

Special Specification 1011

Pressure Irrigation Ductile Iron Pipe (DIP)



1. DESCRIPTION

Furnish and install ductile iron pipe (DIP) for a pressure irrigation pipe system. The pipe will be the sizes, types, and dimensions shown on the plans and will include all connections and joints to new or existing pipes and other appurtenances as required to complete the work.

The abbreviations AWWA, ASA, ASTM, and ANSI, as used in this specification, refer to the following adjustments organizations or technical societies:

- AWWA – American Water Works Association
- ASA – American Standards Association
- ASTM – American Society for Testing and Materials
- ANSI – American National Standards Institute
- NSF – National Science Foundation

Where reference is made to specifications of the above organizations, it is to be construed to mean the latest standard in effect on the date of the proposal.

2. MATERIALS

All materials used in this project are to be new and unused unless otherwise specified on the plans, specifications or the proposal.

2.1. Ductile-Iron Pipe and Fittings.

2.1.1. **Ductile-Iron Pipe: 3 Inch through 64 Inch.** All ductile-iron pipe is to be manufactured by process of centrifugal casting and is to conform to AWWA Standard C-151, "American Standard for Ductile-Iron Pipe Centrifugally Cast with push-on or mechanical joints for Water or Other Liquids," unless otherwise specified.

Pipe is to conform, in accordance with Table 1, to the following pressure classes based on Type 3 bedding conditions, a depth of bury of 6 ft. and a working pressure of 150 psi:

Table 1
Pipe Pressure Classes

Pipe Size	Pressure Class
3" through 12"	350 psi
16" through 48"	250 psi
54" through 64"	200 psi

Dimensions and tolerances for each nominal pipe size must be in accordance with table 51.5 (push-on) or table 51.5 (mechanical joint) of AWWA Standard C-151 for pipe with a nominal laying length of 20 ft.

All pipe is to have a standard water works cement mortar lining in accordance with AWWA Standard C-104 with outside coating per Section 51.8.1 of AWWA Standard C-151.

Exterior coating is to consist of a nominal one mil thick asphaltic material applied to the outside of the pipe as described in Section 51.8 of AWWA Standard C-151.

Rubber joint gaskets utilized on ductile-iron pipe are to conform with AWWA Standard C-111, latest revision.

Each length of pipe must bear identification markings in conformance with Section 51.10 of AWWA Standard C-151.

Manufacturer is to take adequate measure during pipe production to assure compliance with AWWA Standard C-151 by performing quality-control tests and maintain results of those tests as outlined in Section 51.14 of that standard.

The Engineer may at no cost to the Contractor, subject random lengths of pipe for testing by an independent laboratory for compliance with this specification. Any visible defects or failure to meet quality standards will be grounds for rejecting the pipe.

- 2.1.2. **Fittings for Ductile-Iron Pipe.** Unless otherwise modified or supplemented herein, the latest revision of AWWA Standard C-110 for Ductile-Iron Fittings, 3 in. through 48 in. for Water and Other Liquids and AWWA Standard C-153 for Ductile-Iron Compact Fittings, is to govern the design, manufacture, and testing of all fittings under this specification.

The pressure rating of all fittings is to be a minimum of 250 psi, unless a change in pressure rating is shown on the plans.

Fittings are to be furnished with the type of end combination specified.

Mechanical joint fittings and anchor type fittings are to be furnished complete, with glands, gaskets, and bolts. Bolts for mechanical joints are to be ASTM A-536 specially alloyed and heat treated ductile iron conforming to ANSI/AWWA Standard C111/A21.1L.

Flanged fittings are to be faced and drilled in accordance with ASA Specifications B 16.1, Class 125.

Anchor fittings are to be furnished in size and type or length as specified.

The exterior of all fittings is to be provided with a petroleum asphaltic coating in accordance with AWWA Standard C-110. The interior of flanged fittings supplied under this Item is to be either cement-mortar lined in accordance with AWWA Standard C-104 or lined with a petroleum asphaltic material in accordance with the latest revision of AWWA Standard C-110 as specified. The interior of all other fittings supplied under this Item is to be cement-mortar lined in accordance with the latest revision of AWWA Standard C-104.

Fittings for 2 in. size are to be manufacturer's standard design, designed in accordance with applicable design standard of AWWA Standard C-110.

- 2.1.2.1. **Fitting Restraint for Ductile Iron Pipe (only).**

Radial bolt type restrainer systems must be limited to ductile iron pipe in conjunction with Mechanical Joint (MJ) bell end pipe or fittings. The system must utilize a standard MJ gasket with a ductile iron replacement gland conforming to ASTM A-536-80. The gland dimensions must conform to Standard MJ bolt circle criteria.

Individual wedge restrainers must be ductile iron heat treated to a minimum hardness of 370 BHN. The wedge screws must be compressed to the outside wall of the pipe using a shoulder bolt and twist-off nuts to insure proper actuating of the restraining system.

Standard MJ fitting Tee-bolts and nuts must be high strength steel conforming to AWWA C111/A21.11 and C153/A21.53-88.

Standard MJ gasket must be virgin SBR meeting ASTM D-2000 3 BA 715 or 3 BA 515.

- 2.1.2.1.1. **Tests.** The Engineer may at no cost to the Contractor, subject random joint restraint system products to testing by an independent laboratory for compliance with these standards. Any visible defect of failure to meet the quality standards will be ground for rejecting the entire order.
- 2.1.2.1.2. **Product List.** Other approved equal products from other manufacturers meeting these specifications may be submitted for review.
- 2.1.2.1.2.1. Fitting restraint (MJ), in accordance with Table 2.

Table 2
Fitting Restraint (MJ)

Manufacturer	Ductile Iron
EBBA Iron Sales, Inc.	MEGALUG 1100
Romac Industries, Inc.	Not Approved
Ford/UniFlange	Series 1400
Star Pipe Products	Stargrip 4000
Sigma Corporation	One Lok SLD
Tyler Union	TUFGRIP 1000F

- 2.1.2.1.2.2. Restrained flange adapters, in accordance with Table 3.

Table 3
Restrained Flange Adapters

Manufacturer	Ductile Iron
EBBA Iron Sales, Inc.	2100 Megaflange
Ford/UniFlange	200, 400, 420

2.1.3. **Brass Fittings.**

- 2.1.3.1. **General.** Water works brass goods consisting of corporation stops, curb stops, couplings, connectors, nipples, etc., will be required in underground installations of service lines in the water distribution system, unless otherwise modified.

The brass composition is to conform to ASTM Designation B-62 and the threads are to conform to AWWA Standard C-800-01 for "Threads for Underground Service Line Fittings."

All casting is to have a natural, clean uniform and smooth surface, and be free from internal porosity.

All machining is to be done in a workmanlike manner and within the acceptable tolerances.

Unless otherwise specified, each fitting is to be furnished with a 1/16 in. thick fiber gasket.

- 2.2. **Polyethylene Wrapping Material.** Polyethylene wrapping material is to be used to encapsulate all ductile and cast-iron pipe.

Polyethylene wrapping for ductile and cast iron water mains is to consist of a 4 mil tubular section of cross-laminated high-density polyethylene, which has a high dielectric and tensile strength, for use in insulating cast-iron and ductile-iron pipe from the electrolytic action encountered in highly active soils.

Polyethylene wrapping is to consist of opaque cross-laminated high-density polyethylene sheet continuously thermally bonded to form a tubular section. The tubes may be supplied in bulk length on rolls or in individual pre-cut lengths. See Table 4 for size and length chart, in accordance with AWWA C-105 (Table 1) for minimum requirements. When supplied in specific pipe lengths, the tubes are to contain a minimum of 4 ft. over the actual pipe length to allow for overlap. Table 5 contains the approved polyethylene wrapping manufacturers and products.

Table 4
4 Mil Polyethylene Wrapping Materials

SIZE & LENGTH (All sizes lay flat size)	
Pipe Size	Product Size Width x Length
4", 6", & 8"	20" x 200/500
8", 10", & 12"	27" x 200/500
16" & 18"	37" x 200/500
20"	41" x 200/500
24"	54" x 200/500
30"	67" x 140/500
36"	81" x 120/500
48"	95" x 100/500
54"	108" x 100/500

Table 5
Approved Polyethylene Wrapping Manufacturer and Products

Manufacturer	Product
Van Leer Flexibles Inc.	Valeron
Manufactured Plastics and Distribution Inc.	Cross Tuff 450 Black

The polyvinyl sheet of film for the tubular wrapping is to be of virgin resins meeting raw and physical properties of ASTM D-1248 and AWWA C-105, latest edition. The material is to be 4 mil cross-laminated high-density polyethylene of uniform film thickness and be free of imperfections such as pin holes, etc., after being thermally seamed into tubular form. The finished product will have a nominal thickness of 4 mils, with tolerances of minus 10%.

The material is to have no volatile constituents, the loss of which may affect ductility. The material is also to have the following properties:

- **Mechanical:** The polyethylene film is to have a tensile strength per latest ASTM D-882 test, of 6300 psi min. The film is to have an elongation of not less than 100% of the test strip per latest ASTM D-882 test. The film is to have an impact resistance 800 gram min per (ASTM D-1709 Method B). The film is to have a propagation tear resistance of 250 gf minimum in machine and transverse direction (ASTM D1922).
- **Dielectric:** The film is to have a dielectric strength of 800 volts per mil thickness per ASTM D-149.

2.2.1.

Marking Requirements.

The polyethylene film supplied must be clearly marked, at a minimum of every 2 ft. along its length, containing the following information:

- Manufacturer's name or trademark;
- Year of manufacture;
- ANSI/AWWA C-105/A21.5;
- Minimum film thickness and material type;
- Applicable range of nominal pipe diameter size(s); and
- Warning-Corrosion Protection-Repair any Damage.

The Engineer may at no cost to the Contractor, subject random testing by an independent laboratory for compliance with this Specification. Any visible defect of failure to meet the quality standards herein will be grounds for rejecting the entire order.

3. CONSTRUCTION

3.1. **Excavation.** Excavation (trenching) as required to complete the pipe installation is to be performed in accordance with Item 400, "Excavation and Backfill for Structures," as outlined herein, as shown on the plans and as directed.

3.1.1. **Trenches.** Trench walls must be vertical. The practice of undercutting at the bottom or flaring at the top will not be permitted except where it is justified for safety or at the Engineer's and/or Inspector's direction. In special cases, where trench flaring is required, the trench walls must remain vertical to a depth of at least 1 ft. above the top of the pipe.

The trench bottom must be square or slightly curved to the shape of the trenching machine cutters. The trench must be accurately graded along its entire length to provide uniform bearing and support for each section of pipe installed upon the bedding material. Bell holes and depressions for joints must be dug after the trench bottom has been graded and bedding installed. The pipe must rest upon the new bedding material for its full length

Where over-excavation occurs, the under-cut trench must be restored to grade at no cost to the Department by replacement with a material conforming to the requirements of the bedding material or a material approved by the Engineer.

3.1.2. **Width of Trench.**

3.1.2.1. **Minimum Width of Trench.** The minimum width of pipe trenches, measured at the crown of the pipe, must be not less than 12 in. greater than the exterior diameter of the pipe, exclusive of bells. The minimum base width of such trench must be not less than 12 in. greater than the exterior diameter of the pipe, exclusive of special structures or connections. Such minimum width must be exclusive of trench supports and not greater than the width at the top of the trench.

3.1.2.2. **Maximum Width of Trench.** The maximum allowable width of trench for pipelines measured at the top of the pipe must be the outside diameter of the pipe (exclusive of bells or collars) plus 24 in. A trench wider than the outside diameter plus 24 in. may be used without special bedding if the Contractor, at his expense, furnishes pipe of the required strength to carry additional trench load. Such modifications must be submitted to the Engineer and approved in writing. Whenever such maximum allowable width of trench is exceeded, except as provided for on the drawings, or in the specifications, or by the written approval of the Engineer, the Contractor, at his expense, must encase the pipe in concrete from trench wall to trench wall, or other pipe bedding material approved by the Engineer. Any excavation wider than this maximum width or subsequent Surface or Paving work, will be done at the Contractor's expense.

3.1.3. **Classification of Excavated Materials.** No classification of excavated materials will be made. Excavation and trench work is to include the removal and subsequent handling of all materials excavated in accordance with Item 400, "Excavation and Backfill for Structures."

3.1.4. **Grade of Trench Bottom.** The trench is to be over-excavated to a depth of 6-in. below the grade line established for the bottom of the pipe, regardless of the type of pipe. The grade line of the pipe is to then be met by the addition of a layer of approved bedding material as directed.

3.1.5. **Excavation Below Grade.** Any part of the bottom of the trench excavated below the limits specified in Section 3.1.3., "Grade of Trench Bottom," is to be corrected with approved material and compacted as directed. Should excessive over-excavation occur, except at bell holes, the grade is to be restored in accordance with the methods described in Section 3.1.5., "Unstable Conditions at Grade," at no cost to the Department.

3.1.6. **Unstable Conditions at Grade.** Where the bottom of the trench at grade is found to be unstable or to include ashes, cinders, any type of refuse, vegetable or other organic material, or large pieces of fragments or inorganic materials which in the judgment of the Engineer should be removed, the Contractor is to

excavate and remove such unsuitable material to the a depth no less than 6 in. below pipe. Before the pipe is laid the grade is to be restored by backfilling with an approved material in layers of 3 in. prior to compaction. The layers are to be slightly moistened and thoroughly compacted so as to provide a uniform and continuous bearing and support for the pipe at every point between bell or collar holes. The finished grade is to be accurately graded to provide uniform bearing and support for each section of pipe at every point along its entire length except for the portions of the pipe sections where it is necessary to excavate for bell holes and for the proper seating of pipe joints.

3.1.7. **Trench Excavation Protection.** All trench excavation required on this project is to be accomplished as required by the provisions of Item 402, "Trench Excavation Protection."

3.1.8. **Backfill Material Derived from Excavation.** All excavated materials which the Engineer determines are suitable for reuse as trench backfill is to be separated where practicable from the general excavation material, or as directed.

3.2. **Pipe Laying.**

General. The Contractor is to start his work at a tie-in point, unless otherwise indicated on the plans. Pipe is to be laid with bell ends facing the direction of lying, unless otherwise authorized or directed. Under no circumstances is pipe to be laid in water and no pipe is to be laid under unsuitable weather or trench conditions.

Proper facilities must be provided for hoisting and lowering the section of pipe into the trench without damaging the pipe or disturbing the bedding and side of the trench. Any pipe which is not in alignment or which shows any undue settlement after laying must be removed and relaid at the Contractor's expense.

3.2.1. **Shaping and Bedding.** The pipe must be bedded in a foundation of compacted cohesionless material, such as sand, crushed stone, or pea gravel, with maximum size not exceeding 3/8 in. This material must extend a minimal of 6 in. below the outermost corrugations or ribs, and must be carefully and accurately shaped to fit the lowest part of the pipe exterior for at least 10% of the overall height. When requested by the Engineer, the Contractor must furnish a template for each size and shape of pipe to be placed for use in checking the shaping of the bedding. The template must consist of a thin plate or board cut to match the lower half of the cross-section of the pipe.

3.2.2. **Installing Pipe.** Every precaution is to be taken to prevent foreign material from entering the pipe while it is being placed in the line. Under adverse trench conditions, extended period of time and/or otherwise required by the Engineer, a manufactured cap/plug is to be used to prevent any foreign type material entering. Leave the cap/plug in place until a connection is made to the adjacent pipe. Inspect the interior of each pipe for defects and reject if defects are found.

After placing a length of pipe in the trench, the jointed end is to be centered on the pipe already in place, forced into place, brought to correct line and grade, completed in accordance with the requirements specified herein. The pipe is to be secured in place with approved backfill material tamped around it. Pipe and fittings which do not allow a sufficient and uniform space for joints will be rejected and are to be replaced with pipe and fittings of proper dimensions. Precautions are to be taken to prevent dirt or other foreign matter from entering the joint space.

At times when pipe laying is not in progress the open end of pipe in the trench is to be closed by a watertight plug or other means approved. Pipe in the trench which cannot temporarily be jointed is to be capped or plugged at each end to make it watertight. This provision is to apply during all periods when pipe laying is not in progress.

Should water enter the trench, the seal is to remain in place until the trench is completely dry. The Contractor is to provide plug & caps of various sizes required.

3.2.3. **Coating and Wrapping Underground Pipe.**

3.2.3.1. Ductile-Iron Pipe.

- 3.2.3.1.1. **Open Trench.** Ductile-iron pipe to be installed in a trench is to be protected in the following manner. Each pipe joint is to be covered with a 4 mil thick polyethylene sleeve that is 2-ft. longer than the pipe joint. The sleeve is to cover the full length of the pipe joint, lap over 1-ft. on each end of the adjoining pipe joints and be secured with a minimum of 2 circumferential turns of pressure sensitive polyvinyl tape. Excess material should be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe and held in place by means of pieces of pressure sensitive tape at approximately 5-ft. intervals. After assembling the joint, the polywrap tube from the previously installed pipe is to be pulled over the joint and secured by the contractor. The polywrap tube from the new joint is to be pulled over the first tube and secured to provide a double seal.

Cast iron and ductile-iron fittings are to be completely wrapped in 8 mil thick polyethylene films with a minimum of 1-ft. overlap on each end and appropriately taped. Laps are to cover joints with adjoining pipe joints or fittings when installed.

Any damaged areas in the polyethylene film are to be repaired by covering the area with a sheet of polyethylene film large enough to lap over the damaged area 1-ft. minimum in any direction and appropriately taped. Take care at service to locations to insure that tape extends beyond corporation and onto service line pipe 1 ft.

- 3.3. **Backfilling.** Particular attention is necessary when backfilling DI pipe. After the pipe structure has been installed as required by the plan details it must be backfilled according to the following, except where it is placed in steel casing:

Type I. Backfill consists of Item 401, "Flowable Backfill." The flowable backfill must be placed across the entire width of the trench and must maintain a minimum depth of 12 in. above the pipe.

Type II. Backfill consists of a cohesionless material, such as sand, crushed stone, or pea gravel, and having a maximum size not to exceed 3/8 in. The backfill material must be placed along both sides of the completed structure(s) to a depth of 12 in. above the pipe. The backfill must be placed in uniform layers not exceeding 6 in. in depth (loose measurement), wetted if required, and thoroughly compacted between adjacent structures and between the structure and the sides of the trench. Until a minimum cover of 12 in. is obtained, only hand operated tamping equipment will be allowed within vertical planes 2 ft. beyond the horizontal projection of the outside surfaces of the structure.

All pipe, excluding private driveway and side road culvert pipe, must be backfilled with Type I backfill. For private driveway and side road culvert pipe the Contractor must have the option of using either Type I or Type II backfill.

Backfill above Type I or Type II backfill material shall be Cement-Stabilized Backfill and must be placed in accordance with Item 400, "Excavation and Backfill for Structures." If Type I backfill is used a minimum of 24 hr. must elapse prior to backfilling the remaining portion of the trench with backfill material in accordance with Item 400, "Excavation and Backfill for Structures."

During the backfilling operations, special emphasis is placed upon the need for obtaining uniform backfill material and uniform compacted density throughout the length of the structure so that unequal pressure will be avoided. Extreme care is to be taken to insure proper backfill under the structure (haunch zone).

- 3.4. **Protection of Pipe.** Unless otherwise shown on the plans or permitted in writing by the Engineer, no heavy earth moving equipment will be permitted to be hauled over the structure until a minimum of 4 ft. of compacted fill (permanent or temporary) has been placed over the top of the structure.

Prior to adding each new layer of loose backfill material, until a minimum of 12 in. of cover is obtained, an inspection will be made of the inside periphery of the structure for local or unequal deformation caused by improper construction methods. Evidence of such will require corrective measures as directed by the Engineer.

Pipe damaged by the Contractor must be removed and replaced by the Contractor at no additional cost to the Department.

4. MEASUREMENT

- 4.1. This Item will be measured by the foot. Such measurements will be made between the ends of the barrel along its flow line. Where spurs, branches or connections to existing pipe lines are involved, measurement of the spur or new connecting pipe will be made from the intersection of its flow line with the outside surface of the pipe into which it connects.
- 4.2. This is a plans quantity measurement Item and the quantity to be paid for will be that quantity shown in the proposal and on the "Estimate and Quantity" sheet of the contract plans, except as may be modified by Article 9.2. If no adjustment of quantities is required additional measurements or calculations will not be required.
- 4.3. Flowable backfill will not be measured, but considered subsidiary to this Item.

5. PAYMENT

- 5.1. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Pressure Irrigation DI Pipe, Furnish and install ductile iron pipe (DIP) for a pressure irrigation pipe system. The pipe will be the sizes, types, and dimensions shown on the plans and will include all connections and joints to new or existing pipes and other appurtenances as required to complete the work." of the size and pressure class specified. This price will be full compensation for furnishing, hauling, placing and joining of pipes; for all connections to new or existing pipes; for the bedding and Type I or II backfill material as required; for cutting of pipe ends on skew; and for all labor, tools, equipment and incidentals necessary to complete the work.
- 5.2. Excavation and backfill above the Type I or II backfill will be paid for in accordance with Item 400, "Excavation and Backfill for Structures."