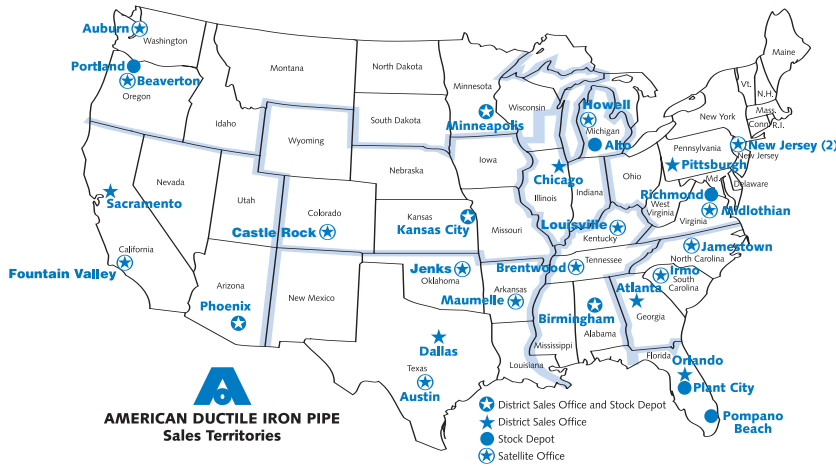


AMERICAN Linings and Coatings



AMERICAN DUCTILE IRON PIPE



AMERICAN DUCTILE IRON PIPE
Sales Territories

American Ductile Iron Pipe (A Division of ACIPCO) General Offices and Plants

Mailing Address:
P.O. Box 2727
Birmingham, AL 35202-2727
Street Address:
1501 31st Avenue North
Birmingham, AL 35207

Customer Service:
1-800-442-ADIP (2347)
Facsimile 1-800-442-2348
Internet Address:
<http://www.acipco.com>

District Sales Offices

ATLANTA

3575 Koger Boulevard
Ste. 240, Duluth, GA 30096
Telephone: 770/381-3611
Facsimile: 770/381-3688

North Carolina Satellite Office:
3140 Goldmist Drive
Buford, GA 30019
Telephone: 770/846-1493
Facsimile: 770/381-3688

South Carolina Satellite Office:
PMB #30
7320-L Broad River Road
Irmo, SC 29063
Telephone: 803/407-9107
Facsimile: 803/407-9108

BIRMINGHAM

III Riverchase Office Plaza
Ste. 226
Birmingham, AL 35244
Telephone: 205/307-2800
Facsimile: 205/307-2806

Kentucky Satellite Office:
3703 Woodgrove Place
Louisville, KY 40245
Telephone: 502/243-0510
Facsimile: 502/243-0650

Tennessee Satellite Office:
7003 Chadwick Dr., Ste. 361
Brentwood, TN 37027
Telephone: 615/370-2900
Facsimile: 615/370-2901

CHICAGO

2225 Enterprise Road, Ste. 2502
Westchester, IL 60154
Telephone: 708/947-7680
Facsimile: 708/947-7685

Michigan Satellite Office:
903 S. Latson Road
Ste. 291
Howell, MI 48843
Telephone: 517/545-4604
Facsimile: 517/545-4641

Grand Rapids Regional Depot:
6170 Alden Nash Road
Alto, MI 49302
Telephone: 616/868-7041
Facsimile: 616/868-7046

DALLAS

Preston Plaza
17950 Preston Road, Ste. 990
Dallas, TX 75252
Telephone: 214/237-1900
Facsimile: 214/237-1901

Arkansas Satellite Office:
6 Ouachita Cove
Maumelle, AR 72113
Telephone: 501/851-0947
Facsimile: 501/851-4111

Oklahoma Satellite Office:
514 N. Douglas Street
Jenks, OK 74037
Telephone: 918/298-4446
Facsimile: 918/298-4449

Texas Satellite Office:
P.O. Box 1389
Austin, TX 78767
Telephone: 512/445-5631
Facsimile: 205/307-3873

KANSAS CITY

6445 Carter Avenue
P.O. Box 40
Shawnee Mission, KS 66201-0040
(Depot located on Carter Ave. at
65th St., Merriam, KS)
Telephone: 913/432-4112
Facsimile: 913/432-4157

Colorado Satellite Office:
P.O. Box 1735
Castle Rock, CO 80104
Telephone: 303/660-2321
Facsimile: 303/660-2317

MINNEAPOLIS

21695 Highview Avenue
Lakeville, MN 55044
Telephone: 952/469-1100
Facsimile: 952/469-3311

Washington Satellite Office:
P.M.B. 222-3930 A Street SE
Ste. 305, Auburn, WA 98002
Telephone: 253/735-8281
Facsimile: 253/735-8278

Minneapolis Regional Depot:
21695 Highview Avenue
Lakeville, MN 55044

Portland Regional Depot:
9700 North Hurst
Portland, OR 97217

ORLANDO

300 Primera Blvd., Suite 240
Primera Four
Lake Mary, FL 32746
Telephone: 407/804-1420
Facsimile: 407/804-1201

Florida Satellite Office:
110 Paseos Way
Jupiter, FL 33458
Telephone: 561/747-6640
Facsimile: 561/747-6987

Plant City Regional Depot:
2910 Sammonds Road
Plant City, FL 33563
Telephone: 813/752-6521
Facsimile: 813/759-6504

Pompano Regional Depot:
4000 N. Dixie Highway
Pompano Beach, FL 33064-4355
Telephone: 954/781-6568
Facsimile: 954/946-4091

PITTSBURGH

2581 Washington Rd.
Ste. 220/222
Pittsburgh, PA 15241
Telephone: 412/851-1230
Facsimile: 412/851-1243

New England Satellite Office:
637 Wyckoff Avenue
Ste. 230, Wyckoff, NJ 07481
Telephone: 201/891-0644
Facsimile: 201/891-0971

New Jersey Satellite Office:
1614-O Union Valley Road
Ste. 304
West Milford, NJ 07480
Telephone: 973/853-4288
Facsimile: 973/853-4289

Virginia Satellite Office:
13817 Shadow Ridge Rd.
Midlothian, VA 23112
Telephone: 804/763-4671
Facsimile: 804/763-0154

Richmond Regional Depot:
5000 Deepwater Terminal Rd.
Richmond, VA 23234

SACRAMENTO

4811 Chippendale Drive
Ste. 707
Sacramento, CA 95841-2554
Telephone: 916/339-8151
Facsimile: 916/339-8161

Phoenix Satellite Office:
2303 N. 44th Street
Suite 14-1049
Phoenix, AZ 85008-2442
Telephone: 602/275-3540
Facsimile: 602/275-2276

Phoenix Regional Depot:
4703 W. Pasadena Ave.
Glendale, AZ 85301

Sacramento Satellite Office:
18377 Stanislaus Street
Fountain Valley, CA 92708
Telephone: 714/593-0325
Facsimile: 205/307-3886

INTERNATIONAL SALES

P.O. Box 2727
Birmingham, AL 35202-2727
Telephone: 205/325-7815
Facsimile: 205/325-8014



AMERICAN Linings for Pipe and Fittings

The principal standard covering cement lining is ANSI/AWWA C104/A21.4. This and other standards are referenced throughout this Section either by the full ANSI/AWWA designation or by only the AWWA numbering, such as AWWA C104.

Along with technical and metallurgical advancement in piping materials, research on lining requirements for pipe and fittings has resulted in the development of linings to meet many different service requirements. AMERICAN offers several types of linings, the most common being cement lining.

Pipe and fittings furnished by AMERICAN are offered unlined or with linings as follows:

1. Cement Lined per AWWA C104.
2. Asphaltic Lined per AWWA C110, C115 or C151.

3. Fusion-Bonded Epoxy (for 4" -16" Fastite fittings) per AWWA C116.

4. PROTECTO 401 Lined - Ceramic Epoxy Lined.

5. Special Lining - for unusual service conditions.

Cement Lining

Cement-mortar lining for ductile iron pipe and ductile and gray iron fittings for water service is in accordance with ANSI/AWWA C104/A21.4.

Cement-lined pipe is also furnished for some sewage service and a number of other applications. In fact, most pipe furnished is cement lined, providing improved flow characteristics and the required protection against internal corrosion. The cement lining is satisfactory for temperatures up to 212°F. If asphaltic seal coat is furnished, the lining is only adequate for temperatures up to 150°F. For other services contact AMERICAN regarding temperature limitations of cement lining.

The first recorded installation of cement-lined gray iron pipe was in 1922 at Charleston, S.C. This lining was developed by the Charleston Commission of Public Works in cooperation with American Cast Iron Pipe Company. Since this beginning, AMERICAN has furnished most of its pipe with cement lining. The lining is applied centrifugally with the speed of rotation designed to produce a smooth waterway surface, minimal voids, yet retaining enough moisture for proper curing. AMERICAN cement-lined

pipe and fittings are listed by ANSI/NSF Standard 61 for potable water contact.

Flow tests on cement-lined pipe under varying service conditions have established that the Hazen-Williams flow coefficient remains as expected at about 140, and flow tests on cement-lined, large-diameter AMERICAN Ductile Iron pipe have confirmed flow coefficients much higher than 140.

Handling Cement-Lined Pipe and Fittings

Pipe and fittings with cement lining should be handled with rubber-covered hooks or other type equipment to prevent damage to the cement lining. Bare fork lift arms or bare hooks should not be inserted into open ends.

Characteristics of Cement Lining

AWWA C104 allows for surface crazing and cracks of a specified nature and magnitude. Occasionally cracks and looseness in linings may occur prior to installation, particularly where pipe is stored for a considerable time. Many years' experience with cement-lined pipe and fittings has verified that this condition is not detrimental to the perfor-



mance and effectiveness of the lining.

When a cement-lined pipe is placed in service and filled with water, two reactions begin immediately. The first is a gradual elimination of the temperature differential between pipe and lining, thus eliminating any stresses in the lining due to this condition.

Secondly, the lining begins to absorb water. Water is absorbed into the pores of the cement and into the capillary channels of the calcium silicate gel. The water absorption causes the lining to swell, restoring it to intimate contact with the pipe wall and virtually closing any cracks present in the lining. This swelling process is relatively slow, taking up to several weeks for the lining to be restored to its maximum volume. This process has been demonstrated on a number of occasions to the satisfaction of customers, contractors and engineers by immersing a pipe or fitting in water for one or two weeks.

After a period of exposure to water, not only does the lining tighten against the pipe wall and the cracks close, but finally the surfaces of the cracks actually re-bond. This occurs by a process called autogenous healing. This phenomenon, long recognized by the cement industry, has been documented by laboratory tests to occur in cement-lined ductile pipe. In one test, a 48" ductile iron pipe with severely cracked cement lining was held half full of water for several months. At the end of that period, the lining both above and below the water surface was found to be tight, with all cracks either healed completely or sealed by the formation of calcium carbonate.

Field inspections of lines that have been in service for many years have verified the laboratory results; cement linings do tighten and heal in service and provide the corrosion protection to the pipe and the high flow coefficients for which they were designed.

Field Repair of Damaged Cement Linings

Cement lining will withstand normal handling; nevertheless, pipe or fittings may be found at times to have damaged linings which need to be repaired before placing in service.

AWWA C104 provides that damaged lining may be repaired, and the following repair procedure is recommended:

1. Cut out the damaged lining to the metal. Square the edges.
2. Thoroughly wet the cut-out area and adjoining lining.
3. With the damaged area cleaned and the adjoining lining wet, spread the mortar (see recommended mix below) evenly over the area to be patched. (See Table No. 11-1, next page, for lining thicknesses.) After the lining has become firm and adheres well to the surface, finish it with a wet 3" or 4" paint brush or similar soft bristle brush.
4. The repaired lining should be kept moist by tying canvas, wet burlap, or other wrap over the ends of the pipe or fitting for at least 24 hours. As an alternative the repaired lining may be seal coated with a cut back type of asphaltic seal coating. This must be sprayed or brushed on within five to 30 minutes after lining. To maintain NSF certification, patch must be made using a NSF certified cement for 4" pipe and larger, or the patch must be topcoated with NSF certified asphalt paint.

Recommended Cement Mix

Cement mix by volume: 3 Parts Portland Cement; 2 Parts Clean Sand; necessary water for slump of 5" to 8". The sand should be free of clay and screened through a No. 20 Screen.

Precautions

1. Mortar for lining should not be used after it has been mixed for more than one hour.
2. Too rapid a loss of moisture from fresh linings due to hot weather or high wind will prevent proper cure, resulting in the lining being soft and powdery. To prevent this loss of moisture, (a) do not line hot castings and (b) close the ends of the castings with wet burlap.
3. Fresh linings that become frozen will not be serviceable. Avoid lining in freezing weather.



**Cement Lining
ANSI/AWWA C104/A21.4
Thicknesses and Weights**

Table No. 11-1

Size in.	Nominal Pipe Length ft.	Standard Thickness			Double Thickness		
		Minimum Thickness in.	Weight Per Foot lb	Weight Per Length lb	Minimum Thickness in.	Weight Per Foot lb	Weight Per Nominal Length lb
4	18	1/16	.87	17	1/8	1.71	31
6	20	1/16	1.30	26	1/8	2.57	51
8	20	1/16	1.74	35	1/8	3.45	69
10	20	1/16	2.15	43	1/8	4.28	86
12	20	1/16	2.57	51	1/8	5.12	102
14	20	3/32	4.49	90	3/16	8.93	179
16	20	3/32	5.13	103	3/16	10.19	204
18	20	3/32	5.76	115	3/16	11.47	229
20	20	3/32	6.40	128	3/16	12.73	255
24	20	3/32	7.68	154	3/16	15.31	306
30	20	1/8	12.76	255	1/4	25.42	508
36	20	1/8	15.31	306	1/4	30.51	610
42	20	1/8	17.82	356	1/4	35.53	711
48	20	1/8	20.35	407	1/4	40.60	812
54	20	1/8	22.89	458	1/4	45.68	914
60	20	1/8	24.71	494	1/4	49.32	986
64	20	1/8	26.35	527	1/4	52.61	1052

Weights are based on the minimum lining thicknesses for minimum pressure classes of Fastite ductile iron pipe. Actual lengths and weights may differ from above.
 Linings may taper at the ends.
 AMERICAN recommends the use of standard thickness cement lining per AWWA C104 for all normal installations.



This 64" Ductile Iron Fastite Joint water transmission main was furnished with standard cement lining for continuing high flow performance.



Other Linings Available From AMERICAN

Pipe and fittings lined with the following types of coatings are available from AMERICAN on a special order basis. For more detailed information regarding lining selection, application parameters and typical field topcoats, please contact AMERICAN.

ASPHALTIC LINING

AMERICAN furnishes some pipe and fittings lined with an asphaltic material in accordance with AWWA C110, C115, C153 and C151. After thoroughly drying, the lining has no deleterious effect upon the quality, color, taste or odor of potable water. Asphaltic lining is not normally used in water service; the majority of ductile water lines are cement lined. Asphaltic lining or seal-coat, if furnished, on cement lining is adequate for temperatures up to 150°F.

PROTECTO 401 LINING

AMERICAN can furnish 4"-64" PROTECTO 401 Ceramic Epoxy-lined ductile iron pipe and fittings. This third-party-designed and -applied lining is amine-cured with novalac and ceramic quartz pigment for an approximately 40-mil-thick, high-build lining.

FUSION-BONDED EPOXY

All 4"-16" Fastite fittings are fusion-bonded-epoxy lined and coated. Fusion-bonded epoxy is furnished in accordance with AWWA C116.

OTHER SPECIAL LININGS

Customers can request pipe and fittings with special linings other than those listed above (e.g. glass lining, etc.). Because of the variables and complexities involved in the selection of a proper lining for a given service, AMERICAN invites inquiries for technical assistance, availability, and cost.

UNLINED

Because some service applications may require unlined pipe & fittings, AMERICAN furnishes any of its products without lining when so specified at time of purchase.



AMERICAN Coatings and Primers for Pipe and Fittings

Several different generic types of exterior primers for pipe and fittings are available upon request. Because of variables and complexities involved in the selection and application of a proper coating for a given service, AMERICAN invites inquiries for technical assistance.

AMERICAN furnishes most pipe and fittings coated outside with an asphaltic coating approximately one mil thick per AWWA C151 for ductile iron pipe, AWWA C115 for flanged pipe and AWWA C110 and C153 for fittings.

All across the United States ductile iron and gray iron pipe and fittings with this standard coating have provided trouble-free service for decades. Unless otherwise specified, an asphaltic coating is applied to the outside of all pipe and fittings manufactured by AMERICAN.

The asphaltic coating works in conjunction with manufacturing annealing scale to provide a barrier to corrosion. If soils are deemed to be corrosive to ductile iron pipe when evaluated in accordance with the Design Decision Model™ (DDM™*) or Appendix A of AWWA C105, polyethylene wrap or other appropriate methods should be used.

Asphaltic coating is not compatible with most top coats. See the following alternative primer recommendations.

MCU UNIVERSAL PRIMER (Moisture-Cured Urethane)

This is a quality, fast-curing, surface-tolerant, immersion-grade, moisture-cured urethane (MCU) specially developed and tested for iron substrates. This coating is essentially a universal primer compatible with all major generic topcoats, including acrylics, epoxies, polyurethanes and moisture-cured urethane topcoats. It can also be topcoated with solvent or water-based asphaltic coatings. For the above reasons, it is well suited for most applications, including where the generic topcoats or end uses may not be known.

*DDM™ (Design Decision Model™) developed jointly by Corrpro Companies, Inc., and the Ductile Iron Pipe Research Association. See acipco.com, dipra.org or corrpro.com for details.

Other advantages include a very tough, damage-resistant film resulting in less handling and shipping damage and less touch-up and repair in the field than traditional epoxy primers used in the past. This primer does not have a maximum recoat window and does not require field blast cleaning, as long as the surface is clean and free of dust. This primer is considered a high-performance, chemical-resistant coating suitable for immersion and non-immersion services. Refer to AMERICAN Recommended and Preferred Primer System - Universal Primer (Moisture-cured urethane) for more information and advantages.

PHENOLIC ALKYD PRIMER

This is a fast-drying, lead- and chromate-free, corrosion-resistant primer formulated to accept a wide variety of topcoats. It is well suited for applications where the generic topcoats are unknown but its service is limited to atmospheric exposure. Refer to AMERICAN Alkyd-Phenolic Primer. NOTE: NOT RECOMMENDED FOR IMMERSION. MUST ALLOW UP TO 30 DAYS OF CURING BEFORE TOPCOATING WITH CERTAIN COATINGS.

EPOXY PRIMER

This is a high-solids, chemical- and corrosion-resistant coating for protection against abrasion, moisture, corrosive fumes, chemical attack and immersion.



This 30" AMERICAN Ductile Iron Fastite joint treated-water transmission main was furnished and installed—as is most ductile iron pipe—with standard asphaltic coating approximately one mil thick on the outside.



High-build properties provide outstanding corrosion protection with fewer coats, particularly on edges. Such high-solids, high film-build epoxies are compatible with most catalyzed finish coats.

Typical (field) finish coatings include: epoxies (amine, polyamide, polyamidoamine, water-borne, coal-tar) and polyurethane. Refer to AMERICAN Polyamidoamine Epoxy Primer. NOTE: AFTER 60 DAYS OF CURING, THIS PRIMER SHOULD BE UNIFORMLY SCARIFIED BY BRUSH-BLASTING WITH FINE ABRASIVE BEFORE TOPCOATING.

FUSION-BONDED EPOXY

All 4" -16" Fastite fittings are fusion-bonded epoxy (FBE) lined and coated. The FBE coating/lining meets the applicable requirements of AWWA C116, and both FBE and cement linings are ANSI/NSF

Standard 61 certified for contact with potable water.

OTHER SPECIAL COATINGS

AMERICAN can also furnish other special exterior coating systems. Contact AMERICAN for technical assistance in the selection of special exterior coating systems, lead times and costs.

UNCOATED PIPE

Because some customer applications may require piping or fittings that have no coating applied to the exterior, AMERICAN furnishes, when specified at time of purchase, any of its products without exterior coatings.

NOTE: AMERICAN also has the ability to furnish other primers, but this may affect price and availability.

AMERICAN Cast Iron Pipe Company Standard O.D. Shop Primer Systems

RECOMMENDED AND PREFERRED PRIMER

MCU Universal Primer

Interior/Exterior/Immersion (Above and Below Grade)

- Single-coat thickness: 3.0-5.0 mils DFT (76-127 microns).
- Typical Topcoats: alkyds, aluminums, epoxies, bituminous, polyurethanes and moisture-cured urethane topcoats.
- Specially developed and tested for iron substrates.
- Single component.
- Low-temperature, fast-curing capability.
- Can be applied over damp, but not wet surfaces.
- Infinite recoat window, as long as surface is clean and free of dust before topcoating.
- This primer is compliant with ANSI/NSF Standard 61 **as a primer and spigot surface coating for pipe, fittings, and valves** when combined with approved topcoats.

OTHER PRIMERS

Alkyd-Phenolic Primer

Interior/Exterior/Non-Immersion (Above Grade Only)

- Single-coat thickness: 2.0-4.0 mils DFT (50-101 microns).
- Typical Topcoats: alkyds, aluminums, epoxies, and urethanes.
- Coating must be cured for 30 days before being overcoated with certain topcoats.
- This primer is **not** recommended for immersion service.
- This primer is compliant with NSF Standard 61 **as an exterior surface coating only**.

Polyamidoamine Epoxy Primer

Interior/Exterior/Immersion (Above and Below Grade)

- Single-coat thickness: 3.0-8.0 mils DFT (76-203 microns).
- Typical Topcoats: epoxies and urethanes.
- This coating must be lightly blast cleaned before topcoating if it has not been exterior exposed for 60 days or longer.
- This primer is compliant with ANSI/NSF Standard 61 for potable water contact for pipe, fittings, and valves when combined with approved topcoats.



Polyethylene Encasement

In areas where severely aggressive soils are encountered, the use of a polyethylene tube or sheet encasement has been proven to provide highly effective, economical protection. The protection against corrosion provided by loose polyethylene is different in several ways and should not be confused with coatings applied directly to the barrel of the pipe. The most significant difference is its ability to protect without creation of concentration cells at holidays. Also, since the encasement is applied when the pipe is actually put in the ground, coating damage due to shipping, handling, etc., is minimized.

As water may be present in the soil around the pipe, water may also be present between the pipe and wrap. Water inside the polyethylene tubing initially bears some characteristics of the soil environment, and corrosion may start. But within a short period of time initial oxidation depletes the oxygen supply in the water, and other electrochemical corrosion reactions also progress to completion. At this point a state of chemical equilibrium is reached.

Since the first field installation of polyethylene wrap on gray iron pipe in 1958, installations have been made in severely corrosive soils throughout the United States. The success of the polyethylene encasement procedure developed in the United States has been adopted by several other countries, and an International Standard for Polyethylene Sleeving (ISO-8180) has been developed.

Research by the Ductile Iron Pipe Research Association at several severely corrosive test sites has verified that polyethylene encasement provides a high degree of protection and results in minimal

and generally insignificant exterior surface corrosion of either ductile or gray iron pipe thus protected. These findings have been confirmed by the results of numerous investigations of field installations.

Field tests have also indicated that the dielectric capability of polyethylene provides shielding for ductile and gray iron pipe against stray current at most levels encountered in the field.

Because polyethylene encasement is a passive method of protecting ductile iron pipe in aggressive soils, it can effect greater reliability and savings than cathodic protection systems which require continual monitoring, maintenance and other operating expenses, and trained personnel. Cathodic protection systems can also cause collateral harm in some cases to nearby unprotected ferrous structures.

For protection in areas of severely aggressive soils, AWWA C105 covers materials and installation procedures for polyethylene encasement of underground installations of ductile iron piping for water and other liquids.

Polyethylene wrap in tube or sheet form for piping encasement is manufactured of virgin polyethylene material conforming to the requirements of ANSI/ASTM Standard Specification D1248. The specified minimum thickness for linear low-density polyethylene film is 0.008 in. (8 mils). The specified minimum thickness for high-density, cross-laminated polyethylene film is 0.004 in. (4 mils).

Material, required markings, and installation methods are all in accordance with the requirements of AWWA C105. This standard and more detailed publications by DIPRA regarding loose polyethylene encasement are available from AMERICAN.



**Polyethylene Tubing and Tape
ANSI/AWWA C105/A21.5**



Tubing in Roll

Table No. 11-2

Pipe Size in.	Flat Tube † Min. Width in.	Approximate Weight in Pounds 8 mil low-density P.E.		Approx. weight (lb.) per 500' roll 4 mil high-density cross- laminated P.E.	Tape Required* Per Joint ft.
		Per 1000' of Tube	Per 22' Long Individual Tube		
4	14	89	2	21	5
6	16	102	3	24	6
8	20	128	3	30	8
10	24	154	4	36	9
12	27	173	4	40	10
14	30	192	5	45	11
16	34	218	5	51	12
18	37	237	6	55	13
20	41	262	6	61	15
24	54	346	8	80	17
30	67	429	10	100	21
36	81	518	12	120	25
42	81	518	12	120	28
48	95	608	14	141	32
54	108	689	16	161	35
60	108	689	16	161	36
64	121	772	18	180	39

*Based on one turn at each end, six 4"-long strips to secure loose wrap plus approximately 5% extra.

†Flat tube widths are shown for Fastite, Flex-Ring, Lok-Ring, and MJ Joints. Check AMERICAN for Flat tube widths required for Flex-Lok Joints.

The standard color for low-density polyethylene is black. It can also be furnished white, green, red, buff, royal blue, and lavender on special order. The standard color for high-density, cross-laminated polyethylene is white. It can also be furnished black on special order.

Installation of Polyethylene Encasement

Installation methods as set forth in ANSI/AWWA C105/A21.5 and DIPRA's "Polyethylene Encasement" brochure should be followed.



AMERICAN DUCTILE IRON PIPE



AMERICAN reserves the right to modify or change designs, materials, specifications, or dimensions shown herein without prior notice.



This is a revised reprint of a section from the 19th Edition of the AMERICAN Pipe Manual. References may be made in this section to other sections of this manual.

