# POLYETHYLENE ENCASEMENT

**Effective, Economical Protection**
**for Ductile Iron Pipe**
**In Corrosive Environments**

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# POLYETHYLENE ENCASEMENT

## *Introduction*

In more than 50 years of service in thousands of utilities in the United States and throughout the world, polyethylene encasement has proved an effective corrosion-protection system for millions of feet of Gray and Ductile Iron pipe. Today, it is the most widely used method of protecting Ductile Iron pipe installed in corrosive environments.

Polyethylene encasement involves simply wrapping the pipe with a tube or sheet of polyethylene immediately before installing the pipe. It is easy for construction crews to install on-site and is by far the most economical way to protect Ductile Iron pipe.

Polyethylene encasement is a passive protection system, so it requires no monitoring, maintenance, or supervision once installed.

This brochure will briefly present the history and development of polyethylene encasement, explain how it protects Ductile Iron pipe, and highlight field investigations across the nation. It will also discuss how to ascertain if protection is warranted and outline proper installation procedures.

## *History and Development*

Polyethylene encasement was first used experimentally in 1951 by the Cast Iron Pipe Research Association (CIPRA)* and one of its member companies to protect a mechanical joint pipe assembly in a highly corrosive cinder fill in Birmingham, Alabama. When examined two years later, the unprotected parts of the pipe showed significant pitting due to corrosion. The glands, nuts, bolts, and portion of the pipe protected by polyethylene encasement were in excellent condition.

Also in the early 1950s, CIPRA began an ongoing testing program, burying bare and polyethylene-encased Gray Iron pipe specimens in highly corrosive muck in the Florida Everglades and later in a tidal salt marsh near Atlantic City, New Jersey.

The success of these early installations led to the development of an extensive, ongoing research program that determined polyethylene encasement's efficacy in providing a high degree of corrosion protection for Gray and Ductile Iron pipe in most soil environments.

By the late 1950s, successful results in CIPRA's research program led to the first use of polyethylene encasement in operating water systems in Lafourche Parish, Louisiana, and Philadelphia, Pennsylvania. And, in 1963, CIPRA continued its research with the burial of the first polyethylene-encased Ductile Iron pipe specimens in test sites in the Everglades and Wisconsin Rapids, Wisconsin. Millions of feet of polyethylene-encased Gray and Ductile Iron pipe have since been installed in thousands of operating water systems across the United States and throughout the world.

Due to polyethylene encasement's excellent success in actual field conditions, the first national standard, ANSI/AWWA C105/A21.5, was adopted in 1972. The American Society for Testing and Materials issued a standard for polyethylene (ASTM A674) in 1974. In 1981, Great Britain adopted a national standard. National and industry standards in several other countries followed. An international standard for polyethylene sleeving (ISO 8180) was adopted in 1985.

The material requirement called for in AWWA C105 Standard when it was issued in 1972 was 8-mil, low-density (LD) polyethylene. With the 1993 revision to this standard, the section on materials was expanded to include 4-mil, high-density, cross-laminated (HDCL) polyethylene.

HDCL polyethylene was first installed on an operating pipeline in Aurora, Colorado, in 1981. In 1982, DIPRA began investigating the corrosion protection afforded Ductile Iron pipe by 4-mil HDCL polyethylene encasement at its Logandale, Nevada, test site. During the 1993 revision of AWWA C105, the A21 Committee reviewed the test data on 4-mil HDCL polyethylene and concluded that from all indications, it provides comparable protection of Ductile Iron pipe to that afforded by the standard 8-mil LD polyethylene. Based on that conclusion, the A21 Committee elected to incorporate the 4-mil HDCL polyethylene into the standard.

* The Cast Iron Pipe Research Association (CIPRA) became the Ductile Iron Pipe Research Association (DIPRA) in 1979.

Chuck Seal

**Although most soil environments are not considered corrosive to Ductile Iron pipe, soils in landfill sites such as the one pictured here are generally considered corrosive. Other typically corrosive environments include swamps, peat bogs, expansive clays, and alkali soils.**

With the 1993 revision of the standard, the section on materials was also updated to include Class B (colored) polyethylene to allow for color coding of potable/reclaimed/wastewater pipelines as required by many local/state regulatory agencies.

The 1999 revision of AWWA C105 included: (1) the deletion of 8-mil LD polyethylene film, (2) the addition of 8-mil linear low-density (LLD) polyethylene film, and (3) the addition of impact, tear-resistant and marking requirements for both materials (LLD and HDCL). The revision benefitted the user by reflecting an improved polyethylene material.

Since the standard was first published in 1972, the polyethylene film industry has made a number of technological advances. The LD film, which continues to serve the industry well, had become more difficult to obtain. Newer materials, such as LLD film, which replaced the LD film, are readily available, much stronger, and more resistant to damage. The material requirements for the LLD film were closely patterned after the Australian Standard for Polyethylene Sleeving for Ductile Iron Pipelines (AS 3680) where the material has been in use for several years.

## Standards for Polyethylene Encasement

| | |
|---|---|
| ANSI/AWWA C105/A21.5<br>United States | 1972 |
| ASTM A674<br>United States | 1974 |
| JDPA Z 2005<br>Japan | 1975 |
| BS6076<br>Great Britain | 1981 |
| ISO 8180<br>International | 1985 |
| A.S. 3680 and A.S. 3681<br>Australia | 1989 |

Laboratory tests indicate that the 4-mil HDCL and the 8-mil LLD polyethylene may be more resistant to construction damage than the old 8-mil LD polyethylene. Tensile strength, impact strength, and puncture resistance of the 4-mil HDCL and the 8-mil LLD polyethylene are typically greater because of inherent differences in the materials. Based on DIPRA's laboratory and field research, either the 8-mil LLD or the 4-mil HDCL polyethylene material is recommended in accordance with AWWA C105 Standard for corrosion protection of Ductile Iron pipe in aggressive environments.

## *How Polyethylene Encasement Protects Ductile Iron Pipe*

At the trench, crew members encase Ductile Iron pipe with a tube or sheet of polyethylene immediately before installing the pipe. The polyethylene acts as an unbonded film, which prevents direct contact of the pipe with the corrosive soil. It also effectively reduces the electrolyte available to support corrosion activity to any moisture that might be present in the thin annular space between the pipe and the polyethylene film.

Typically, some groundwater will seep beneath the wrap. Although the entrapped water initially has the corrosive characteristics of the surrounding soil, the available dissolved oxygen supply beneath the wrap is soon depleted, and the oxidation process stops long before any damage occurs. The water enters a state of stagnant equilibrium, and a uniform environment exists around the pipe.

The polyethylene film also retards the diffusion of additional dissolved oxygen to the pipe surface and the migration of corrosion products away from the pipe surface.

Polyethylene encasement is not designed to be a watertight system. Yet, once installed, the weight of the earth backfill and surrounding soil prevents any significant exchange of groundwater between the wrap and the pipe.

## *Advantages of Polyethylene Encasement*

Polyethylene encasement is both effective and economical. Its excellent dielectric properties enable it to effectively shield the pipe from low-level stray direct current. And, because polyethylene provides a uniform environment for the pipe, local galvanic corrosion cells are virtually eliminated.

Pinholes in the loose wrapping material do not significantly diminish its protective ability. And, unlike bonded coatings, polyethylene has the ability to protect the pipe without the formation of concentration cells at coating holidays.

Polyethylene encasement is easy to install and requires no additional manpower or special equipment. Construction crew members simply slip the polyethylene over the pipe as they install it.

Effective corrosion protection with polyethylene encasement is very inexpensive. The initial cost of material and installation is very low — only pennies per foot in most sizes. In fact, many utilities that install their own pipe assign no installation cost for the encasement, reporting that the material costs as little as a few cents per inch-diameter per foot.

Polyethylene encasement is field-applied, so the pipe doesn't require special handling or packaging during shipment. And, because installation is on site, damage is less likely than on factory-applied coatings. If damaged, the polyethylene is easy and simple to repair at the job site with polyethylene compatible adhesive tape.

Because polyethylene is a passive system of protection, it requires no maintenance or monitoring and costs nothing to operate once installed.

*Chuck Seal*

**As with any corrosion-protection system, proper installation is important to polyethylene encasement's success. Polyethylene encasement should be carefully installed following one of three installation methods outlined in ANSI/AWWA C105/A21.5.**

### Polyethylene Encasement

- Proven effective protection.
- Provides a uniform environment for the pipe, virtually eliminating galvanic corrosion cells.
- Protects the pipe without the formation of concentration cells at coating holidays.
- Doesn't deteriorate underground.
- Is easily repaired with polyethylene adhesive tape if damaged.
- Doesn't require any special handling or packaging during shipment.
- Is inexpensive.
- Is simple to install.
- Requires no additional manpower.
- Requires no maintenance or monitoring.
- Costs nothing to operate.

## How to Identify Corrosive Environments

It is important to identify potentially corrosive environments prior to pipeline installation because, once a pipeline is installed, it is both costly and difficult to retrofit with corrosion-protection measures. Although Ductile Iron pipe possesses good resistance to corrosion and needs no additional protection in most soils, experience has shown that external corrosion protection is warranted in certain soil environments. Examples include soils with low resistivities, anaerobic bacteria, differences in composition, and differential aeration around the pipe. Dissimilar metals and external stray direct currents may also necessitate additional corrosion protection. Soils contaminated by coal mine wastes, cinders, refuse, or salts also are generally considered corrosive. So are certain naturally occurring environments, such as swamps, peat bogs, expansive clays, and alkali soils. And soils in wet, low-lying areas are generally considered more corrosive than those in well-drained areas.

## Design Decision Model™

Corrosion-control recommendations for new Ductile Iron pipelines have often varied widely depending on the experiences of the design engineers involved. A frequent result has been that utility and consulting engineers have had to base corrosion-control design decisions on contradictory recommendations. To better serve the water and wastewater industries, the Ductile Iron Pipe Research Association ("DIPRA") and Corrpro Companies, Inc. tapped their extensive knowledge and experiences to jointly develop a practical, cost-effective corrosion-control solution. The result is a Design Decision Model™ (DDM™) that both DIPRA and Corrpro use as an engineering tool to address corrosion on proposed Ductile Iron transmission and distribution pipeline projects. The DDM™ represents a significant advancement in the area of corrosion control for Ductile Iron pipelines. In the three years of development of this practical design tool, DIPRA and Corrpro evaluated many factors, including:

- Shared corrosion experiences and know-how.
- Analysis of DIPRA's and Corrpro's extensive databases on corrosion.
- Laboratory and field testing of standard, as-manufactured Ductile Iron pipe.
- Field inspections of existing Ductile and Gray Iron pipe, including test site and in-service pipes.
- Joint field investigations of proposed Ductile Iron pipelines.
- A comparison of soil-testing protocols and results.

The advanced, two-dimensional DDM™ is a highly effective, economical corrosion-control strategy that gives utility managers confidence that, throughout its intended life, the pipeline they install tomorrow will provide the reliable service they insist upon for their customers. Due to the extensive investment by the Ductile Iron Pipe Research Association and Corrpro Companies, Inc. in developing the DDM™, its details are currently being treated as a trade secret.

## 10-Point Soil Evaluation Procedure

The 10-point soil evaluation procedure was instituted by CIPRA in 1964 and is included in the Appendix to the ANSI/AWWA C105/A21.5 Standard. This procedure has proved invaluable in surveying more than 100 million feet of proposed pipeline installations to determine soil corrosivity. The DDM™ is an extension of the 10-point soil evaluation procedure, and its development is not intended to invalidate the 10-point system. The 10-point system addresses just the likelihood of corrosion, while the DDM™ also addresses the consequence of a failure in determining a corrosion-control strategy. The 10-point system is an accurate and dependable method of evaluating soils to determine if corrosion protection is warranted for iron pipe and can continue to be used with confidence.

The evaluation procedure is based upon information drawn from five tests and observations:

- Soil resistivity
- pH
- Oxidation-reduction (redox) potential
- Sulfides
- Moisture

For a given soil sample, each parameter is evaluated and assigned points according to its contribution to corrosivity. The points for all five areas are totaled, and if the sum is 10 or more, the soil is considered corrosive to Ductile Iron pipe, and protective measures should be taken.

### Soil Test Evaluation for Ductile Iron Pipe

(10-Point System)*

| Soil Characteristics | Points |
|---|---|
| **Resistivity (ohm-cm)**** | |
| <1,500 | 10 |
| ≥ 1,500-1,800 | 8 |
| >1,800-2,100 | 5 |
| >2,100-2,500 | 2 |
| >2,500-3,000 | 1 |
| >3,000 | 0 |
| **pH** | |
| 0-2 | 5 |
| 2-4 | 3 |
| 4-6.5 | 0 |
| 6.5-7.5 | 0*** |
| 7.5-8.5 | 0 |
| >8.5 | 3 |
| **Redox potential** | |
| >+100 mv | 0 |
| +50 to +100 mv | 3.5 |
| 0 to +50 mv | 4 |
| Negative | 5 |
| **Sulfides** | |
| Positive | 3.5 |
| Trace | 2 |
| Negative | 0 |
| **Moisture** | |
| Poor drainage, continuously wet | 2 |
| Fair drainage, generally moist | 1 |
| Good drainage, generally dry | 0 |

* Ten points–corrosive to Ductile Iron pipe. Protection is indicated.

** Based on water-saturated soil box. This method is designed to obtain the lowest–and most accurate–resistivity reading.

*** If sulfides are present and low (<100 mv) or negative redox-potential results are obtained, 3 points should be given for this range.

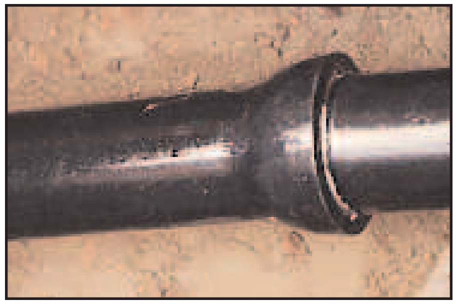
Note: DIPRA recommends that the soil sample used in the 10-point evaluation be taken at pipe depth rather than at the surface. Soil corrosivity readings can vary substantially from the surface to pipe depth.

# POLYETHYLENE ENCASEMENT

## Merritt Island, FL
## 27 years

24-inch Gray Iron pipe encased in loose 8-mil polyethylene
Installed 1963. Inspected 1990.
Soil Analysis:
- Description: gray and black loamy sand
- Resistivity: 1,120 ohm-cm (10)*
- pH: 7.1 (3)
- Redox: -20 mv (5)
- Sulfides: positive (3.5)
- Moisture: saturated (2)

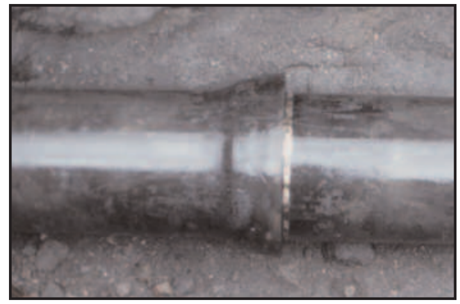
Soil Condition: corrosive (23.5)
Condition of Pipe and Encasement: excellent



## Waterford, MI
## 20 years

8-inch Ductile Iron pipe encased in loose 8-mil polyethylene
Installed 1975. Inspected 1995.
Soil Analysis:
- Description: black and gray silty clay
- Resistivity: 960 ohm-cm (10)
- pH: 7.5 (3)
- Redox: +27 mv (3.5)
- Sulfides: positive (3.5)
- Moisture: saturated (2)

Soil Condition: corrosive (22)
Condition of Pipe and Encasement: excellent

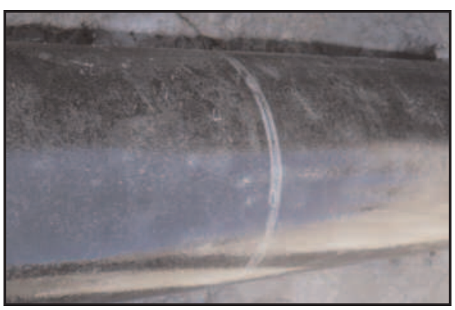


## Philadelphia, PA
## 30 years

12-inch Gray Iron pipe encased in loose 8-mil polyethylene
Installed 1959. Inspected 1989.
Soil Analysis:
- Description: landfill area–brownish red clayey silts and dark gray organic clays with organic materials and petroleum and paper wastes
- Resistivity: 2,400 to 5,600 ohm-cm (2)
- pH: 3.9 to 6.2 (3)
- Redox: +67 to +69 mv (3.5)
- Sulfides: positive (3.5)
- Moisture: moist to saturated (2)

Soil Condition: corrosive (14)
Condition of Pipe and Encasement: very good

*Numbers in parentheses indicate point count per Soil Test Evaluation procedure outlined in Appendix A of ANSI/AWWA C105/A21.5. See table on page 5 of this brochure for explanation.



## Ogden, UT
## 10 years

16-inch Ductile Iron pipe encased in loose 8-mil polyethylene
Installed 1979. Inspected 1989.
Soil Analysis:
- Description: dark gray silty clay
- Resistivity: 192 ohm-cm (10)
- pH: 7.9 (0)
- Redox: -165 mv (5)
- Sulfides: positive (3.5)
- Moisture: saturated (2)

Soil Condition: corrosive (20.5)
Condition of Pipe and Encasement: excellent

## Mitchell, SD
## 18 years

12-inch Gray Iron pipe encased in loose 8-mil polyethylene
Installed 1963. Inspected 1981.
Soil Analysis:
- Description: brown clay and sand with cinders present
- Resistivity: 840 ohm-cm (10)
- pH: 7.1 (0)
- Redox: +450 mv (0)
- Sulfides: trace (2)
- Moisture: moist (1)

Soil Condition: corrosive (13)
Condition of Pipe and Encasement: excellent

## Detroit, MI
## 21 years

8-inch Ductile Iron pipe encased in loose 8-mil polyethylene
Installed 1974. Inspected 1995.
Soil Analysis:
- Description: gray and black silty clay
- Resistivity: 1,320 ohm-cm (10)
- pH: 7.4 (3)
- Redox: -113 mv (5)
- Sulfides: positive (3.5)
- Moisture: saturated (2)

Soil Condition: corrosive (23.5)
Condition of Pipe and Encasement: excellent

# INVESTIGATIONS

## Omaha, NE
## 15 years

12-inch Gray Iron pipe encased in loose
8-mil polyethylene
Installed 1974. Inspected 1989.
Soil Analysis:
Description: gray clay
Resistivity: 600 ohm-cm (10)*
pH: 7.4 (3)
Redox: +90 mv (3.5)
Sulfides: positive (3.5)
Moisture: wet (2)
Soil Condition: corrosive (22)
Condition of Pipe and Encasement:
excellent

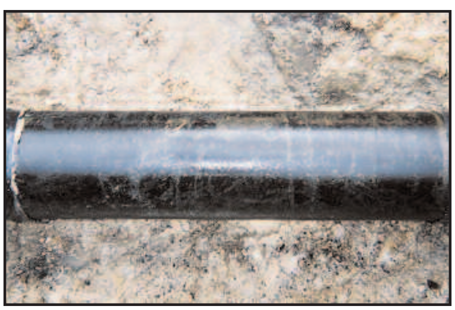

## Syracuse, NY
## 15 years

8-inch Ductile Iron pipe encased in loose
8-mil polyethylene
Installed 1988. Inspected 2003.
Soil Analysis:
Description: dark, organic brown clay
Resistivity: 410 ohm-cm (10)
pH: 6.9 (3)
Redox: -60 mv (5)
Sulfides: positive (3.5)
Moisture: saturated (2)
Soil Condition: corrosive (23.5)
Condition of Pipe and Encasement:
excellent

## Charleston, SC
## 21 years

24-inch Ductile Iron pipe encased in loose
8-mil polyethylene
Installed 1967. Inspected 1988.
Soil Analysis:
Description: gray sand and clay with organic muck in reclaimed marsh subjected to fluctuating water table due to coastal tidal effect
Resistivity: 560 ohm-cm (10)
pH: 6.9 (3)
Redox: -132 mv (5)
Sulfides: positive (3.5)
Moisture: saturated (2)
Soil Condition: corrosive (23.5)
Condition of Pipe and Encasement:
excellent

*Numbers in parentheses indicate point count per Soil Test Evaluation procedure outlined in Appendix A of ANSI/AWWA C105/A21.5. See table on page 5 of this brochure for explanation.



## Fayetteville, AR
## 30 years

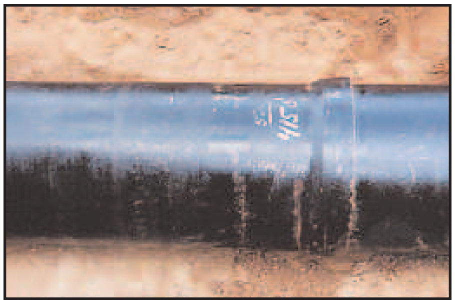
12-inch Gray Iron pipe encased in loose
8-mil polyethylene
Installed 1973. Inspected 2003.
Soil Analysis:
Description: dark gray clay
Resistivity: 1,600 ohm-cm (8)
pH: 6.8 (3)
Redox: -100 mv (5)
Sulfides: positive (3.5)
Moisture: saturated (2)
Soil Condition: corrosive (21.5)
Condition of Pipe and Encasement:
excellent


## Jackson, MS
## 9 years

8-inch Ductile Iron pipe encased in loose
8-mil polyethylene
Installed 1977. Inspected 1986.
Soil Analysis:
Description: mixture of organic clay and brown silty clay
Resistivity: 880 ohm-cm (10)
pH: 4.4 (0)
Redox: -150 mv (5)
Sulfides: positive (3.5)
Moisture: saturated (2)
Soil Condition: corrosive (20.5)
Condition of Pipe and Encasement:
excellent

## Little Rock, AR
## 14 years

30-inch Ductile Iron pipe encased in loose
8-mil polyethylene
Installed 1972. Inspected 1986.
Soil Analysis:
Description: dark reddish and grayish brown clay
Resistivity: 600 ohm-cm (10)
pH: 6.9 (3)
Redox: +40 mv (4)
Sulfides: trace (2)
Moisture: saturated (2)
Soil Condition: corrosive (21)
Condition of Pipe and Encasement:
excellent



## Montgomery, AL
## 20 years

36-inch Ductile Iron pipe encased in loose 8-mil polyethylene
Installed 1982. Inspected 2002.
Soil Analysis:
Description: reddish brown clayey sand
Resistivity: 172 ohm-cm (10)*
pH: 8.7 (3)
Redox: +30 mv (4)
Sulfides: negative (0)
Moisture: saturated (2)
Soil Condition: corrosive (19)
Condition of Pipe and Encasement: excellent

## Lafourche Parish, LA
## 45 years

4-inch Cast Iron pipe encased in loose 8-mil polyethylene
Installed 1958. Inspected 2003.
Soil Analysis:
Description: gray clay with black organics
Resistivity: 460 ohm-cm (10)
pH: 7.1 (0)
Redox: -70 mv (5)
Sulfides: positive (3.5)
Moisture: saturated (2)
Soil Condition: corrosive (20.5)
Condition of Pipe and Encasement: excellent

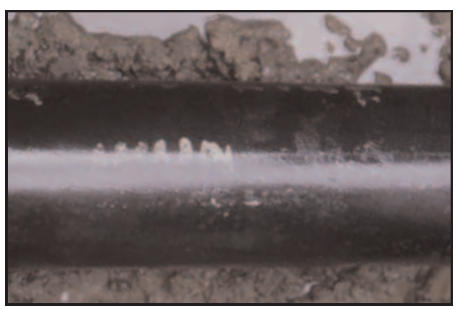
## Latham, NY
## 36 years

6-inch Ductile Iron pipe encased in loose 8-mil polyethylene
Installed 1962. Inspected 1998.
Soil Analysis:
Description: dark brown stiff clay
Resistivity: 600 ohm-cm (10)
pH: 7.1 (0)
Redox: +200 mv (0)
Sulfides: negative (0)
Moisture: saturated (2)
Soil Condition: corrosive (12)
Condition of Pipe and Encasement: excellent

*Numbers in parentheses indicate point count per Soil Test Evaluation procedure outlined in Appendix A of ANSI/AWWA C105/A21.5. See table on page 5 of this brochure for explanation.

## St. George, UT
## 16 years

12-inch Ductile Iron pipe encased in loose 8-mil polyethylene
Installed 1968. Inspected 1984.
Soil Analysis:
Description: dark gray clayey silt
Resistivity: 720 ohm-cm (10)
pH: 7.3 (0)
Redox: +110 mv (0)
Sulfides: negative (0)
Moisture: saturated (2)
Soil Condition: corrosive (12)
Condition of Pipe and Encasement: excellent



## City of Orange, CA
## 18 years

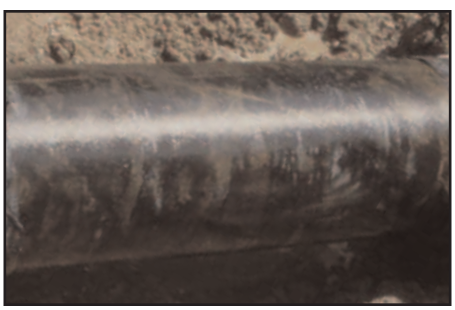
6-inch Gray Iron pipe encased in loose 8-mil polyethylene
Installed 1969. Inspected 1987.
Soil Analysis:
Description: brown silty clay
Resistivity: 640 ohm-cm (10)
pH: 6.3 (0)
Redox: +170 mv (0)
Sulfides: negative (0)
Moisture: saturated (2)
Soil Condition: corrosive (12)
Condition of Pipe and Encasement: excellent

## St. Louis, MO
## 13 years

12-inch Ductile Iron pipe encased in loose 8-mil polyethylene
Installed 1973. Inspected 1986.
Soil Analysis:
Description: sticky gray-brown clay
Resistivity: 600 ohm-cm (10)
pH: 6.7 (0)
Redox: +150 mv (0)
Sulfides: negative (0)
Moisture: moist (1)
Soil Condition: corrosive (11)
Condition of Pipe and Encasement: excellent

## Nanticoke, ON, Canada
## 16 years

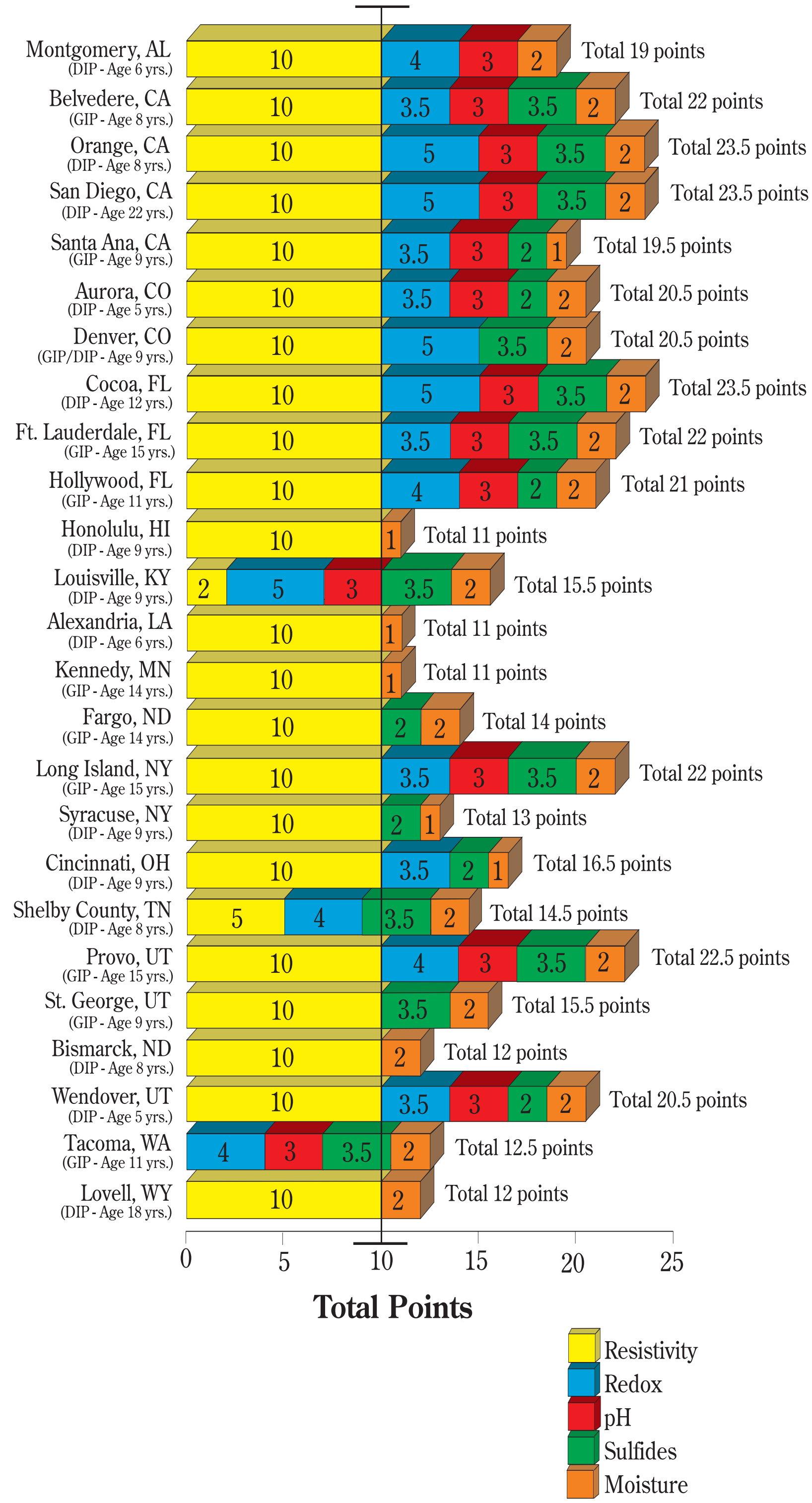
16-inch Ductile Iron pipe encased in loose 8-mil polyethylene
Installed 1977. Inspected 1993.
Soil Analysis:
Description: brown, gray, and black silty clay
Resistivity: 960 ohm-cm (10)
pH: 7.3 (3)
Redox: -18 mv (5)
Sulfides: positive (3.5)
Moisture: saturated (2)
Soil Condition: corrosive (23.5)
Condition of Pipe and Encasement: very good



## Farmington / Shiprock, NM
## 20 years

16-inch Ductile Iron pipe encased in loose 8-mil polyethylene
Installed 1968. Inspected 1988.
Soil Analysis:
Description: light brown clayey silt with some gravel and rock
Resistivity: 400 ohm-cm (10)
pH: 7.7 (0)
Redox: +146 mv (0)
Sulfides: trace (2)
Moisture: saturated (2)
Soil Condition: corrosive (14)
Condition of Pipe and Encasement: excellent

## Additional Polyethylene Encasement Investigations



# Proper Installation of Polyethylene Encasement

As with any corrosion-protection system, proper installation is important to polyethylene encasement's success. Care taken during installation is as important as the installation method itself. The few known failures of polyethylene-encased Gray and Ductile Iron pipe have generally been due to improper installation or poor workmanship.

The ANSI/AWWA C105/A21.5 Standard outlines three methods of installing polyethylene sleeving. Methods A and B use polyethylene tubes, and Method C uses polyethylene sheets.

Method A uses one length of polyethylene tube, overlapped at the joints, for each length of pipe. Because installation is faster and easier, most utilities and contractors choose some form of Method A.

Method B uses a length of polyethylene tube for the barrel of the pipe and a separate length of polyethylene tube or sheet for the joints. *The national standard does not recommend Method B for bolted-type joints unless an additional layer of polyethylene is provided over the joint area as in Methods A and C.*

In Method C, each section of pipe is completely wrapped with a flat polyethylene sheet.

## ANSI/AWWA C105/A21.5 Installation Methods

### Method A

In this method, which is preferred by most utilities and contractors, one length of polyethylene tube, overlapped at the joints, is used for each length of pipe.

### Method B

A length of polyethylene tube is used for the barrel of the pipe and separate lengths of polyethylene tube or sheets are used for the joints. *Note: Method B is not recommended for bolted-type joints unless an additional layer of polyethylene is provided over the joint area as in Methods A and C.*

### Method C

Each section of pipe is completely wrapped with a flat polyethylene sheet.

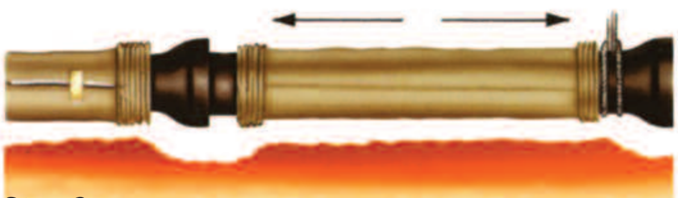
## Tips for proper installation

1. Quality of installation is more important than the actual sequence followed.
2. Don't leave the polyethylene outside in the sun for long periods before installation.
3. When lifting polyethylene-encased pipe with a backhoe, use a fabric-type "sling" or padded cable to protect the polyethylene.
4. Be sure to remove all lumps of clay, mud, cinders, etc., on the pipe surface before you encase the pipe.
5. Take care to keep soil or bedding material from becoming trapped between the pipe and the polyethylene.
6. When installing polyethylene encasement below the water table or in areas subject to tidal action, seal as thoroughly as possible both ends of each polyethylene tube with polyethylene adhesive tape or plastic tie straps at the joint overlap. Additionally, place circumferential wraps of tape or plastic tie straps at two-foot intervals along the barrel of the pipe to help minimize the space between the polyethylene and the pipe.

# Method A
# for Normal Dry Trench Conditions

**Step 1.**
Cut a section of polyethylene tube approximately two feet longer than the pipe section. Remove all lumps of clay, mud, cinders, or other material that might have accumulated on the pipe surface during storage. Slip the polyethylene tube around the pipe, starting at the spigot end. Bunch the tube accordion-fashion on the end of the pipe. Pull back the overhanging end of the tube until it clears the pipe end.

**Step 2.**
Dig a shallow bell hole in the trench bottom at the joint location to facilitate installation of the polyethylene tube. Lower the pipe into the trench and make up the pipe joint with the preceding section of pipe.



**Step 3.**
Move the cable to the bell end of the pipe and lift the pipe slightly to provide enough clearance to easily slide the tube. Spread the tube over the entire barrel of the pipe. *Note: Make sure that no dirt or other bedding material becomes trapped between the wrap and the pipe.*

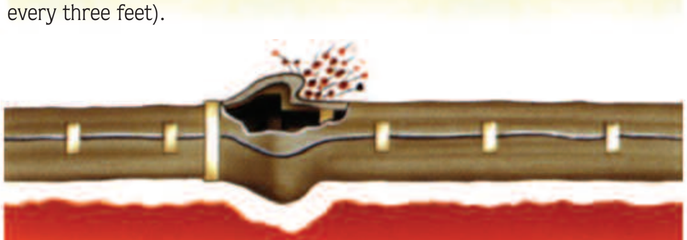
**Step 4.**
Make the overlap of the polyethylene tube by pulling back the bunched polyethylene from the preceding length of pipe and securing it in place. *Note: The polyethylene may be secured in place by using adhesive tape or plastic tie straps.*

**Step 5.**
Overlap the secured tube end with the tube end of the new pipe section. Secure the new tube end in place.

**Step 6.**
Take up slack in the tube along the barrel of the pipe to make a snug, but not tight, fit. Fold excess polyethylene back over the top of the pipe.

**Step 7.**
Secure the fold at several locations along the pipe barrel (approximately every three feet).

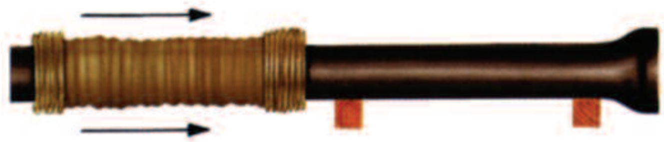
**Step 8.**
Repair all small rips, tears, or other tube damage with adhesive tape. If the polyethylene is badly damaged, repair the damaged area with a sheet of polyethylene and seal the edges of the repair with adhesive tape.



**Step 9.**
Carefully backfill the pipe according to the AWWA C600 standard for backfill procedure. To prevent damage during backfilling, allow adequate slack in the tube at the joint. Backfill should be free of cinders, rocks, boulders, nails, sticks, or other materials that might damage the polyethylene. Avoid damaging the polyethylene when using tamping devices.

## Alternate Method A for Wet Trench Conditions

In wet, sloppy trench conditions, the pipe should be completely covered by the polyethylene tube before it is lowered into the trench. This alternate method is illustrated below.



**Step 1.**
Cut the polyethylene tube to a length approximately two feet longer than that of the pipe section. Slip the tube over the pipe.

**Step 2.**
Spread the tube over the entire barrel of the pipe, pushing back both ends of the tube until they clear both pipe ends. Make sure the tube is centered on the pipe to provide a one-foot overlap at each end.

**Step 3.**
Take up slack in the tube to make a snug, but not tight, fit. (See previous page.) Circumferential wraps of tape or plastic tie straps should be placed at two-foot intervals along the barrel of the pipe to help minimize the space between the polyethylene and the pipe. Wrap a piece of tape or plastic tie strap completely around the pipe at each end to seal the polyethylene, leaving ends free to overlap the adjoining sections of pipe.

**Step 4.**
Lower pipe into the trench and make up the pipe joint. Be careful not to damage the polyethylene when handling or jointing the pipe. Complete the installation following dry condition Steps 4, 5 (taking care to seal ends of overlap by wrapping tape or plastic tie straps completely around the pipe at each end), 8, and 9 on previous page. *Note: When lifting polyethylene-encased pipe, use a fabric-type sling or a suitably padded cable or chain to prevent damage to the polyethylene.*

If you have any problems or questions about installing polyethylene encasement, contact DIPRA or one of its member companies.

## *Appurtenances*

**Pipe-shaped appurtenances**
Cover bends, reducers, offsets, and other pipe-shaped appurtenances in the same manner as the pipe.

**Odd-shaped appurtenances**
Wrap odd-shaped appurtenances such as valves, tees, and crosses with a flat sheet or split length of polyethylene tube by passing the sheet under and then over the appurtenance and bringing it together around the body of the appurtenance. Make seams by bringing the edges of the polyethylene together, folding over twice, and taping them down.

**Joints**
Overlap joints as in normal installation; then tape the polyethylene securely in place at valve stems and other penetrations. When bolted-type joints are used, care should always be taken to prevent bolts or other sharp edges of the joint configuration from penetrating the wrap.

**Branches, blowoffs, air valves**
To provide openings for branches, blow-offs, air valves, and similar appurtenances, make an X-shaped cut in the polyethylene and temporarily fold back the film. After installing the appurtenance, tape the slack securely to the appurtenance and repair the cut and any other damaged areas in the polyethylene with tape.

**Service taps**
The preferred method of tapping polyethylene-encased Ductile Iron pipe involves wrapping two or three layers of polyethylene adhesive tape completely around the pipe to cover the area where the tapping machine and chain will be mounted. Then install the corporation stop directly through the tape and polyethylene. After the tap is made, inspect the entire circumferential area for damage and make any necessary repairs.

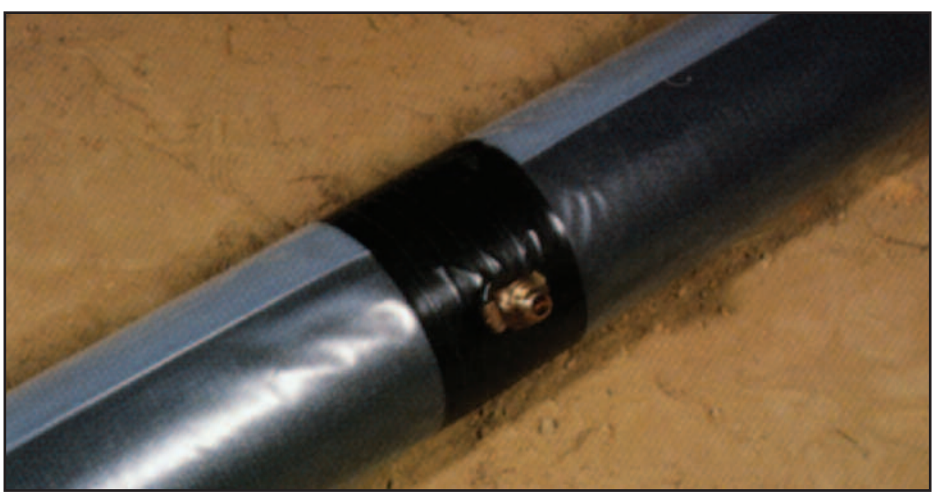
# Recommended Tapping Method

Sylvia Caswell

To perform the preferred method of tapping polyethylene-encased Ductile Iron pipe, wrap two or three layers of polyethylene adhesive tape completely around the pipe to cover the area where the tapping machine and chain will be mounted.

Sylvia Caswell

Mount the tapping machine on the pipe area covered by the polyethylene tape. Then make the tap and install the corporation stop directly through the tape and polyethylene.



Sylvia Caswell

After making the direct service connection, inspect the entire circumferential area for damage and make any necessary repairs.

## Recommended Polyethylene Tube and Sheet Sizes for Ductile Iron Pipe

| Nominal Pipe Diameter | | 3″ | 4″ | 6″ | 8″ | 10″ | 12″ | 14″ | 16″ | 18″ | 20″ | 24″ | 30″ | 36″ | 42″ | 48″ | 54″ | 60″ | 64″ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Minimum Polyethylene Width (Inches) | Flat Tube | 14 | 14 | 16 | 20 | 24 | 27 | 30 | 34 | 37 | 41 | 54 | 67 | 81 | 81 | 95 | 108 | 108 | 121 |
| | Sheet | 28 | 28 | 32 | 40 | 48 | 54 | 60 | 68 | 74 | 82 | 108 | 134 | 162 | 162 | 190 | 216 | 216 | 242 |

## *Cost Considerations*

Polyethylene encasement is more cost effective when compared to alternative corrosion-control systems like bonded coatings and cathodic protection.

According to costs outlined in a 1985 U.S. Army Corps of Engineers Technical Report, installing a 16-mil-thick coating of coal tar epoxy is five times the cost of installing polyethylene encasement. And, this figure doesn't include the additional costs of packaging, handling, transportation, and inspection.

Compared to polyethylene encasement, cathodic protection is very expensive to install. According to the same Corps of Engineers report, the cost to install an impressed-current cathodic protection system on 12-inch Ductile Iron pipe is five times the cost of polyethylene encasement. The cost to install a sacrificial-anode system is approximately 30 times the cost of polyethylene. These figures don't include the ongoing maintenance expense required by both systems, which, over the life of the systems, are often much greater than initial design and installation costs.

According to a study conducted by Corrpro Companies, Inc., the cost for shop coated polyethylene tape with joints coated in the field was 21, 24, and 29 times the cost of materials and labor to install polyethylene encasement for 30-, 42-, and 54-inch diameter Ductile Iron pipe, respectively. As reported in NACE Paper No. 05037, the cost for a wax coating applied over-the-ditch was 32 times the cost of materials and labor to install polyethylene encasement for 30-inch diameter ductile iron pipe and 39 times the cost for 42-, and 54-inch diameter ductile iron pipe.

## *Conclusion*

There is no perfect system of corrosion protection for buried metallic pipelines. Failures have been documented with all types of corrosion-protection systems.

Polyethylene encasement, as with all systems, has limitations–and it is not universally applicable for all Ductile Iron pipelines where corrosion protection is warranted. There are instances where it is not feasible to install polyethylene encasement due to unusual construction conditions. Additionally, in certain high-density stray current environments and in "uniquely severe environments," as defined in Appendix "A" of ANSI/AWWA C105/A21.5, the sleeving alone might not provide the degree of protection needed. In such cases, DIPRA sometimes recommends alternative methods of corrosion protection such as cathodic protection. And, as with all corrosion-control methods, the success of polyethylene encasement is dependent upon proper installation procedures.

Since the early 1950s, DIPRA has researched numerous methods of corrosion protection for Gray and Ductile Iron pipe, including hundreds of investigations in the laboratory, in field test sites, and in operating water systems throughout the United States. New types of polyethylene, various external pipe coatings, and the use of select backfill have also been investigated.

More than 50 years of experience have demonstrated polyethylene encasement's effectiveness in protecting Gray and Ductile Iron pipe in a broad range of soil conditions. Properly installed polyethylene encasement can effectively eliminate the vast majority of corrosion problems encountered by most utilities.

Based on numerous laboratory and field test results, DIPRA continues to recommend polyethylene encasement as the most economical and effective method of protecting Ductile Iron pipe in most corrosive environments.

**For more than 50 years, polyethylene encasement has been used successfully to protect millions of feet of Cast and Ductile Iron pipe in a broad range of soil conditions.**

## *For Further Information*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# DIPRA MEMBER COMPANIES

American Cast Iron Pipe Company
P.O. Box 2727
Birmingham, Alabama 35202-2727

Atlantic States Cast Iron Pipe Company
183 Sitgreaves Street
Phillipsburg, New Jersey 08865-3000

Canada Pipe Company, Ltd.
1757 Burlington Street East
Hamilton, Ontario L8N 3R5 Canada

Clow Water Systems Company
P.O. Box 6001
Coshocton, Ohio 43812-6001

McWane Cast Iron Pipe Company
1201 Vanderbilt Road
Birmingham, Alabama 35234

Pacific States Cast Iron Pipe Company
P.O. Box 1219
Provo, Utah 84603-1219

United States Pipe and Foundry Company
P.O. Box 10406
Birmingham, Alabama 35202-0406

DUCTILE IRON PIPE
RESEARCH ASSOCIATION

An association of quality producers dedicated to highest pipe standards through a program of continuing research.
245 Riverchase Parkway East, Suite O
Birmingham, Alabama 35244-1856
Telephone 205 402-8700 FAX 205 402-8730
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Published 1-92
Rev. 5-07