maximum allowable deflections from a straight line or grade, or offsets, will be five degrees.

5.4.9 PLACING AND LAYING

A. General:
   1. Lower pipe and accessories into trench by means of derrick, ropes, belt slings.
   2. Do not dump or drop any of the materials of this Section into the trench.
   3. Except where necessary in making connections to other lines, lay pipe with the bells facing in the direction of laying.
   4. Rest the full length of each section of pipe solidly on the pipe bed, with recesses excavated to accommodate bells, couplings, and joints.
   5. Take up and relay pipe that has the grade or joint disturbed after laying.
   6. Do not lay pipe in water, or when trench conditions are unsuitable for the work; keep water out of the trench until jointing is completed.
   7. Securely close open ends of pipe, fittings, and valves when work is not in progress.
   8. Where any part of coating or lining is damaged, replace pipe section or repair to the approval of the Batesville Water Utility inspector.
   9. Ductile Iron pipe, fittings, valves, bolted sleeves, and other components of dissimilar metal when buried in corrosive soils or backfill shall have loose polyethylene encasement film installed in accordance with AWWA C105.

B. Polyethylene and P.V.C. pipe (2” only):
   1. Position pipe and fittings in trench in a manner that identifying markings will be readily visible for inspection.
   2. Cutting and joining:
      a. Protect against abrasion from serrated holding devices.
      b. Remove burrs and glosses from surfaces to be jointed; use abrasive paper, file, or steel wool.
      c. Remove dirt, dust, and moisture by wiping clean with chemical cleaner or dry cloth.
   3. Do not thread plastic pipe; make connections only with the solvent cement or with special adapter fittings designed for the purpose.
   4. Align pipe system components without strain.
   5. Support piping at intervals of not more than four feet, at ends, branch fittings, and change of direction or elevation.
   6. Support plastic pipe in trenches with a 3" layer of sand. Allow no rocks, debris, or potentially damaging substances within 6" of plastic pipe in trenches.
   7. Provide an electrically continuous insulated 10-gauge solid copper insulated tracer wire in the trench above the pipe, fastened to the pipe at 20-foot intervals. The wire shall come above ground every 500’ through a 3” PVC marking post that will be supplied by the Batesville Water Utility. There shall be an 18" minimum lead of wire left at the top of the marking

post. All underground connections shall be made with brass split nuts, and sealed or taped. A one pound anode shall be attached to the tracer wire every 1000 feet. The anode will be supplied by the Batesville Water Utility and billed to the contractor.

C. Connections: Use specials and fittings to suit the actual conditions where connections are made between new work and existing mains. Use only those specials and fittings approved by the Batesville Water Utility.

D. Sleeves:
   1. Where pipe passes through walls of valve pits or structures, provide P.V.C. or cast iron wall sleeves.
   2. Fill annular space between walls and sleeves with rich cement mortar.
   3. Fill annular space between pipe and sleeves with high-grade chaulk

5.4.10 COVERING ENDS

A. Before leaving the Work for the night, during a storm, or for any other reason, care must be taken that the unfinished end of any pipe is securely closed with a tightly fitting cover or plug. Any earth or other material that may find entrance into the pipe, through any such open end of an unplugged pipe shall be removed at the Contractor's expense.

5.4.11 STABILIZATION

A. If portions of the bottom of trenches or excavations consist of material unstable to such a degree that, in the opinion of Batesville Water Utility inspector, it cannot adequately support the pipe or structure, the bottom shall be overexcavated and stabilized with granular material in compliance with the INDOT Standard Specifications, current edition. Depth of stabilization shall be as directed by the Inspector.

5.4.12 BACKFILLING

A. Pipe bedding and initial backfill shall be as shown on the Water Main Construction Details of the Construction Standards. Initial backfill shall be placed in lifts of a maximum of 6 inches loose thickness. The method for placing and compacting the backfill shall comply with the INDOT Standard Specifications as applicable. At a minimum, the Contractor shall use a vibrating plate compactor with adequate “passes” to achieve compaction. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. Care shall be taken to ensure thorough compaction of the fill under pipe haunches.

B. Final backfill for the remainder of the trenches shall be as follows:
   1. Backfill for trenches under sidewalks, under turfed or seeded areas, and in miscellaneous areas shall be of approved earth material and contain no

stones over four inches (4") in their largest dimensions. Stones which are used in backfilling shall be distributed among the earth backfill so that all interspaces are filled with fine material. All such backfilling shall be deposited in lifts of a maximum 12 inches loose thickness and compacted with a vibrating plate compactor or approved mechanical tamping devices. Excess earth to the amount required to replace settlement shall be neatly rounded over the trench and the remainder hauled off the work site. Trenches shall be maintained by the Contractor until settlement has ceased and trenches remain level with the adjacent ground.

2. Backfill of all trenches under existing or proposed roadways and structural footings or slabs shall be “B” Borrow, Coarse Aggregate No.12, or sand. In addition, the top seven (7) inches below the base of the pavement shall be backfilled with no. 53 or 73 crushed stone unless flowable fill is used for backfilling per item 5.4.12.B.3. The backfill shall be placed in 6" maximum lifts and the method of placing and compacting the backfill shall comply with the INDOT Standard Specifications, as applicable. At a minimum, the Contractor shall use a vibrating plate compactor with adequate “passes” to achieve compaction.

3. Flowable fill shall be used as backfill for trenches under or within five (5) feet of existing city streets as shown on the “Water Main Construction Details” of the Construction Standards. Flowable fill shall be used as required by the City Street Superintendent or on a case by case basis. Flowable fill shall be placed up to the base of the pavement section. Allow a minimum of 24 hours of curing time for the flowable fill prior to placement of the pavement section.

C. Pipe bedding and each backfill lift shall be compacted to a dry density not less than the following percentage of maximum dry density as determined by the Modified Proctor Test (ASTM D1557):

Usage	Compaction %
Beneath piping	95
Upper 2 feet of backfill under roadways	95
Under roadways (except upper 2 feet of backfill)	92
Under haunches and up to springline of pipe	95
From springline to 12 inches above top of pipe	90
Adjacent to (or behind) vertical walls	90
Under turfed or seeded areas below topsoil, and miscellaneous area (from 12” above pipe to surface)	85

D. No fill shall be placed against any structure until placed concrete has been allowed to cure for at least 3 days. Backfill shall be placed in such a manner that the structure will not be damaged by shock from falling earth. The backfill material shall be deposited and compacted as specified for final

backfill, and shall be placed in such a manner as to prevent eccentric loading and excessive stress on the structure. Heavy equipment for spreading and compacting shall not operate closer to foundation walls than set forth as follows.

E. Fill placed adjacent to vertical or near vertical walls (within a zone defined by imaginary lines extending horizontally away from the base of the wall for a distance of three feet and thence upward and outward on a one to one slope to the elevation of the top of the wall) shall be compacted to the specified density with light equipment not exceeding 1500 pounds in static weight or dynamic rated impact.

5.4.13 COMPACTION TESTING

A. Sampling and testing shall be the responsibility of the Contractor. Tests shall be performed by an approved commercial testing laboratory or may be tested with approved facilities furnished by the Contractor.

B. Laboratory tests for moisture-density relations shall be determined in accordance with ASTM D1557. A minimum of one test shall be performed on each different type of material used for backfill.

C. Field In-Place Density Tests:
   1. Shall be performed in sufficient numbers to ensure that the specified compaction is being obtained. A minimum of one test per lift of backfill for every 200 feet of installation shall be performed. Locations for performing the density tests will be coordinated with the Batesville Water Utility inspector.

   2. Shall be determined in accordance with ASTM D1556, ASTM D2167 or ASTM D2922. When ASTM D2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as per ASTM D1556. ASTM D2922 results in a wet unit weight of soil and when using this method, ASTM D3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gages shall be checked along with density calibration checks as described in ASTM D3017. The calibration checks of both the density and moisture gages shall be made at the beginning of a job, on each different type of material encountered and at intervals as directed by Batesville Water Utility inspector. Copies of calibration curves and results of calibration tests shall be furnished to the Batesville Water Utility inspector.

D. All test results shall be submitted to the Batesville Water Utility inspector.

E. Trenches improperly compacted shall be reopened to the depth directed by the inspector and then refilled and compacted to the density specified.

Field in-place density tests shall also be repeated for improperly compacted trenches that are reopened, refilled and recompacted. A minimum of one repeat test per lift of backfill for every 200 feet of improperly compacted trench that is reopened, refilled and recompacted shall be performed.

5.4.14 JOINTING

A. Pipe joints:
   1. Ductile iron pipe, mechanical joints, and push-on type joints: Install in accordance with AWWA C600, modified as necessary by the recommendation of ductile iron pipe.
   2. Make connections between different types of pipes and accessories with transition fittings.
   3. Rubber gaskets: Handle, lubricate where necessary, and install in strict accordance with the recommendations of the manufacturer.
   4. Polyethylene Pipe and quality assurance. The pipe and fittings manufacturer shall have an established quality control program responsible for inspecting incoming materials and outgoing pipe and fittings and components. Incoming polyethylene materials shall be inspected for density per ASTM D1505 and melt flow rate per ASTM D1238, and contamination. The supplier shall certify all incoming materials. Certifications shall be verified by the pipe manufacturer and submitted to the Engineer.

5.4.15 SETTING VALVES AND VALVE BOXES

A. General:
   1. Center valve boxes on the valves, setting plumb.
   2. Tamp earth fill around each valve box to a distance of four feet on all sides, or to the undisturbed trench face if less than four feet.
   3. Tighten stuffing boxes, and fully open and close each valve to assure that all parts are in working condition.

B. Service boxes:
   1. Where water lines are located below paved streets having curbs, install boxes directly back of the curbs.
   2. Where no curbing exists, install boxes in accessible locations beyond limits of street surfacing, walks, and driveways or as shown on the drawings.

5.4.16 RESTRAINING

A. General:
   1. Acceptable methods of restraining joints, fittings, bends, and valves below grade shall be as follows.

      a. Restrainers for PVC pipe shall be manufactured by Uni-Flange, Series 900, 1300, 1350, 1390, Mega-Lug, or approved equal.

      b. MJ restraining glands for D.I. pipe shall be manufactured by EBAA Iron, Series 1200; Romac Industries, Style MJR6; or approved equal.

      c. Provide stainless steel nuts, bolts, and rods for the stainless steel tie bolt restraining system or approved equal Use Romac "Ductile Lug" or approved equal in lieu of eye bolts.

B. Installation:
   1. Refer to the "Water Main Construction Details" of the Construction Standards for determining the proper location and amount of required restraint.

5.4.17 HYDRANT LOCATIONS

A. Fire hydrants shall be located as shown on the "Water Main Construction Details" of the Construction Standards.

B. Flushing hydrants shall be used for the purpose of flushing water mains. Flushing hydrants shall be located on the dead ends of water mains of less than 6 inches in diameter, or in locations where standard fire hydrants are not required but water main flushing is needed.

5.4.18 TESTING AND INSPECTING

A. Contractor shall notify Batesville Water Utility at least forty-eight (48) hours in advance of starting construction to make arrangements for inspection and shut-down of existing water main, where required.

B. All pressure and leakage tests shall conform to the latest revisions of AWWA standards or the Batesville Water Utility specifications, as herein defined, whichever is most stringent.

C. Closing uninspected work: Do not allow or cause any of the work of this Section to be covered up or enclosed until after if has been completely inspected by the Batesville Water Utility inspector.

D. Hydrostatic tests:

1. Where any section of a water line is provided with concrete thrust blocking for fittings, do not make hydrostatic tests until at least five days after installation of the concrete thrust blocking, unless otherwise directed by the Batesville Water Utility inspector.
2. Devise a method for disposal of waste water from hydrostatic tests, and for disinfection, as approved in advance by the Batesville Water Utility inspector.

E. Pressure tests:
1. After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench backfilled, subject the newly laid piping and valved sections of water distribution and service piping to a hydrostatic pressure of 150 psi for a minimum period of two hours.
2. Valves within the test segment shall not be operated in either direction at a differential pressure exceeding the rated valve working pressure.
3. Replace or remake joints showing visible leakage.
   a. Remove cracked pipe, defective pipe, and cracked or defective joints, fittings, and valves. Replace with sound material and repeat the test until results are satisfactory.
   b. Make repair and replacement without additional cost to the Owner.
4. The pressure in the water main shall not vary more than 5± psi during the 2-hour test.

F. Leakage test:
1. Conduct leakage test.
2. Duration of each leakage test: At least two hours.
3. During the test, subject water lines to a pressure of 150psi with no more than 5± psi variance during the test period.
4. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.
   a. No piping installation will be accepted until the leakage is less than the number of gallons per hour as determined by the following table:

TABLE 5.4.18: Allowable Leakage per 1,000 Feet of Pipeline at 150 PSI Test Pressure (Gallons per hour)			
Size	Leakage	Size	Leakage
4"	0.37	14"	1.29
6"	0.55	16"	1.47
8"	0.74	18"	1.66
10"	0.92	20"	1.84
12"	1.10	24"	2.21
		30"	2.76

Above table based on Mechanical or Push-On joint with 18-foot nominal lengths. For pipe with 20-foot nominal lengths, multiply above leakage by 0.9.

b. Should any test of pipe disclose leakage greater than that specified in Table 5.4.18, locate and repair the defective joint or joints until the leakage is within the specified allowance, and at no additional cost to the Owner.
c. Allowable leakage may also be determined by the allowable leakage formula as detailed in the AWWA Standards.

G. Time for making test:
1. Except for joint material setting, or where concrete reaction backing necessitates a five day delay, pipelines jointed with rubber gaskets, mechanical, or pushon joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill.

H. Disinfection:
1. Before acceptance of the potable water system, disinfect each unit of completed water supply, distribution, and service line in accordance with AWWA C651.
2. Perform all such tests and disinfection in a manner approved by IDEM and the Batesville Water Utility.
3. Furnish copies of two consecutive satisfactory bacteriological analysis from an independent laboratory to the Batesville Water Utility inspector, as required by IDEM.
4. The method of chlorination shall be in accordance with AWWA C651, unless approved otherwise by the Batesville Water Utility inspector in advance.

5.4.19 RECORD DRAWINGS

A. No water system shall be accepted by the City of Batesville unless the installer provides at least two sets of “As Built” drawings. The “As Built” drawings shall show the actual location of the water mains, valves, hydrants and any other appurtenances. All measurements shall be referenced to permanent landmarks. The results of all testing shall also be submitted. “As-Built” drawings and test results shall be certified by a registered engineer.

END OF SECTION