any work proceeds.

C. For HDD operations that will be below waters of the State of Florida, the Contractor shall be responsible for any damage caused by the drilling operation, including, but not limited to, fracturing of the channel bottom. Any State or Federal required environmental cleanup due

to the release of drilling fluids into State waters shall be at the Contractor's expense. The Contractor may at his own expense increase the depth of his drilling operations upon the approval from the County.

3.03 QUALIFICATIONS FOR REJECTION OF DIRECTIONAL BORE

A. The County may reject any portion of the work that is deemed to be non-responsive to the Contract requirements or not in conformance with approved plans and submittals, and for other factors including the following:

1. Failed Bore: When there is any indication that the installed product has sustained damage, stop all work, notify the County and investigate damage. The County may require a pressure and / or mandrel test at no additional cost to the County and shall have a County representative present during the test. Perform all testing within 24 hours unless otherwise approved by the County. Furnish a copy of the test results and all bore logs to the County for review and approval. The County is allowed up to 5 working days to approve or determine if the product installation is not in compliance with the specifications.
2. Obstructions: If an obstruction is encountered during boring which prevents completion of the installation in accordance with the design location and specification, the pipe may be taken out of service and left in place at the discretion of the County.
3. Pull-back Failure: If the installed breakaway device should fail during pull back.
4. Loss of Drilling Fluids: If the drilling fluid is “lost” during the pull back of the product and cannot be regained within the required timeframe of the manufacturer or if more than a reasonable amount of fluid is used to fill an unknown void and flow cannot be regained. No pipe shall be pulled without visible flow of drilling fluid.
5. Test Failure: If the pipe shall fail a hydraulic pressure test or mandrel test as specified by the County.
6. Damaged Pipe: If at any time when the product is pulled back and any exposed areas have a greater than allowable “gouging” or visible marring of the pipe per the table in 3.08 G.
7. Alignment Tolerance Exceeded: If the vertical and horizontal limits are not within tolerances.

   Vertical Alignment Tolerance: ~~Maximum slope shall not exceed 2% (2.0 feet within a length of 100 ft),~~ The vertical alignment tolerance shall have no reverse curvature within 200 feet and shall not be shallower than 2 feet and deeper than 10 feet than the proposed profile. (Addendum No. 3) ~~and no vertical deviation greater than ten (10) percent of the proposed depth of cover at that specific station~~.

   Horizontal Alignment Tolerance: ~~Maximum rate of deviation shall not exceed 1.5% (1.5 feet within a length of 100 feet),~~ The horizontal alignment tolerance shall ~~no reverse curvature, and total deviation shall not exceed 2.0 feet~~. not deviate more than 2 feet from the beginning of the drill to Station 100+68.93 and from Station 125+66.13 to the end of the drill. The horizontal alignment tolerance can deviate ±10 feet along the bore path between Station 100+68.93 and Station 125+66.13. (Addendum No. 3)

8. Defective Material: Any other defect in material or workmanship which would affect

the quality, performance, or installation life of the installed pipeline.

B. Remediation: All rejected bores shall be at the Contractor's expense to correct and provide a satisfactory installed product. The Contractor shall submit to the County a revised installation plan and procedure for approval before resuming work. The County may require non-compliant installations to be filled with excavatable flowable fill or to be completely removed at no additional cost to the County.

3.04 PRODUCT LOCATING AND TRACKING

A. The County recognizes ~~walkover~~ gyroscopic steering (Addendum No. 3), wire line, and wire line with surface grid verification, or any other system as approved by the County, as the accepted methods of tracking directional bores. Use a locating and tracking system capable of ensuring that the proposed installation is installed as intended. The locating and tracking system must provide information on:

1. Clock and pitch information
2. Depth
3. Transmitter temperature
4. Battery status
5. Position (x,y)
6. Azimuth, where direct overhead readings (~~walkover~~ gyroscopic steering (Addendum No. 3)) are not possible (i.e. sub aqueous)

B. Ensure proper calibration of all equipment before commencing directional drilling operation.

C. Prepare the Driller's Log. Take and record alignment readings or plot points such that elevations on top of and offset dimensions from the center of the product to a permanent fixed feature are provided. Such permanent fixed feature must have prior approval of the County. Provide elevations and dimensions at all bore alignment corrections (vertical and horizontal) with a minimum distance between points of 10 feet. Provide a sufficient number of elevations and offset distances to accurately plot the vertical and horizontal alignment of the installed product.

D. Installation Location Tolerances:

a. It shall be the Contractors responsibility to notify the County when the pilot bore activities are taking place. The Contractor shall provide the County a printout of the completed pilot bore path for review prior to pull back of the product.

b. The location of the initial bored hole shall be deemed acceptable by the County if the deviations of the bore from the design alignment or approved adjustments do not exceed the following tolerances:

1. Profile (vertical):
   a. max. slope shall not exceed 2% (2.0 feet within a length of 100 feet).
   b. No reverse curvature within 200 feet.
   c. No vertical deviation greater than ten (10) percent of the proposed depth of cover at that specific station.

2. Alignment (horizontal:

a. max. rate of deviation shall not exceed 1.5% (1.5 feet within a length of 100 feet).
b. No reverse curvature.
c. Total deviation not to exceed 2.0 feet.

c. If the pilot bore does deviate from the above criteria, the Contractor shall notify the County prior to pull back. The County, at its discretion, may require the Contractor to pull back and re-drill the pilot bore to correct any deviations.

3.05 PRODUCT BORE HOLE DIAMETER

Minimize potential damage from soil displacement/settlement by limiting the ratio of the bore hole to the product size. The size of the back reamer bit or pilot bit, if no back reaming is required, will be limited relative to the product diameter to be installed as follows:

Table 2-1. Recommended Relationship between Product Diameter and Reamed Diameter

Product Diameter	Reamed Diameter
< 8”	Diameter of product + 4”
8” – 24”	Diameter of product x 1.5
> 24”	Diameter of product + 12”
*Horizontal Directional Drilling Good Practices Guidelines – HDD Consortium	

3.06 EQUIPMENT REQUIREMENTS

A. The HDD equipment selected by the Contractor shall be capable of drilling, steering, tracking, reaming and installing the pipeline through all the subsurface conditions that may be present at the site.

B. Match equipment to the size of pipe being installed. Obtain the County’s approval for installations differing from the above chart. Ensure that the drill rod can meet the bend radius required for the proposed installation.

C. All HDD equipment shall have an electronic data logger to record pull back force during all pipe installations.

~~D. All HDD equipment that has the capability to exceed the maximum recommended pulling force shall have a breakaway swivel properly attached to the product pipe that will release if the pullback force exceeds the pipe manufacturer’s recommended pulling force.~~ (Addendum No. 3)

3.07 THRUST / PULLBACK REQUIREMENTS

The Contractor shall provide as part of the required working drawings submittal complete data regarding the operational and maximum thrust or pulling forces to be used for the initial drill head and back-reamer installations, and the final pull-back of the pipe. Gages or other measurement tools shall be used to monitor the forces being used.

3.08 INSTALLATION PROCESS

A. Contractor shall contact the County and Engineer at least forty-eight (48) hours before each of the following activities:

1. The setup of a drill rig pit,
2. The start of the pilot bore,
3. The pull back of the product pipe. Upon completion of the pilot-hole phase of the operation, a complete set of as-built records shall be submitted in duplicate to the Engineer. These records shall include copies of the plan and profile drawing, as well as directional readings recorded during the drilling operation.

B. Ensure adequate removal of soil cuttings and stability of the bore hole by monitoring the drilling fluids such as the pumping rate, pressures, viscosity and density during the pilot bore, back reaming and pipe installation. Relief holes can be used as necessary to relieve excess pressure down hole. Obtain the County's approval of the location and all conditions necessary to construct relief holes to ensure the proper disposition of drilling fluids is maintained and unnecessary inconvenience is minimized to other facility users.

C. At all times during the pilot bore the Contractor shall provide and maintain a bore tracking system that is capable of accurately locating the position of the drill head in the x, y, and z axes. The Contractor shall record these data at least twice per drill pipe length or every ~~fifteen (15) feet~~ thirty-one and a half (31.5ft) feet, (Addendum No. 3) whichever is more frequent.

1. Contractor shall monitor and record x, y, and z coordinates relative to an established surface survey benchmark, from downhole survey data using downhole wireline system. "Tru-Tracker" energized surface grid, or equivalent, shall be installed and used to supplement the wireline system. The "Tru-Tracker" grid shall encompass the entire area of the bore including underwater across the water. Alternatively, the Contractor may propose fixed "TruTracker" grids on land outside the waterway, supplemented by moveable grids on floating templates that can be temporarily anchored and surveyed while drilling the pilot hole. The moveable template should be sufficiently large to encompass the active drilling area for a two hour drilling period, and should be at least as wide as the maximum depth of the bore. The grids shall be surveyed to establish horizontal and vertical position to 0.1 feet accuracy. The data shall be continuously monitored and recorded at least twice per drill pipe length or every ~~fifteen (15) feet~~ thirty-one and a half (31.5ft) feet (Addendum No. 3), whichever is most frequent.

2. Deviations between the recorded and design bore path shall be calculated and reported on the daily log. If the deviations exceed tolerances specified elsewhere, such occurrences shall be reported immediately to the County and Engineer. The Contractor shall undertake all necessary measures to correct deviations and return to design line and grade.

3. Drilling fluid pressures and flow rates shall be continuously monitored and recorded by the Contractor. The pressures shall be monitored at the pump and within the annular space with a downhole pressure-sensing tool located within thirty (30) feet of the drilling head.

4. Maximum allowable drilling speeds shall be calculated by the Contractor for pilot

boring and each reaming pass and shall not be exceeded for pilot boring or reaming passes. Measurements shall be taken every ~~fifteen (15) feet~~ thirty-one and a half (31.5ft) feet. (Addendum No. 3)

5. The Contractor shall measure and record drilling fluid viscosity and density at least three times per shift with at least two hours between readings, using calibrated Marsh funnel and mud balance. These measurements shall be included in daily logs submitted to the Engineer. The Contractor shall document modifications to the drilling fluids, by noting the types and quantities of drilling fluid additives and the dates and times when introduced. The reason for the addition of drilling fluid additives or other modifications shall be documented and reported.

6. The Contractor shall measure and record the pH on a regular basis (three times per shift with at least two hours between readings) with pH strips, paper or a pH meter.

7. The drilling fluid report shall include desired mud properties including weight, viscosity in cP, yield point in lb/100 sf, measured mud weight, funnel viscosity, plastic viscosity, fluid loss, % solids, chlorides, and detailed log of type and quantity of bentonite and all additives.

8. The Contractor shall constantly monitor and record the circulating volume, particularly for the early detection of drilling fluid losses, or thinning, or the danger of borehole collapse. Ground upheavals can also be detected early from such differences, and necessary action can be implemented to prevent further damage.

9. The Contractor shall constantly monitor and record the solid (sand) content to assure there is no significant increase, which can diversely impact efficiency of the circulations system.

D. The Contractor shall determine the pull-back rate in order to allow the removal of soil cuttings without building excess down-hole pressure and to avoid local heaving, or spills. Contain excess drilling fluids at entry and exit points until they are recycled and separated from excavated materials, or removed from the site or vacuumed during drilling operations. Ensure that entry and exit pits and storage tanks are of sufficient size to contain the expected return of drilling fluids and soil cuttings. The bored hole shall always be maintained full of drilling fluids for support of surfaces, and the fluid re-circulation equipment shall operate continuously until the pipe installation is completed and accepted by the County.

E. Ensure that all drilling fluids are disposed of or recycled in a manner acceptable to the appropriate local, state, or federal regulatory agencies. When drilling in suspected contaminated ground, test the drilling fluid for contamination and appropriately dispose of it. Remove any excess material upon completion of the bore. If in the drilling process it becomes evident that the soil is contaminated, contact the County immediately. Do not continue drilling without the County's approval.

F. The timing of all boring processes is critical. Install a product into a bore hole within the same day that the pre-bore is completed to ensure necessary support exists. Once pullback operations have commenced, the operation shall continue without interruption until the pipe is completely pulled into the borehole.

G. All prepared pipe that is being used for installation shall be adequately supported off the ground along the entire length to avoid damaging of the material during pullback due to ground surface conditions. Surface cuts or scratches greater than or equal to the maximum defect depth are not acceptable.

Pipe Size In.	Max. Defect Depth In.
4	1/16
6	1/11
8	5/32
10	3/16
12	1/4
> 12	Per Pipe Manufacturer's Recommendations

H. The drilling fluid specialist shall remain on the project site during the entirety of the directional boring operation to ensure proper mixture and production of drilling fluids needed for the bore.

I. Upon successful completion of the pilot hole, the borehole shall be reamed to a minimum of 25 percent greater than the outside diameter of the pipe being installed.

J. For bores with more than two radii of curvature (entrance and exit), the borehole should be reamed up to 50 percent larger than the outside diameter of the carrier pipe. Prereaming may be necessary dependent on size of material to be pulled.

K. Additional passes for prereaming may be required for larger pipe. Incremental increases shall be used as needed until appropriate bore hole size has been achieved.

L. Prereaming must be accomplished with no product attached to the reamer head on all bore pipe 6" and larger. The bore product may be pulled back on final pass of prereaming upon prior approval from the County.

M. After reaming the borehole to the required diameter, the pipe shall be pulled through the hole. In front of the pipe shall be a breakaway swivel and barrel reamer to compact the borehole walls.

N. The Contractor shall not ream at a rate greater than the drilling equipment and drilling fluid system are designed to safely handle.

O. Install all piping such that their location can be readily determined by electronic designation (tracer wire) after installation.

1. For all pipe installations, externally attach tracer wire; see 2.01E in the Products Section above, to the top of product pipe and secure in place with duct tape or 10-mil thickness polyethylene pressure sensitive tape at every joint and at 5 foot intervals.

P. Connect any break in the conductor line before construction with an electrical clamp, or solder, and coat the connection with a rubber or plastic insulator to maintain the integrity of the connection from corrosion. Clamp connections must be made of brass or copper and of the butt end type with wires secured by compression. Soldered connections must be made

by tight spiral winding of each wire around the other with a finished length minimum of 3 inches overlap. Tracking conductors must extend 2 feet beyond bore ends. Test conductors for continuity. Each conductor that passes must be identified as such by removing the last 6 inches of the sheath. No deductions are allowed for failed tracking conductors. Upon completion of the directional bore, the Contractor shall demonstrate to the County that the wire is continuous and unbroken through the entire run of the pipe by providing full signal conductivity (including splices) when energizing for the entire run in the presence of the County Representative. If the wire is broken, the Contractor shall repair or replace it at no additional cost to the County.

Q. The pilot bore shall follow the design path of the bore shown on the Drawings:

1. The Contractor shall continuously monitor horizontal and vertical position and record the position at least twice per drill pipe length, or at every thirty-one and a half (31.5) feet intervals (Addendum No. 3) ~~fifteen (15) feet intervals~~, whichever is most frequent.
2. The radius of curvature shall not be less than seventy-five percent (Addendum No. 3) of that shown on the Drawings. The radius of curvature shall be calculated over the distance of three drill pipe sections. If design radius of curvature is exceeded, the Contractor shall re-drill the pilot hole at no extra cost to the contract.
3. The location of the entry and exit points shall be as shown on the Drawings. The Contractor shall be solely responsible for all work necessary to correct excessive deviations from line and grade, including re-drilling, redesigning connections, and acquiring additional easement, at no additional cost to the Owner and without schedule extension.

R. Inadvertent Returns (Frac-Outs) and planned returns (at relief wells):

1. Contractor shall be responsible for avoiding any impact to existing utilities, structures, facilities, pools, and waterways in the Project area during the drilling operation. If the drilling fluid starts leaking to the surface (other than at the entry and exit points or relief wells), or if fluid loss results in surface movement, Contractor shall cease drilling until fluid loss volumes can be brought under control to minimize any inadvertent returns in the Project area. In such event, notify Engineer immediately. The Contractor shall clean up any locations where drilling fluid surfaces, including releases at relief well locations. Contractor shall pay particular attention to the potential of inadvertent returns washing out along existing utility crossings, and shall have preventive measures in place to prevent these occurrences from happening. Contractor shall be fully responsible for all damages caused by the main installation operations. The pilot bore shall be pre-reamed and reamed using equipment and methods submitted by the Contractor. The Contractor shall completely ream the borehole to the final diameter prior to pull back, when practical or as directed by the Engineer.

S. The Contractor shall perform hydrostatic water pressure test in accordance with the manufacturer's guidelines prior to product pipe pullback.

3.09 PIPELINE TESTING

A. HYDROSTATIC TESTING

1. Refer to Manatee County Public Works Part I Utilities Standards Manual Section

1.9.

B. MANDREL DEFLECTION TESTING PROCESS

1. The deflection test for flexible pipe systems shall be performed by pulling a mandrel through the pipeline. The mandrel shall have a diameter equal to 80 percent of the inside diameter of the pipe system being tested. When the mandrel cannot be pulled through the pipeline the Contractor shall locate and correct the defect to the satisfaction of the County. After the defect is corrected and trench backfilled, the section of line shall then be retested to compliance.

2. Deflection tests shall be performed not sooner than 24 hours after completion of the pipe pull-back. The Contractor shall take measures to ensure the pipe is clean as not to interfere with the mandrel test.

3. The mandrel types that can be used are:
   a. a rigid, nonadjustable, odd number of legs (9 legs minimum), mandrel having an effective length not less than its nominal diameter; and to be fabricated of steel, fitted with pulling rings at each end, stamped or engraved on some segment other than a runner indicating the pipe material specification, nominal size and be furnished in a suitable carrying case labeled with the same data as stamped or engraved on the mandrel.

   b. If approved by the County, a smaller diameter piece of similar material that is approximately double the nominal diameter in length and meets the 80% reduction of the inside diameter of the pipe being tested. The pipe length may need to be adjusted to ensure the pipe section cannot become skewed and become lodged; this may cause the test to fail.

4. The mandrel shall be pulled through the pipe by hand to ensure that maximum allowable deflections have not been exceeded or that “necking” has not occurred. Prior to use, the mandrel shall be inspected by County personnel. Use of an unapproved mandrel or a mandrel altered or modified after inspection will invalidate the test. If the mandrel fails to pass, the pipe will be deemed overdeflected or necked.

5. Overdeflected or necked pipe shall be abandoned and reinstalled. The replaced pipe shall be tested for deflection not sooner than 24 hours after installation.

C. The following deficiencies in the flexible pipe system installation shall be corrected by the Contractor at no cost to the County:

1. Overdeflections
2. Stretched or “Necked” Pipe
3. Damaged Pipe
4. Improper Pipe Welds
5. Infiltration Points
6. Debris in the line

D. The County will not accept a credit, maintenance bond, or any other form of compensation

in lieu of corrective measures that may be required to correct any sections of flexible pipe system that are improperly installed or do not meet the requirements of these specifications. In addition, all corrective measures proposed by the Contractor shall be approved by the County. In addition, should repairs of the flexible pipe system be accomplished by the use of any unauthorized materials or procedure, the County will require replacement of those substandard portions or repairs made to conform to the requirements of these specifications.

END OF SECTION