Designation: A674 – 22

Standard Practice for Polyethylene Encasement for Ductile Iron Pipe[1]

This standard is issued under the fixed designation A674; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers materials and installation procedures for polyethylene encasement to be applied to underground installations of ductile iron pipe. It may also be used for polyethylene encasement of fittings, valves, and other appurtenances to ductile iron pipe systems.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.2.1 Important SI values are provided in brackets. Also, certain important SI values appear without brackets or parentheses.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D149 Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies

D882 Test Method for Tensile Properties of Thin Plastic Sheeting

D1709 Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method

D1922 Test Method for Propagation Tear Resistance of Plastic Film and Thin Sheeting by Pendulum Method

D4976 Specification for Polyethylene Plastics Molding and Extrusion Materials

2.2 *ANSI/AWWA Standards:*[3]

C600 Installation of Ductile Iron Water Mains and Their Appurtenances

C105/A21.5 Polyethylene Encasement for Ductile-Iron Pipe Systems

3. Terminology

3.1 *Definitions:*

3.1.1 *high-density, cross-laminated polyethylene film*—film extruded from virgin high-density polyethylene raw material, which is then molecularly oriented by stretching. The final product is then formed by two single-ply layers of the film that are then laminated together with their orientations at 90° to one another using molten, high-density, virgin resin.

3.1.2 *linear low-density polyethylene film*—film extruded from virgin linear low-density polyethylene raw material.

3.1.3 *polyethylene encasement*—polyethylene material, in tube or sheet form, that is used to encase ductile iron pipe.

3.1.4 *securing overlap*—any one of various methods of holding polyethylene encasement in place at the point of overlap until backfilling operations are completed. This may be accomplished with adhesive tape or plastic tie straps.

4. Requirements

4.1 *Materials:*

4.1.1 *General*—All films shall be manufactured of virgin polyethylene material, as non-virgin polyethylene materials may be susceptible to accelerated environmental degradation.

4.1.1.1 *Requirements*—The sections that follow list the material requirements for linear low-density and high-density, cross-laminated polyethylene film. In each category, the film shall meet all of the listed requirements.

4.1.2 *Linear Low-Density Polyethylene Film*—Linear low-density polyethylene film shall be manufactured of virgin

[1] This practice is under the jurisdiction of ASTM Committee A04 on Iron Castings and is the direct responsibility of Subcommittee A04.12 on Pipes and Tubes.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American Water Works Association (AWWA), 6666 W. Quincy Ave., Denver, CO 80235, http://www.awwa.org.

polyethylene material conforming to the requirements of Specification D4976 shown in Table 1.

4.1.2.1 *Thickness*—Linear low-density polyethylene film shall have a minimum thickness of 0.008 in. [0.20 mm].

4.1.3 *High-Density, Cross-Laminated Polyethylene Film*—High-density, cross-laminated polyethylene film shall be manufactured of virgin polyethylene material conforming to the requirements of Specification D4976 shown in Table 2.

4.1.3.1 *Thickness*—High-density, cross-laminated polyethylene film shall have a minimum thickness of 0.004 in. [0.10 mm].

4.2 *Tube Size*—The tube size for each pipe diameter shall be as listed in Table 3.

4.3 *Color*—Polyethylene film may be supplied in its natural color, white, black, or weather-resistant black containing not less than 2 % carbon black with a particle diameter of 90 nm or less. A minimum 2 % of a hindered-amine ultraviolet inhibitor is required for all films other than the weather-resistant black film with carbon black. Where other colors are specified for purposes of identification, the pigmentation shall not contain any regulated substances.

4.4 *Marking Requirements*—Polyethylene film shall be clearly marked at a minimum of every 2 ft [0.6 m] along its length with print that does not contain hazardous material. Marking shall contain the following information:

(1) Manufacturer's name or registered trademark.

(2) Year of manufacture.

(3) ANSI/AWWA C105/A21.5.

(4) Minimum film thickness and material type (LLDPE or HDCLPE).

(5) Applicable range of nominal pipe diameter size(s).

(6) Warning—Corrosion Protection—Repair Any Damage.

4.4.1 *Marking Height*—Letters and numerals used for marking items (*1*) through (*5*) in 4.4 shall not be less than 1 in. [25.4 mm] in height. Item (*6*) in 4.4 shall be not less than 1½ in. [38.10 mm] in height.

5. Installation

5.1 *General:*

TABLE 1 Linear Low-Density Polyethylene Characteristics

Raw Material Used to Manufacture Polyethylene Encasement Material	
Group, density, and dielectric strength in accordance with the latest revision of Specification D4976	
Group	2 (Linear)
Density	0.910 to 0.935 g/cm^3
Dielectric strength, volume resistivity	10^{15} ohm-cm, min
Polyethylene Encasement Material	
Tensile strength	3600 psi (24.83 MPa), for an 8 mil (200µm) minimum thickness, or 28.8 lbf/in. width (50.4 N/cm width), minimum in machine and transverse direction (Test Method D882)
Elongation	700 %, min in the machine and transverse direction (Test Method D882)
Dielectric strength	800 V/mil (31.5 V/µm) thickness, min (Test Method D149)
Impact resistance	600 g, min (Test Methods D1709 Method B)
Propagation tear resistance	2550 gf, min in machine and transverse direction (Test Method D1922)

TABLE 2 High-Density Cross-Laminated Polyethylene Characteristics

Raw Material Used to Manufacture Polyethylene Encasement Material	
Group, density, and dielectric strength in accordance with the latest revision of Specification D4976	
Group	2 (Linear)
Density	0.940 to 0.960 g/cm^3
Dielectric strength, volume resistivity	10^{15} ohm-cm, min
High-Density Cross-Laminated Polyethylene Encasement Material	
Tensile strength	6300 psi (43.47 MPa), for a 4 mil (100 µm) minimum thickness, or 25.2 lbf/in. width (44.1 N/cm width), minimum in machine and transverse direction (Test Method D882)
Elongation	100 %, min in machine and transverse direction (Test Method D882)
Dielectric strength	800 V/mil (31.5 V/µm) thickness, min (Test Method D149)
Impact resistance	800 g, min. (Test Methods D1709 Method B)
Propagation tear resistance	250 gf, min. in machine and transverse direction (Test Method D1922)

TABLE 3 Polyethylene Tube Sizes for Push-On Joint Pipe[A]

Nominal Pipe Diameter, in.	Recommended Polyethylene Flat Tube Width, in. [cm][B]
3	14 [36]
4	14 [36]
6	16 [41]
8	20 [51]
10	24 [61]
12	27 [69]
14	30 [76]
16	34 [86]
18	37 [94]
20	41 [104]
24	54 [137]
30	67 [170]
36	81 [206]
42	81 (206)
48	95 [241]
54	108 [274]
60	108 [274]
64	121 [307]

[A] These wrap sizes should work with most push-on joint pipe and fitting bell sizes. Lay flat tube widths are minimums for each size of pipe. Tube widths used may be as much as two sizes wider than shown. Where bell circumferences are larger than the sheet sizes shown, the bell areas should be carefully wrapped with cut film sections, effectively lapping and securing cut edges as necessary; or, alternatively, sufficiently large tube or sheet film to effectively cover these joints should be ordered.

[B] For flat-sheet polyethylene, see 5.4.5.

5.1.1 The polyethylene encasement shall prevent contact between the pipe and the surrounding backfill and bedding material but is not intended to be a completely airtight or watertight enclosure. All lumps of clay, mud, cinders, etc. which may be on the pipe surface shall be removed prior to installation of the polyethylene encasement. During installation, care shall be exercised to prevent soil or embedment material from becoming entrapped between the pipe and the polyethylene.

5.1.2 The polyethylene film shall be fitted to the contour of the pipe to effect a snug, but not tight, encasement with minimum space between the polyethylene and the pipe. Sufficient slack shall be provided in contouring to prevent stretching

the polyethylene bridging irregular surfaces, such as bell-spigot interfaces, bolted joints, or fittings, and to prevent damage to the polyethylene due to backfilling operations. Overlaps and ends shall be secured by the use of adhesive tape or plastic tie straps.

5.1.3 For installations below the water table or in areas subject to tidal actions, or both, it is recommended that tube-form polyethylene be used with both ends sealed as thoroughly as possible with adhesive tape or plastic tie straps at the joint overlap. It is also recommended that circumferential wraps of tape or plastic tie straps be placed at 2 ft [0.6 m] intervals along the barrel of the pipe to help minimize the space between the polyethylene and the pipe.

5.2 *Polyethylene Installers*—The polyethylene encasement shall be installed by personnel trained or experienced in the proper application of the encasement as described in this standard. At all times during construction of the pipeline, precautions shall be taken to prevent damage to the encasement film.

5.3 *Repairs to Encasement*—Repair cuts, tears, punctures, or damage to polyethylene with adhesive tape or with a short length of polyethylene sheet; or with a tube cut open, wrapped around the pipe to cover the damaged area, and secured in place.

5.4 *Methods of Installation*—This practice includes three different methods for the installation of polyethylene encasement. Methods A and B are for use with polyethylene tubes, and Method C is for use with polyethylene sheets.

5.4.1 *Method A (see Fig. 1):*

5.4.1.1 Cut the polyethylene tube to a length approximately 2 ft [0.6 m] longer than the length of the pipe section. Slip the tube around the pipe, centering it to provide a 1 ft [0.3 m] overlap on each adjacent pipe section, and bunching it accordion fashion lengthwise until it clears the pipe ends.

5.4.1.2 Lower the pipe into the trench and make up the pipe joint with the preceding section of pipe. A shallow bell hole must be made at joints to facilitate installation of the polyethylene tube.

5.4.1.3 After assembling the pipe joint, make the overlap of the polyethylene tube. Pull the bunched polyethylene from the preceding length of pipe, slip it over the end of the new length of pipe, and secure in place. Then slip the end of the polyethylene from the new pipe section over the end of the first wrap until it overlaps the joint at the end of the preceding length of pipe. Secure the overlap in place. Take up the slack width at the top of the pipe as shown in Fig. 2, to make a snug, but not tight, fit along the barrel of the pipe, securing the fold at quarter points.

5.4.2 *Modified Method A (see Fig. 3):*

5.4.2.1 This is a modification of Method A, which uses one length of polyethylene tube for each length of pipe. In this modified method, one end of the tube is secured with circumferential tape to the spigot prior to making the joint. The 12 in. (300 mm) overlap is achieved when bringing the remaining film over the joint from the previous length of pipe.

5.4.2.2 Cut a section of polyethylene tube approximately 1 ft (300 mm) 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 and circumferentially tape it to the barrel of the pipe behind the insertion line. After assembly of the joint, the tape should be as close to the face of the bell as possible but not so close to the spigot end that it interferes with the gasket.

5.4.2.3 Take up the 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 and use pieces of tape across the fold to securely hold it. This step is extremely important to avoid the sagging of the film at the bottom of the pipe.

5.4.2.4 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.

5.4.2.5 Move the sling (that is, no chains or metal, use nonabrasive sling material) to the bell end of the pipe and lift the pipe slightly to provide enough clearance to easily slide the tube over the remaining barrel of the pipe. Snugly fold over the excess wrap using tape to hold it in place. Note: Make sure that no dirt or other bedding material becomes trapped between the wrap and the pipe.

5.4.2.6 Secure the polyethylene in place behind the preceding bell by using a circumferential wrap of tape. Make the overlap of the polyethylene tube by pulling back the bunched polyethylene from the preceding length of pipe and ensure there is at least a 12 in. overlap.

5.4.2.7 Carefully backfill the trench according to the procedures in AWWA Standard C600. 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.

5.4.3 *Modified Method A in Wet Trench Conditions:*

5.4.3.1 In installations where the water table may intrude into the pipe zone, either constantly or intermittently, it is

FIG. 1 Method A

FIG. 2 Slack Reduction Procedure – Methods A and B

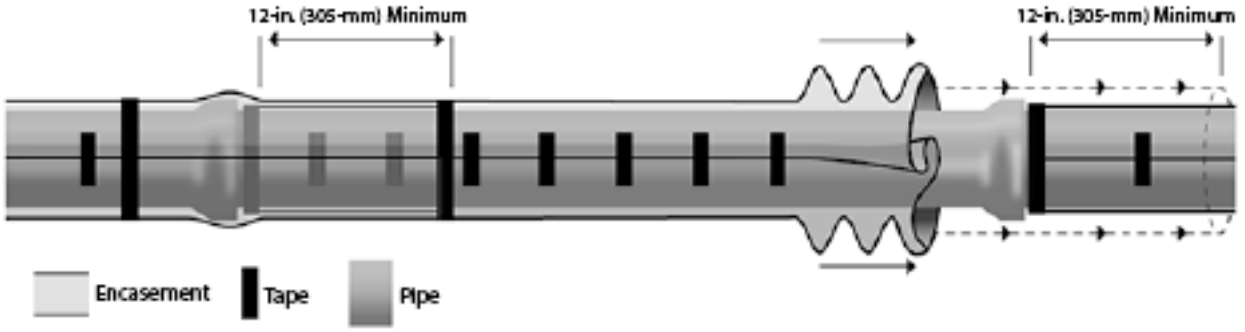

FIG. 3 Modified Method A

important to take steps to impede the intrusion of the groundwater under the film. While it is not required that the environment between the film and the pipe be water-free, it is important that any initial moisture be allowed to become stagnant. Therefore, when the water table may intrude into the pipe zone, circumferential wraps of tape shall be applied at 2 ft (600 mm) intervals along the barrel of the pipe, as shown in Fig. 4. Also, tape shall be used instead of tie straps to secure the ends of the film.

5.4.4 *Method B (see* Fig. 4*):*

5.4.4.1 Cut the polyethylene tube to a length approximately 1 ft [0.3 m] shorter than the length of the pipe section. Slip the tube around the pipe, centering it to provide 6 in. [150 mm] of bare pipe at each end. Make the polyethylene snug, but not tight, as shown in Fig. 2. Secure ends as described in 5.1.

5.4.4.2 Before making up a joint, slip a 3 ft [0.9 m] length of polyethylene tube over the end of the preceding pipe section, bunching it accordion fashion lengthwise. Alternatively, place a 3 ft [0.9 m] length of polyethylene sheet in the trench under the joint to be made. After completing the joint, pull the 3 ft length of polyethylene over or around the joint, overlapping the previously installed on each adjacent section of pipe by at least 1 ft [0.3 m]; make snug and secure each end as described in 5.1. A shallow bell hole must be made at joints to facilitate installation of the polyethylene tube or sheet.

5.4.5 *Method C (see* Fig. 5*):*

5.4.5.1 Flat-sheet polyethylene shall have a minimum width twice the flat tube width shown in Table 3.

5.4.5.2 Cut the polyethylene sheet to a length approximately 2 ft [0.6 m] longer than the length of pipe section. Center the cut length to provide a 1 ft [0.3 m] overlap on each adjacent pipe section, bunching it until it clears the pipe ends. Wrap the polyethylene around the pipe so that it overlaps circumferentially over the top quadrant of the pipe. Secure the cut edge of polyethylene sheet at approximately 3 ft [0.9 m] intervals along the pipe length.

5.4.5.3 Lower the wrapped pipe into the trench and make up the pipe joint with the preceding section of pipe. A shallow bell hole must be made at joints to facilitate installation of the polyethylene. After completing the joint, make the overlap as described in 5.1.

5.5 *Pipe-Shaped Appurtenances*—Bends, reducers, offsets, and other pipe-shaped appurtenances shall be covered with polyethylene in the same manner as the pipe.

5.6 *Odd-Shaped Appurtenances*—Wrap valves, tees, crosses, and other odd-shaped pieces which cannot practically be wrapped in a tube with a flat sheet or split length of polyethylene tube. Pass the sheet under the appurtenance and bring up around the body. Make seams by bringing the edges together, folding over twice, and taping down. Handle slack

FIG. 4 Method B

FIG. 5 Method C

width and overlaps at joints as described in 5.1. Tape polyethylene securely in place at valve stem and other penetrations.

5.7 *Repairs*—Repair any cuts, tears, punctures, or damage to polyethylene with adhesive tape or with a short length of polyethylene tube cut open, wrapped around the pipe covering the damaged area, and secured in place.

5.8 *Openings in Encasement*—Make openings for branches, service taps, blow-offs, air valves, and similar appurtenances by making an X-shaped cut in the polyethylene and temporarily folding the film back. After the appurtenance is installed, tape the slack securely to the appurtenance and repair the cut, as well as any other damaged areas in the polyethylene, with tape. Direct service taps may also be made through the polyethylene, with any resulting damage areas being repaired as described previously. The preferred method of making direct service taps consists of applying two or three wraps of adhesive tape completely around the polyethylene-encased pipe to cover the area where the tapping machine and chain will be mounted. This method minimizes possible damage to the polyethylene during the direct tapping procedure. After the tapping machine is mounted, the corporation stop is installed directly through the tape and polyethylene as shown in Fig. 6. Experience has shown that this method is very effective in eliminating damage to the polyethylene encasement by the tapping machine and chain during the tapping operation. After the direct tap is completed, the entire circumferential area should be closely inspected for damage and repaired if needed.

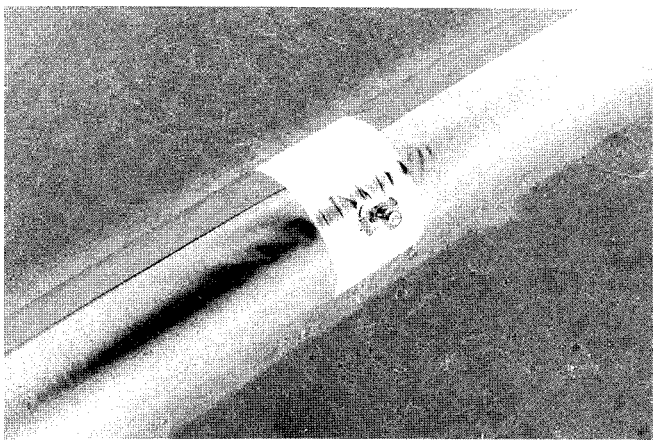

FIG. 6 Preferred Method for Making Direct Service Taps on PE-Encased Iron Pipe

5.9 *Junctions Between Wrapped and Unwrapped Pipe*—Where polyethylene-wrapped pipe joins a pipe that is not wrapped, extend the polyethylene tube to cover the unwrapped pipe a distance of at least 3 ft [0.9 m]. Secure the end with circumferential turns of adhesive tape. Service lines of dissimilar metals shall be wrapped with polyethylene or a suitable dielectric tape for a minimum clear distance of 3 ft [0.9 m] away from the ductile iron pipe.

5.10 *Backfill for Polyethylene-Wrapped Pipe*—Backfill material shall be the same as specified for pipe without polyethylene wrapping. Take special care to prevent damage to the polyethylene wrapping when placing backfill. Backfill material shall be free of cinders, refuse, boulders, rocks, stones, or other material that could damage polyethylene. In general, backfilling practice should be in accordance with the latest revision of ANSI/AWWA C600.

6. Inspection and Certification by Manufacturer

6.1 *Quality Control and Inspection*—The manufacturer of polyethylene film for corrosion protection encasement of ductile iron pipe systems shall have a documented quality control system or a current compliance certificate from an accredited quality auditing organization to ensure that it complies with all requirements of this standard. The film manufacturer, the film distributor, or both shall maintain accessible quality records for a minimum period of one year from the date of manufacture. In lieu of the above records, the manufacturer may elect to test a customer-selected film sample provided that proof of manufacturer and the date of manufacture (DOM) are verifiable to the sample.

6.2 *Manufacturer's Statement*—The purchaser may require a signed affidavit by an officer representing the polyethylene film manufacturer that the film meets the inspection and all applicable material requirements of 4.1. The manufacturer's statement of compliance with this standard and use of similar statements on packaging or promotional material must be verifiable as required under 6.1. Statements from suppliers shall not be accepted in lieu of a statement from the original manufacturer of the polyethylene film.

6.3 *Freedom from Defects*—Polyethylene film to be manufactured and used in accordance with this standard shall not be made from recycled materials and shall be clean, sound, and without defects.