Designation: ~~A674 – 10~~ A674 – 10 (Reapproved 2014)

Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids[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 and health practices and determine the applicability of regulatory limitations prior to use.*

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]

C 600 Installation of Ductile Iron Water Mains and Their Appurtenances

C 105/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:*

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[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.

Current edition approved ~~Oct. 1, 2010~~Oct. 1, 2014. Published ~~November 2010~~October 2014. Originally approved in 1972. Last previous edition approved in ~~2005~~2010 as ~~A674 - 05.~~A674 - 10. DOI: ~~10.1520/A0674-10.~~10.1520/A0674-10R14.

[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), ~~1401 New York Ave., NW, Suite 640, Washington, DC 20005.~~6666 W. Quincy Ave., Denver, CO 80235, http://www.awwa.org.

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 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:

(a) Manufacturer's name or registered trademark
(b) Year of manufacture
(c) ASTM A674
(d) Minimum film thickness and material type (LLDPE or HDCLPE)
(e) Applicable range of nominal pipe diameter size(s)
(f) Warning—Corrosion Protection—Repair Any Damage

4.4.1 *Marking height*—Letters and numerals used for marking items a through e in Section 4.4 shall not be less than 1 in. [25.4 mm] in height. Item f in Section 4.4 shall be not less than 1½ in. [38.10 mm] in height.

5. Installation

5.1 *General:*

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.

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 (ASTM D882)
Elongation	700 %, min in the machine and transverse direction (ASTM D882)
Dielectric strength	800 V/mil (31.5 V/μm) thickness, min (ASTM D149)
Impact resistance	600 g, min (ASTM D1709 Method B)
Propagation tear resistance	2550 gf, min in machine and transverse direction (ASTM 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 (ASTM D882)
Elongation	100 %, min in machine and transverse direction (ASTM D882)
Dielectric strength	800 V/mil (31.5 V/μm) thickness, min (ASTM D149)
Impact resistance	800 g, min. (ASTM D1709 Method B)
Propagation tear resistance	250 gf, min. in machine and transverse direction (ASTM 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. 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 5.3.3.

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

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

5.3.1.1 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.

5.3.1.2 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.

5.3.1.3 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

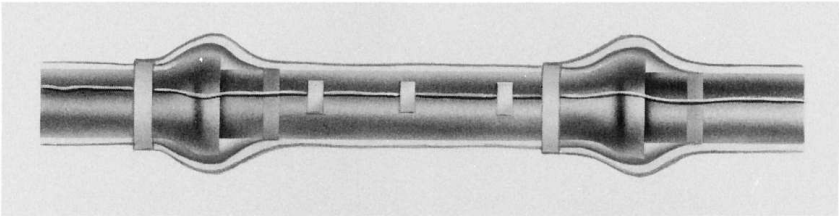

FIG. 1 Method A

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.

5.3.1.4 Repair any rips, punctures, or other damage to the polyethylene with adhesive tape or with a short length of polyethylene tube cut open, wrapped around the pipe, and secured in place. Proceed with installation of the next section of pipe in the same manner.

5.3.2 *Method B (see Fig. 3):*

5.3.2.1 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.

5.3.2.2 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.

5.3.2.3 Repair any rips, punctures, or other damage to the polyethylene as described in 5.6. Proceed with installation of the next section of pipe in the same manner.

5.3.3 *Method C (see Fig. 4):*

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

5.3.3.2 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.

5.3.3.3 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.

5.3.3.4 Repair any rips, punctures, or other damage to the polyethylene as described in 5.6. Proceed with installation of the next section of pipe in the same manner.

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

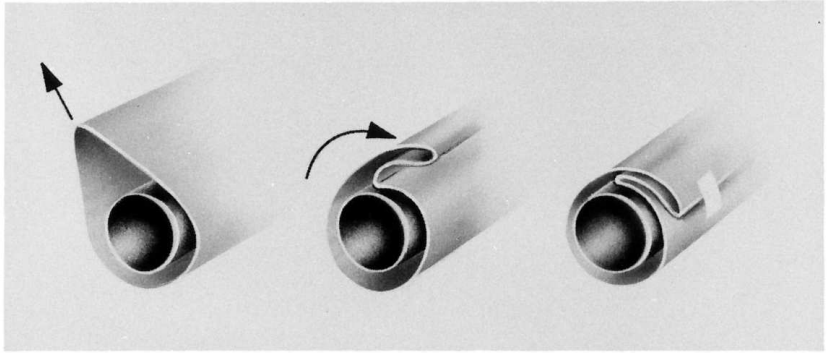

FIG. 2 Slack Reduction Procedure—Methods A and B

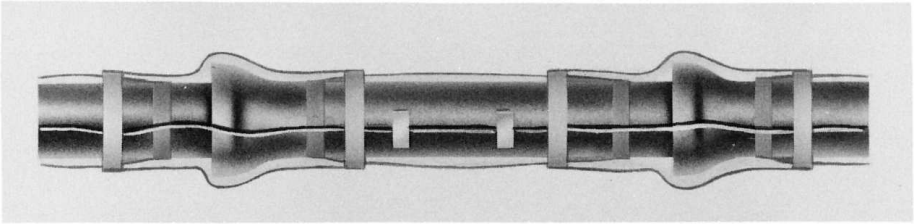

FIG. 3 Method B

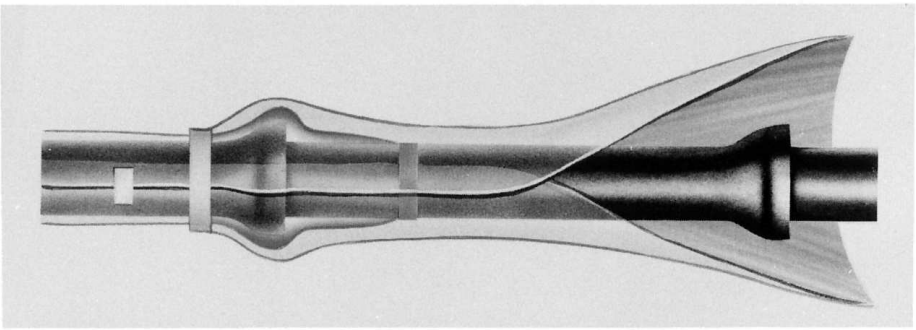

FIG. 4 Method C

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

5.6 *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.

5.7 *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. 5. 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.

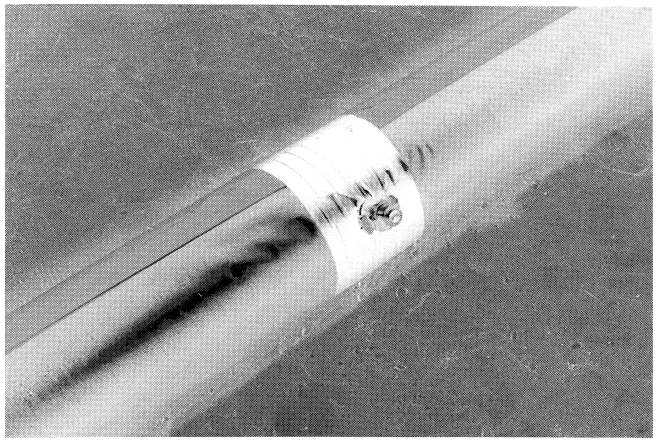

FIG. 5 Preferred Method for Making Direct Service Taps on PE Encased Iron Pipe

5.8 *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.

5.9 *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 C 600.

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 assure 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 . 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.

7. Keywords

7.1 corrosion protection; ductile iron pipe; polyethylene encasement; soil-test evaluation; stray direct current

APPENDIX

(Nonmandatory Information)

X1. PROCEDURES FOR SOIL SURVEY TESTS AND OBSERVATIONS AND THEIR INTERPRETATION TO DETERMINE WHETHER DUCTILE IRON PIPE FOR WATER OR OTHER LIQUIDS REQUIRES POLYETHYLENE ENCASEMENT

X1.1 Scope

X1.1.1 In the appraisal of soil and other conditions that affect the corrosion rate of ductile iron pipe (see Note X1.1), a minimum number of factors must be considered. They are outlined in the following sections. A method of evaluating and interpreting each factor and a method of weighting each factor to determine whether polyethylene encasement should be used are subsequently described.

NOTE X1.1—The information contained in Appendix X1 is also applicable to grey iron pipe. Although grey iron pressure pipe is no longer produced in the United States, many miles of this product remain in service.

These methods should be employed only by qualified personnel who are experienced in soil analysis and evaluation of conditions potentially corrosive to ductile-iron pipe. Factors such as moisture content, soil temperature, location of soil sample with respect to pipe, time between removal of soil sample and testing, and other factors can significantly affect the soil-test evaluation. For example, certain soil environments are generally accepted to be potentially corrosive to ductile-iron pipe based on experience, and thus do not require evaluation to determine the need for corrosion protection. Such environments include, but are not limited to, coal, cinders, muck, peat, mine wastes, and landfill areas high in foreign materials. Experience with existing installations and potential for stray direct current corrosion should also be taken into consideration as a part of the evaluation.

X1.2 Applicable Document

X1.2.1 *ANSI/AWWA Standard:* C 105/A21.5, Polyethylene Encasement for Ductile-Iron Pipe Systems