# STANDARD PLASTIC SHEATHS

CONTENTS PAGE



**NOTICE**
Not for use or disclosure outside the
Bell System except under written agreement

## 1. GENERAL

1.01 This section contains general information on ***standard*** plastic-jacketed sheaths, including code designations and physical characteristics common to sheaths made with jackets of standard polyethylene (PE) or polyvinyl chloride (PVC). It also covers their use and special features.

1.02 This section is reissued to:

- Include information on bonded ASP sheath (letter code "Y") and bonded stalpeth sheath (letter code "Z")
- Include information on crossply sheath which is not assigned a letter code and is used only on lightguide cable.

Arrows are used to indicate changes and additions to this section.

1.03 The ***standard polyethylene-jacketed sheaths*** covered in this section are: alpeth, self-supporting, reinforced self-supporting, PAP, PASP, ARPAP, ASP, ➧bonded ASP,➧ stalpeth, ➧bonded stalpeth,➧ steampeth, tolpeth J, tolpeth K, ➧and crossply.➧ ➧Self-supporting and reinforced self-supporting cables are not available with any outer protection. All other sheaths are available with outer protection.➧ The ***standard PVC-jacketed sheath*** covered in this section is designated as bonded alvyn. No outer protective coverings are used over this sheath. (See paragraph 1.12 for information on sheath letter codes.)

1.04 The sheaths described in this section are used on cable containing pairs, quads, coaxials, or videos.

1.05 ***Core Wrapper:*** Plastic or rubber tape is used on plastic-insulated conductors and paper tape is generally used on paper- or pulp-insulated conductors, coaxials, and videos.

1.06 ***Metal Shields:*** Except as noted in paragraph 1.07, the metallic shields in composite sheath cable serve as noise suppression shields. It is essential that continuity of the shields be maintained and that they contain no high resistance connections. Sheaths with a steel member provide a modest degree of mechanical protection.

1.07 The inner aluminum in ARPAP sheath is provided only as a moisture barrier, and must not be used as a shielding element. This approach simplifies cable manufacture since the inner aluminum need not be electrically continuous along a cable length. At splice points, there must be no electrical connection to this inner aluminum. (See Section 632-316-210 for isolating aluminum barrier at splice openings.)

1.08 The resistance of the metallic shields in the various types of sheath is given in the 626 Division of the Bell System Practices.

1.09 The thickness of the plastic jackets usually increases as the diameter of the cable core increases.

1.10 The outer plastic jacket is free from holes and in general is smooth and free of score marks or other imperfections.

1.11 ***Outside Diameters:*** Approximate diameters over cable sheaths are covered in the reel length information given in the cable Bell System Practices in the 626 Division.

### CODE DESIGNATIONS

1.12 Standard letter codes are used to indicate plastic-jacketed sheaths. In coded cables the fourth letter of the code indicates the type of sheath; for instance, BHA***H*** is 22-gauge, air core PIC cable with ***PASP*** sheath. For cables furnished under CA-drawings, the sheath is designated by the letter code following the CA-number; for instance, CA-1727-HX indicates 19-gauge low capacitance PIC cable with PASP sheath. These code designations are listed in Table A.

## TABLE A

### STANDARD PLASTIC SHEATH CODE DESIGNATIONS (NOTE 1) (COVERED IN THIS SECTION)

| TYPE OF SHEATH | CODE DESIGNATION |
|---|---|
| Alpeth | A |
| Stalpeth | C |
| PAP | G |
| PASP | H |
| Tolpeth J | J |
| Tolpeth K | K |
| Alvyn (Bonded) | M |
| Reinforced Self-Supporting | P |
| Self-Supporting | S |
| ARPAP (Note 2) | T |
| Steampeth | V |
| ASP | W |
| Bonded ASP | Y |
| Bonded Stalpeth | Z |

*Note 1:* Standard crossply sheath for LGA1-type (lightguide) cable does not utilize this letter code scheme.

*Note 2:* ARPAP has been used only on T2 LOCAP cables since 1975.

**1.13** Any outer protection placed over the cable sheath is indicated by a two-letter code following the cable designation or CA-drawing number. For example, BHAH-***BT*** indicates 22-gauge PIC cable having PASP sheath with ***buried tape armor protection and CA-1911-A-AT*** indicates 22-gauge PIC cable having alpeth sheath with ***aerial tape armor protection.***

**CHARACTERISTICS OF POLYETHYLENE**

**1.14** Polyethylene was selected for cable jacketing because of the following characteristics:

(a) Lightweight, toughness, and extrudability

(b) Flexibility over a wide range of outdoor temperatures

(c) High resistance to chemical and weather attack

(d) High resistance to cracking

(e) Good insulating properties and protection of the metallic shield from electrolytic attack.

(f) Reliability of supply.

**1.15** Except as noted in the next paragraph, the compound used in plastic ***outer jackets*** consists of high molecular weight, low density polyethylene, antioxidant, and carbon black. The approximate composition by weight is 97.30 percent polyethylene, 2.60 percent carbon black, and 0.10 percent antioxidant. The carbon black is evenly dispersed in the polyethylene to provide opaqueness in order to minimize the deteriorating effect of sunlight. The antioxidant retards oxidation of the plastic, thereby ensuring a long life.

**1.16** ♦The outer jacket of steampeth sheath cable consists of high molecular weight, medium density polyethylene. The composition is the same as described in paragraph 1.15, but medium density polyethylene resists thermal cracking which can occur when low density polyethylene is exposed to high temperature.♦

**1.17** ***Inner polyethylene jackets*** are not exposed to the deteriorating effects of sunlight and may be natural in color (translucent milky white). For manufacturing flexibility, the black compound which is used for the outer jacket may also be used for the inner jacket.

**1.18** Tension on the polyethylene must be carefully limited. Cables of less than 1.1-inch diameter over the plastic sheath can usually be placed using a cable grip without danger of rupturing the plastic jacket. Cables with diameters larger than 1.1-inch should be ordered with factory-installed pulling eyes (Section 626-020-050) when they are to be installed in ducts or in steel pipe under highways, railroads, etc. The pulling eye is installed so that the pulling load is taken by the conductors.

**REFERENCES**

**1.19** The following Bell System Practices contain related information:

| SECTION | TITLE |
|---|---|
| 626-759-020 | Lead Sheaths (Including those which have a lead component and a component of polyethylene, such as lepeth, etc.) |
| 626-759-025 | Outer Protections—Buried, Underground, and Aerial—Description and Use |
| 626-759-030 | Wire Armor Protection |
| 627(Division) | Placing Aerial Cables |
| 628(Division) | Placing Underground Cables |
| 629(Division) | Placing Buried Cables |

## 2. DEFINITIONS

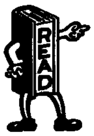
**2.01** Definitions are given in Table B to clarify the meaning of a number of terms used in this and related practices.

TABLE B

DEFINITIONS

| WORD OR PHRASE | DEFINITION |
|---|---|
| Cable Sheath | A general term used to designate the protective covering applied directly over the wrapped core to provide mechanical strength, electromagnetic shielding, and protection against the environment. |
| Jacket | An extruded plastic component of cable sheath. Some sheath designs (eg, PAP) have inner and outer jackets. |
| Multiple Sheath | A sheath containing two or more components, such as aluminum and polyethylene in alpeth sheath. |
| Outer Protection | Covering applied over the basic sheath, used where necessary to protect the sheath against known or potential damage of a mechanical, electrical, or chemical nature. For example, wire armor in river crossings and gopher protection in buried plant. |
| PE (Polyethylene) | High molecular weight, weather-resistant, thermoplastic compounds used as cable jackets. |
| PVC (Polyvinyl Chloride) | Fire-resistant thermoplastic compound used for jacket on terminating cables, connector stubs, etc. The main ingredients of these compounds are polyvinyl chloride resin, plasticizer, flame-retardant, stabilizer, and colorants. |
| Sheath Thickness | Combined radial thickness of the metallic and plastic components of the sheath. |
| Shield | The metallic coverings provided as a shield in all sheaths. |
| Flooding Compound | A hot-melt adhesive coating which is applied between layers in some sheath designs and to the galvanized steel strand of self-supporting cable. Flooding compound provides an adhesive bond between the outer plastic jacket and underlying metallic layers resists the movement of water along sheath interfaces and protects metallic sheath components from corrosion. |
| Filling Compound | A viscous, water-resistant material which is used to fill the free (interstitial) space within the core of waterproof cable. |

## 3. DESCRIPTION AND USE OF PLASTIC SHEATHS




***PIC (Plastic-Insulated Conductor) reference includes solid and dual expanded plastics.***

### ALPETH SHEATH

**3.01** ***Description:*** Alpeth sheath (Fig. 1) is applied over a longitudinal core wrapper of plastic tape. The sheath consists of the following:

(a) A shield of 8-mil corrugated aluminum applied longitudinally with overlap.

(b) The aluminum may be edge formed or an overlay tape may be used to cover the longitudinal aluminum edge. The overlay may be held in place by a spirally applied nylon binder.

(c) An outer extruded jacket of polyethylene.

**3.02** ***Use:*** Alpeth sheath is provided only on air core PIC copper cables and is intended primarily for aerial use. It may be used in buildings but only for horizontal runs or for riser cable protected by fireproof conduit. PIC cable with alpeth sheath should not be buried or used in underground conduit.

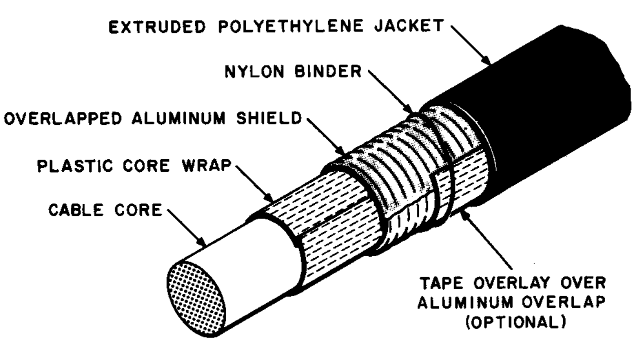



**Fig. 1—Alpeth Sheath**

### SELF-SUPPORTING SHEATH

**3.03** ***Description:*** Self-supporting sheath is so designated because the support member (6.6M galvanized steel strand) is included as an integral part of the cable. Self-supporting sheath (Fig. 2) is applied over a longitudinal core wrapper or plastic tape. The sheath consists of the following:

(a) A shield of corrugated 8-mil aluminum applied longitudinally without overlap. The outside of the aluminum shield on large cables is adhesively bonded to the polyethylene to minimize deformation of the aluminum shield during installation.

(b) A 6.6M support strand which is a preformed 1/4-inch extra high strength (EHS), Class A galvanized steel strand with minimum breaking strength of 6650 pounds.

(c) For corrosion protection, the strand is covered with a flooding compound. Should the jacket be damaged, the flooding compound helps minimize the seepage of moisture along the strand.

(d) The aluminum shielded cable core and the 6.6M strand are paralleled and jacketed with polyethylene in such a way that they are joined by a narrow web of polyethylene (Fig. 2).

**3.04** ***Use:*** Self-supporting sheath is provided only on air core PIC copper cables and is intended for aerial use in exchange plant. Because the self-supporting member (6.6M strand) is included as an integral part of the cable, it is possible to place the cable in a single operation instead of a two-stage method of first placing the support strand and then the cable. Self-supporting cable may also be used for pole-to-building spans and for block cable construction.

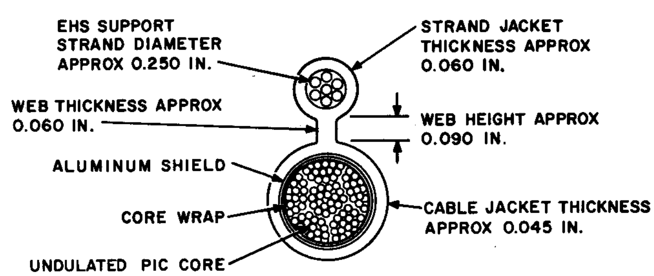



**Fig. 2—Self-Supporting Sheath (End View)**

**REINFORCED SELF-SUPPORTING SHEATH**

**3.05** ***Description:*** Reinforced self-supporting sheath has a support member (6.6M galvanized steel strand) included as an integral part of the cable. The sheath (Fig. 3) is applied over a longitudinal core wrapper of plastic tape. The sheath consists of the following:

(a) A shield of 8-mil corrugated aluminum applied longitudinally without overlap. The outside of the aluminum shield is adhesively bonded to the polyethylene, thereby sealing the shield to the inner polyethylene jacket.

(b) An inner extruded jacket of polyethylene.

(c) A heat barrier wrap (crepe paper).

(d) Corrugated 6-mil tinned or terne steel with longitudinal seam.

(e) The corrugated steel protected cable and a 6.6M strand are paralleled and jacketed with polyethylene in such a way that they are joined by a narrow web of polyethylene (Fig. 3).

*Note:* See paragraph 3.03.

**3.06** ***Use:*** Rodents, birds, or tree limbs may damage the jacket of self-supporting sheath and permit water to reach the core. Transmission can be degraded and cable maintenance or replacement is frequently required. Reinforced self-supporting sheath will protect the inner jacket and is provided for use in areas where such damage is prevalent. Standard codes of self-supporting sheath will continue to be available and are recommended for general applications.

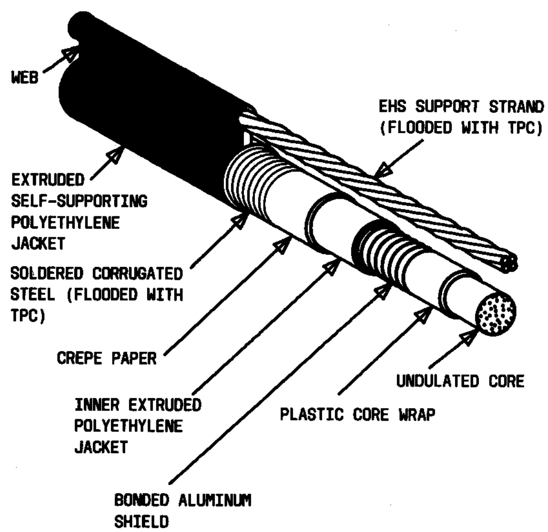



**Fig. 3—Reinforced Self-Supporting Sheath**

**PAP SHEATH**

**3.07** ***Description:*** PAP sheath (Fig. 4) is applied over a longitudinal plastic core wrapper. The sheath consists of the following:

(a) An inner extruded jacket of polyethylene (which affords a high degree of protection against core-to-sheath dielectric breakdown and serves as a water barrier for the core).

(b) A shield of 8-mil corrugated aluminum applied longitudinally with overlap.

(c) The aluminum may be edged formed or an overlay tape may be used to cover the longitudinal aluminum edge. The overlay may be held in place by a spirally-applied nylon binder.

(d) An outer extruded jacket of polyethylene.

**3.08** ***Use:*** PAP sheath is used only on PIC air core cable and was originally intended for buried use in lightning areas. Now, waterproof cable is strongly recommended for all buried installations. PAP sheath may be used in aerial installations that are subject to high lightning exposure.

> ***Note:*** Because moisture can accumulate in the core by a diffusion process, PAP sheath ***must not*** be used as an air feed to paper or pulp-insulated cable. Where rock and rodent damage may occur, UM-type protection or PASP sheath should be used.

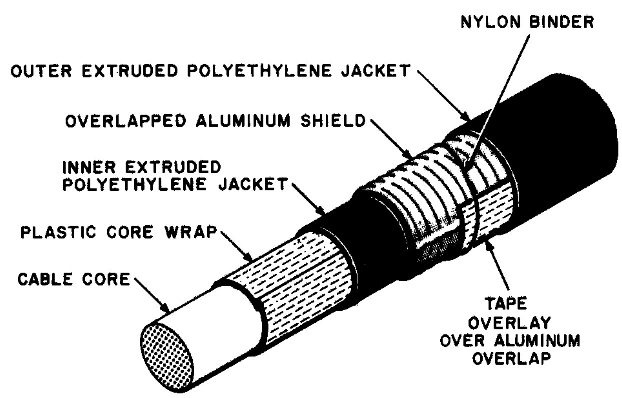



**Fig. 4—PAP Sheath**

## ARPAP SHEATH

**3.09** ***Description:*** ARPAP sheath (Fig. 5) is applied over a longitudinal plastic core wrapper. The sheath consists of the following:

(a) Aluminum applied longitudinally with an overlap. The aluminum is precoated on both sides with adhesive which adhesively bonds the aluminum to the inner polyethylene jacket and also adhesively bonds the overlapping edges of the aluminum together providing an effective moisture barrier.

(b) An inner extruded jacket of polyethylene (which provides an additional moisture barrier and increases the dielectric strength).

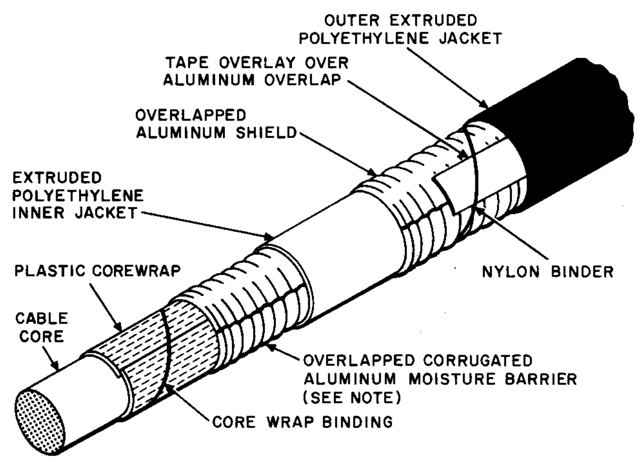
(c) An outer shield of 8-mil corrugated aluminum applied longitudinally with overlap.

(d) A tape overlay to cover the longitudinal aluminum edge. The overlay may be held in place by a spirally-applied nylon binder.

(e) An outer extruded jacket of polyethylene.

**3.10** ***Use:*** ARPAP sheath is used only on T2 carrier air core PIC cables and is intended primarily for buried use and should not be used aerially. The extra moisture protection of ARPAP sheath is not needed aerially. Also, power contacts or longitudinal induction may cause shock hazard because of the ungrounded moisture barrier. This hazard is an overriding objection to aerial use of ARPAP sheath.

> ***Note:*** Where there is gopher infestation or where a modest degree of mechanical protection is needed, UM-type protection on ARPAP should be specified. Where a greater degree of mechanical protection or low frequency shielding is required, specify buried tape (BT) armor over ARPAP.




NOTE:
BOTH SIDES OF ALUMINUM ARE COATED WITH COPOLYMER ADHESIVE.

**Fig. 5—ARPAP Sheath**

## STALPETH SHEATH

**3.11** ***Description:*** Stalpeth sheath (Fig. 6) is applied over a core wrapper of paper or plastic and one strip of heat barrier material over the core wrapper positioned under the steel overlap. The sheath consists of the following:

(a) A shield of 8-mil corrugated aluminum applied longitudinally without overlap

(b) Corrugated 6-mil tinned or terne steel with soldered longitudinal seam

(c) A flooding compound over the corrugated steel

(d) An extruded jacket of polyethylene.

**3.12** ***Use:*** Stalpeth sheath is used on air core pulp cable and is intended for use in conduit. ➧Stalpeth sheath can be used when the maximum cable temperature will not exceed 170°F; however, the use of pulp insulation may require that the cable temperature be limited to a value less than that permitted by the capability of the sheath. For details, see the note after paragraph 4.07.◀ The dielectric strength between the core and sheath is in the order of 1000 volts rms (higher on impulse), which is generally adequate if lightning exposure is not severe.

***Note:*** Stalpeth sheath ***should not be*** buried.

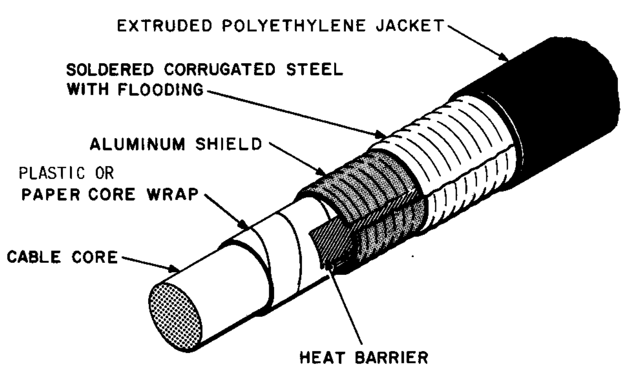



**Fig. 6—Stalpeth Sheath**

## ➧BONDED STALPETH SHEATH

**3.13** ***Description:*** Bonded stalpeth sheath (Fig. 7) is applied over a core wrapper of paper or plastic. The sheath consists of the following:

(a) A shield of 8-mil, corrugated aluminum applied longitudinally without overlap

(b) Corrugated 6-mil, tin-plated steel tape with a 2-mil copolymer adhesive coating on each side. The steel is applied longitudinally with a bonded overlap seam.

(c) An extruded jacket of polyethylene.

***Note:*** The copolymer adhesive bonds the jacket to the steel when the hot jacket is extruded over the steel.

**3.14** ***Use:*** Bonded stalpeth is superior to conventional stalpeth from the standpoints of buckling resistance, moisture diffusion resistance, and corrosion protection for the steel sheath member.

***DUCTPIC and ICOT cables have been converted to bonded stalpeth sheath. Dielectric strength from core-to-sheath is 5kV for DUCT PIC and 8kV for ICOT cables. The operating companies should order these cables with bonded stalpeth (code "Z"). Pulp cable conversion will begin as soon as manufacturing changes can be accomplished. For the present, pulp cables should be ordered with conventional stalpeth (code "C") sheath. Western Electric Company will ship either stalpeth or bonded stalpeth, based upon availability during the conversion period. During the conversion period, a special tag (Fig. 8) will be attached to all bonded sheaths.***◀

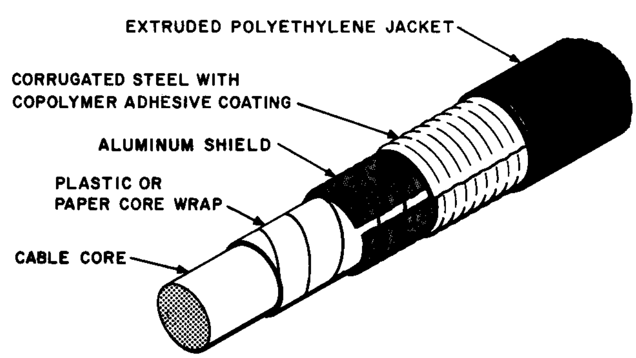



**Fig. 7—➧Bonded Stalpeth Sheath◀**

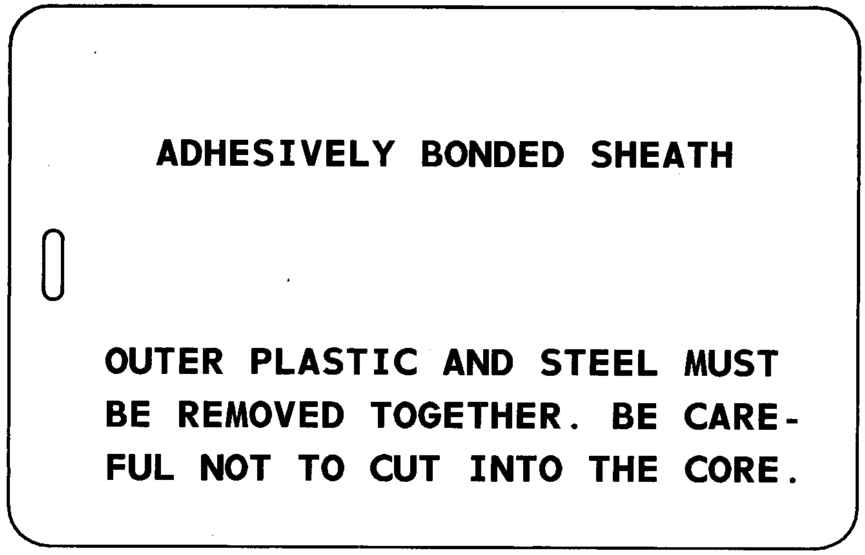



Fig. 8—Bonded Sheath Tag

**ASP SHEATH**

**3.15** ***Description:*** ASP sheath (Fig. 9) is applied over a longitudinal plastic core wrap. The sheath consists of the following:

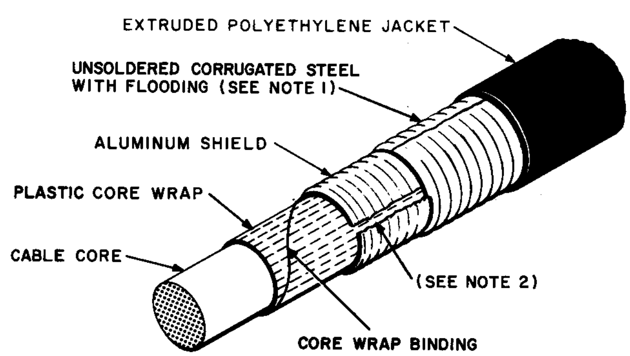
(a) A shield of 8-mil corrugated aluminum is applied longitudinally without overlap. A flooding compound is applied both over and under the corrugated aluminum shield.

(b) A corrugated 6-mil untinned, tinned, or terne steel with unsoldered longitudinal overlapped seam.

(c) A flooding compound.

(d) An outer extruded jacket of polyethylene.

**3.16** ***Use:*** ASP sheath is used on waterproof PIC cables and is intended for buried use in nonpressurized systems. The steel shield of ASP sheath is an excellent facility for bonding and grounding the sheath. The purpose of the flooding compound applied over the core wrap and over the aluminum shield in ASP-sheathed cables is to prevent corrosion and eliminate any flow of water.




NOTES:
1. FLOODING COMPOUND IS APPLIED FROM CORE WRAP TO OUTER STEEL
2. GAP REQUIRED TO BE A MINIMUM OF 75° AWAY FROM UNSOLDERED STEEL SEAM

Fig. 9—ASP Sheath

3.17 ***High Potential Cable With ASP Sheath:*** Same as ASP sheath except that there are two core wraps. Core-to-shield dielectric strength is approximately 20 kV.

3.18 *Use:* For very severe lightning or power exposures, such as in a power station critical zone.

> ***Caution:*** ***♦Do not use ASP-sheathed cable for general distribution in buildings. It may be used as an entrance facility provided that it is spliced to a fire-retardant cable within a sealed metallic splice case and that the pairs of the ASP cable are never exposed within the building.♦***

**♦BONDED ASP SHEATH**

3.19 *Description:* Bonded ASP sheath (Fig. 10) is applied over a longitudinal plastic core wrap. The sheath consists of the following:

(a) A shield of 8-mil corrugated aluminum is applied longitudinally without overlap.

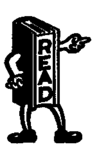
(b) A corrugated 6-mil, tin-plated steel plate with a 2-mil copolymer adhesive coating on the outside (but not necessarily on the inside).

(c) An extruded jacket of polyethylene.

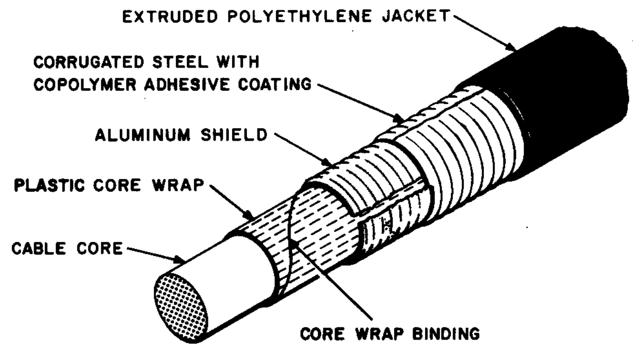
(d) A flooding compound between the core wrap and the aluminum and between the aluminum and the steel.

> *Note:* The copolymer adhesive bonds the jacket to the steel when the hot jacket is extruded over the steel.

3.20 *Use:* At present all waterproof ICOT cable has bonded ASP sheath and is intended for buried use in nonpressurized systems. Other waterproof PIC cables will be converted as supplies permit.




***As with stalpeth, Western Electric Company will be allowed to substitute ASP for bonded ASP (or vice versa) during the conversion period. A bonded sheath tag (Fig. 8) will be attached to all bonded sheaths.♦***




NOTES:
1. FLOODING COMPOUND IS APPLIED FROM CORE WRAP TO OUTER STEEL.
2. GAP REQUIRED TO BE A MINIMUM OF 75° AWAY FROM UNSOLDERED STEEL SEAM.

**Fig. 10—♦Bonded ASP Sheath♦**

**PASP SHEATH**

3.21 *Description:* PASP sheath (Fig. 11) is applied over a spirally-applied paper core wrap on pulp-insulated cables and longitudinal plastic core wrap on plastic-insulated cables. The sheath consists of the following:

(a) An inner extruded jacket of polyethylene.

(b) Heat barrier tape: A longitudinal wrap of crepe paper for pulp-insulated cable; a strip of AKM (aluminum-kraft-mylar) for PIC cable. Also, on PIC cable with diameters over inner jacket of 0.88 inches or larger, a plastic wrap is applied directly over the inner jacket.

(c) A shield of 8-mil corrugated aluminum applied longitudinally without overlap.

(d) Corrugated 6-mil tinned or terne steel with soldered longitudinal seam.

(e) A flooding compound over the corrugated tinned steel.

(f) An outer extruded jacket of polyethylene.

**3.22** ***Use:*** PASP sheath is used on both pulp- and PIC-insulated (copper) cables. As with PAP, the inner jacket affords a high degree of protection against core-to-sheath dielectric breakdown and serves as a water barrier. In addition, the flooded soldered steel shield provides mechanical protection.

**3.23** PASP sheath is recommended primarily for buried use when waterproof cable is not suitable. It can be used without additional protection in most areas, including those where there is slight gopher activity. ➧PASP sheath is used on pulp cables installed in ducts where there is a danger of lightning damage. Also, PASP sheath is used on pulp cables where short runs of buried pulp cannot be avoided.⬅ However, where it is felt that additional protection is needed because of severe gopher infestation or where a modest degree of mechanical protection is needed, MP- or UM-type protection should be specified. Buried tape armor on PASP sheath is intended for buried use where a greater degree of mechanical protection or low frequency shielding is required.

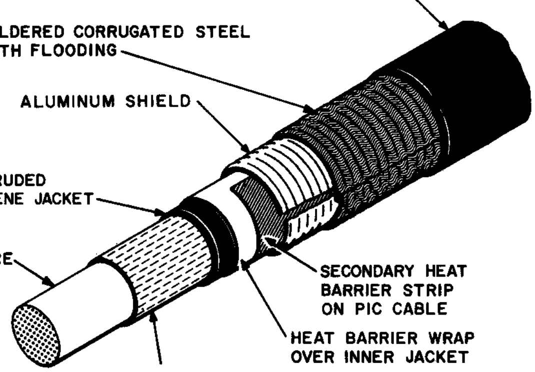



**Fig. 11—PASP Sheath**

**STEAMPETH SHEATH**

**3.24** ***Description:*** Steampeth sheath (Fig. 12) is applied over a spirally-applied paper core wrap on pulp-insulated cables and longitudinal plastic core wrap on plastic-insulated cables. The sheath consists of the following:

(a) A heat barrier strip

(b) A shield of 8-mil corrugated aluminum applied longitudinally without overlap

(c) Corrugated 6-mil tinned or terne steel with soldered longitudinal seam

(d) A flooding compound over the corrugated tinned steel

(e) An outer extruded jacket of medium density polyethylene.

**3.25** ***Use:*** ➧PIC and pulp steampeth underground cables are intended for use in high temperature areas (above 170°F). The steampeth sheath will withstand temperatures up to 230°F. For pulp insulated cores, the local temperature anywhere along the cable should not be less than 55°F to avoid insulation failures due to condensation.⬅

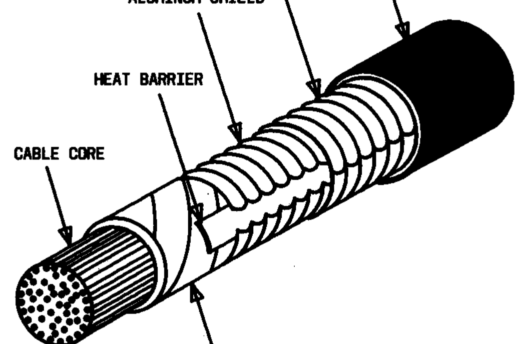



**Fig. 12—Steampeth Sheath**

**ALVYN SHEATH**

**3.26** ***Description:*** Alvyn sheath (Fig. 13) is applied over a longitudinal or spiral core wrapper or plastic tape. The sheath consists of the following:

(a) Eight-mil aluminum, applied longitudinally with a 1/4-inch overlap. ***Alvyn*** sheath (manufactured since 1967), the outer surface of the aluminum shield, is precoated with an adhesive which bonds the shield to the jacket, due to the heat and pressure of extrusion.

*Note:* To facilitate assembly into apparatus cases, some stub cables are made with alvyn sheath which is not bonded.

(b) An extruded jacket of fire-resistant plastic (polyvinyl chloride).

**3.27** On ***sealed alvyn*** sheath, electrical contact with the shield for purposes such as bonding and grounding can be made with the inner surface of the aluminum since this side is not coated with adhesive.

**3.28** ***Sealed*** alvyn sheath is easily removed by cutting the PVC jacket over the aluminum overlap. The double layer of aluminum at the overlap protects the core, and the absence of a seal in this area facilitates jacket removal.

**3.29** ***Use:*** Alvyn sheathed cables with PE-PVC or pulp-insulated conductors are used in open riser shafts and at all locations in central office equipment rooms where a fire resistant sheath is required to meet the requisites of the National Electrical Code. Alvyn sheathed cables are preferred over polyethylene sheathed cables for all building applications.

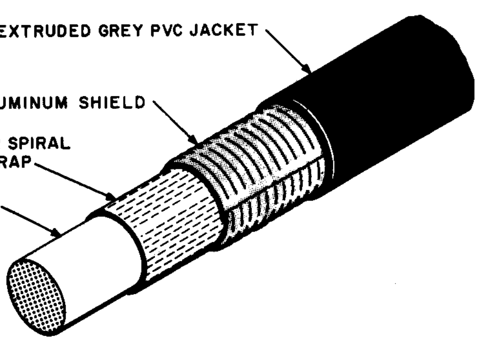



**Fig. 13—Alvyn Sheath**

**TOLPETH J SHEATH**

**3.30** ***Description:*** Tolpeth J sheath (Fig. 14) is applied over a core wrapper of spiraled paper tapes and a strip of heat barrier material under the steel overlap. The sheath consists of the following:

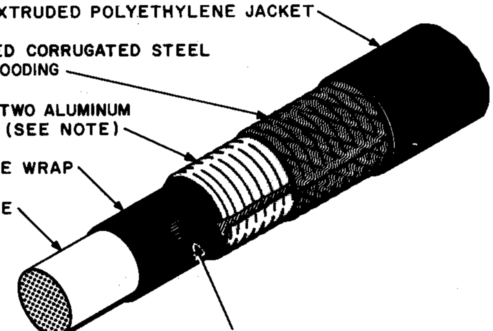
(a) One or two shields of 8-mil aluminum, depending on the core diameter (Fig. 14). Before 1966, an aluminum shield was used on cables up to 0.96 inch od; a copper shield was used on cables 0.97 inch od and larger.

(b) Corrugated 6-mil tinned steel with soldered longitudinal seam positioned over the heat barrier strip.

(c) A flooding compound.

(d) An extruded jacket of polyethylene.

**3.31** ***Use:*** Tolpeth J sheath is used on toll-type cables. The sheath is intended for conduit and aerial use where there is minimum lightning exposure.




NOTE:

ONE ALUMINUM SHIELD IS USED ON CABLES UP TO 0.96 INCH OD; TWO ALUMINUM SHIELDS ARE USED ON CABLES 0.97 INCH AND LARGER.

**Fig. 14—Tolpeth J Sheath**

**TOLPETH K SHEATH**

**3.32** ***Description:*** Tolpeth K sheath (Fig. 15) is applied over a core wrapper of spirally-applied paper tape. The sheath consists of the following:

(a) An inner extruded jacket of polyethylene.

(b) A heat barrier. On plastic-insulated cable, a secondary heat barrier strip is also used.

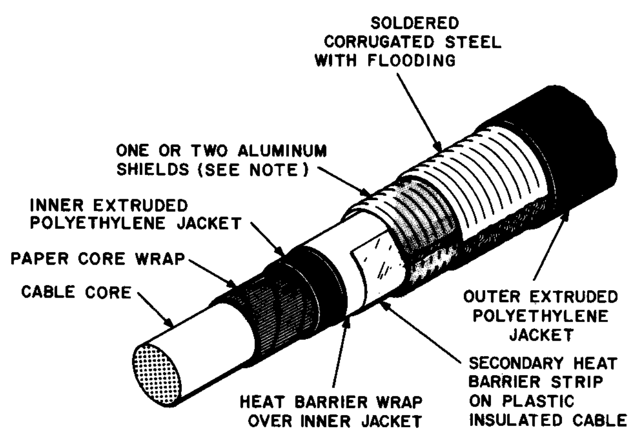
(c) One or two shields of 8-mil corrugated aluminum, depending on the core diameter (Fig. 15). ***Before 1966,*** an aluminum shield was used on cables up to 1.09 inch od; a copper shield was used on cables 1.10 inch od and larger.

(d) Corrugated 6-mil tinned steel with soldered longitudinal seam.

(e) A flooding compound.

(f) An outer extruded jacket of polyethylene.

**3.33** ***Use:*** Tolpeth K sheath is used on toll-type cables. This sheath is intended for buried use and affords protection against lightning exposure. It may be used in conduit or in aerial plant where lightning exposure or other local conditions warrant the additional cost of this type of sheath.




NOTE:

ONE ALUMINUM SHIELD IS USED ON CABLES UP TO 1.09 INCH OD; TWO ALUMINUM SHIELDS ARE USED ON CABLES 1.10 INCH OD AND LARGER

**Fig. 15—Tolpeth K Sheath**

## ♦CROSSPLY SHEATH

**3.34** ***Description:*** Crossply sheath (Fig. 16) is applied over a longitudinal plastic thermal tape. The sheath consists of the following:

(a) An innermost jacket which is a natural-colored high-density polyethylene extruded over the tape-wrapped ribbons.

(b) A spiral application of polyester tape.

(c) Fourteen stainless steel wires (0.017 inch od) applied with a right-hand lay over the polyester tape. (The wires are equally spaced around the circumference.)

(d) An extruded intermediate jacket of high-density polyethylene (natural or black) over the steel wires.

(e) Another layer similar to (b).

(f) Another layer similar to (c), except with a left-hand lay.

(g) An extruded outer jacket of high-density black polyethylene over the steel wires. The sheath has a nominal od of 0.48 inch, regardless of the number of ribbons.

**3.35** ***Use:*** Crossply sheath is used only on LGA1FA-type lightguide cables for use in underground, aerial, and buried plant.♦

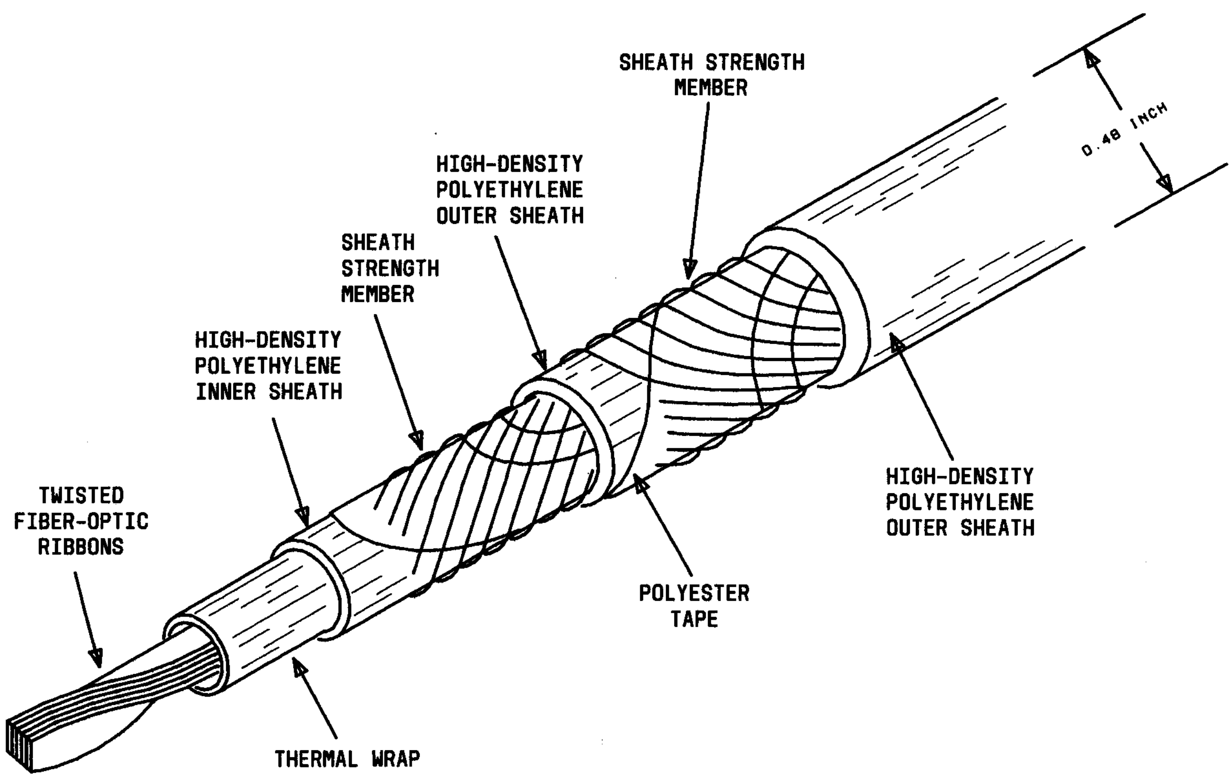



**Fig. 16—♦Crossply Sheath♦**

## 4. ENVIRONMENTAL CONSIDERATIONS

**4.01** Polyethylene resists direct attack by most organic and inorganic materials likely to be encountered in aerial, underground, and buried environments. However, exposure to certain chemical compounds may change the physical characteristics of the polyethylene. The environmental conditions that are of interest from the standpoint of selection, installation, and maintenance of plastic jacketed cables are described briefly in the following paragraphs.

### LOW TEMPERATURE CONDITIONS

**4.02** Polyethylene jacket becomes progressively stiffer as its temperature is reduced and, at very low temperatures, becomes brittle. However, no permanent change in physical characteristics results from cooling, and the sheath returns to normal as the temperature rises.

**4.03** To avoid cracking the plastic jackets, the cables should not be installed at temperatures below 15°F. (See Section 628-200-208.)

**4.04** ***In an emergency,*** the following procedures will warm the polyethylene jacket:

(a) Store the cable at or above 65°F for at least 16 hours.

(b) Place a canvas wrap, or any other type of thermal insulation, over the cable when it is transported from the storage area to the installation site.

***Caution: Avoid prolonged exposure to low temperatures during transit.***

(c) Use manhole heater-blowers to warm the cable while installation preparations are being made. Continue to heat the cable until installation begins.

(d) Repeat (c) if the cable pull is stopped before completion.

**4.05** Once a plastic-sheathed cable has been racked in a manhole, cold temperature has little effect on the sheath.

### HEAT AND STEAM

**4.06** While polyethylene is less heat resistant than lead, its other characteristics make it superior to lead for most uses. No polyethylene-jacketed cables except steampeth should be used where they may be continuously subjected to temperatures above 170°F. This will preclude installation near steam mains or in boiler rooms. Lead-covered or steampeth cable should be used in such an environment. Where the temperature may be in excess of 230°F, use lead sheath cable only.

**4.07** Table C may be used as an aid for cable selection in areas where the steam problem exists. The key input is identifying the high temperature areas. (This can be done by using a map of the steam distribution system or direct measurement).

*Note:* The use of pulp insulation may require that cable temperature be limited to a value less than that permitted by the capability of the sheath. This occurs because moisture, previously absorbed by the pulp, can be released at relatively warm temperatures, transferred to the surrounding air, conveyed along the cable due to air flow, and deposited as condensate in a relatively cool section, resulting in service failures due to low insulation resistance. A typical case in which the problem can arise is that of an underground cable which may be locally due to the proximity of steam or hot water pipes and be relatively cool in another section where the temperature is controlled by prevailing ground or atmospheric conditions. Wintertime temperature extremes can be particularly severe. The temperature drop necessary to cause condensation depends on the temperature and humidity reached by the warm air in the cable and is quite variable; however, if entering air is thoroughly dried and the temperature drop along the cable does not exceed 70°F, condensation should not occur. Individual circumstances may permit larger temperature drops, but the 70°F maximum difference is normally recommended. To determine maximum temperature exposure for pulp-insulated cable:

(1) Establish the minimum temperature that can occur anywhere along the continuous cable run.

(2) Add the permissible rise, eg 70°F, to the temperature determined in (1). The sum is a "reference temperature" for use in (3).

(3) Compare the "reference temperature" determined in (2) with the maximum permissible sheath service temperature, Table C, and use the lower of the two values.

### TABLE C

### SHEATH SELECTION IN ACCORDANCE WITH TEMPERATURE

| TYPE OF SHEATH | TYPE OF INSULATION | MAXIMUM TEMPERATURE DEGREE F | REMARKS |
|---|---|---|---|
| Stalpeth | Pulp | 170 | Note 1 |
| Stalpeth and Bonded Stalpeth | PIC | 170 | — |
| Steampeth | Pulp | 230 | Note 1 |
| Steampeth | PIC | 230 | Specially stabilized polypropylene insulation |
| Lead or Polyjacketed Lead | Pulp | Above 230 | Note 1 |

*Note 1:* Avoid local cold spots along cable run where moisture may condense and cause insulation faults.

## STRESS CRACKING AGENTS

**4.08** Sheath grade polyethylene is inherently flexible at temperatures above 40°F. However, where large stresses occur (as in sharp bends in manholes), polyethylene develops a sensitivity to the environment. Certain chemical agents can cause cracking at stress levels that the material might otherwise resist indefinitely. This behavior was particularly noticeable in the early production of stalpeth sheath which was made using low molecular weight polyethylene then available. The tendency of stalpeth sheath to develop stress cracks decreased since 1949 and further decreased in 1951 following the introduction of higher molecular weight polyethylenes. New sources of the plastic, more reliable methods of evaluating crack resistance of raw material and finished jacket, and better extrusion techniques have also contributed to the general improvement in the quality of polyethylene jackets.

**4.09** ***Stress cracking agents*** are found among organic and inorganic chemical compounds; but most important, from a field standpoint, are surface-active organic materials. These include soaps, synthetic detergents, vegetable and animal oils, mineral oils, and agricultural sprays that include wetting agents. Stress cracking of polyethylene apparently occurs as a result of surface effects since very little of the cracking agent is absorbed by the polyethylene.

**4.10** These generalizations on stress cracking are based largely on failure rates observed for low molecular weight polyethylenes. Tests to determine cracking tendency have been standardized and are applied on a continuing basis to evaluate the raw materials and finished cable sheath at all Western Electric Company, Inc. plants. The polyethylenes now used in sheaths have relatively high resistance to stress cracking under ordinary field conditions. Nevertheless, it is advisable insofar as practical to avoid exposure of the sheath to potential cracking agents.

## PETROLEUM PRODUCTS

**4.11** Low volatile petroleum fuels such as kerosene and furnace fuels are not active stress-cracking agents, but do produce swelling of jackets. Gasoline and other high volatile petroleum products are more active cracking agents; but, because these liquids evaporate readily, they generally do not remain in contact with the sheath long enough to induce cracking. All liquid petroleum products soften polyethylene and, under pressure, the jacket may balloon and burst.

**4.12** Gasoline, fuel oils, and lubricating oils occasionally find their way into conduit from leaky service station tanks, etc. The presence of any of these materials in ducts and manholes creates an explosion hazard that must be corrected as soon as practical after detection. In the normal course of events, this should act to shorten the exposure time to such material.

**4.13** Lubricating and vegetable oils are absorbed and cause swelling and softening of the polyethylene.

**5.14** ***Creosote:*** Liquid creosote is a mild stress cracking agent on low molecular weight polyethylene. However, the high molecular weight polyethylenes used in cable sheath are not affected. This is borne out by long experience with plastic sheath attached to poles and installed in creosoted wood conduit.

**4.15** ***Inorganic Chemicals:*** Strong bases or alkalies such as potassium hydroxide may induce cracking; the acids are not particularly injurious. Inorganic salts, such as sodium or calcium chloride used for snow and ice removal, are relatively harmless to polyethylene.

## ASPHALTIC MATERIALS

**4.16** ***Asphaltic Materials:*** Ordinary asphalts are not injurious to polyethylene sheath. Some asphalts used for road repairs contain caustic potash or soap-type emulsifiers that in themselves might be injurious to the sheath, but tests of such materials that have been found in ducts indicated that no harmful results are likely. However, every effort should be made to avoid the entrance of this material into ducts and manholes since it may create serious obstructions when it hardens.

## ELECTROLYSIS

**4.17** Polyethylene containing 2.60 percent carbon black has relatively high resistivity and is not subject to electrolytic action. Polyethylene sheath is therefore an excellent replacement for lead sheath in areas where lead corrosion has been experienced or is likely to occur. Poly-jacketing over lead is now the standard corrosion protection for major intercity coaxial toll cables. Tolpeth J and K sheaths are available for other toll purposes.

### VAPOR AND GAS DIFFUSION

**4.18** When polyethylene is exposed to gasoline or other volatile material for several days, the vapor diffuses through the polyethylene at a rate depending on jacket thickness, nature and vapor pressure of the liquid or gas, and the air temperature. The diffusion continues until the individual vapor pressures inside the sheath approximates the vapor pressures of the individual liquids or gases outside the sheath. In cables having flooding compound directly under the outer poly-jacket, such as stalpeth and tolpeth J, gasoline vapors are absorbed by the compound and cause it to liquefy. The vapors accumulate in the core and may be driven along a pressurized cable by the flow of air or nitrogen gas.

**4.19** The water vapor diffusion rate through polyethylene increases greater in cable that is exposed to a heavy concentration of gasoline vapor or liquid. This may result in moisture trouble in pulp-insulated cable.

**4.20** ♦The primary reason for pressurizing the inner jacket is to signal (by loss of pressure) when inner jacket damage occurs so it can be repaired and prevent water entry.♦

**4.21** The purpose of the adhered inner aluminum tape in ARPAP sheath is to reduce the moisture permeability of the inner jacket. The aluminum tape itself is impervious to moisture and hence the only path for penetration is through the inner jacket immediately over the aluminum seal and then through the adhesive at the overlap. Compared with a nonadhered inner jacket, improvements by factors of a hundred or more have been measured.

### PRESSURE

**4.22** ***Air or nitrogen gas*** in a pressurized polyethylene-jacketed (alpeth and PAP) cable tends to diffuse outward; the rate depends on the relative internal and external partial pressure of the specified gas. This action is independent of the inward diffusion of water vapor, gasoline, or other vapors and gases from the surrounding environment. Pressurization keeps out water and purges inward diffusing vapors if there is provision for venting.

**4.23** All polyethylene jackets are firm and tough and have adequate strength to withstand internal gas pressure of 8 to 10 psi at temperatures as high as 140°F. Except for steampeth, the strength falls off progressively beyond this temperature and the material flows at 220 to 230°F. The steampeth polyethylene jacket can withstand internal pressure of 8 to 10 psi at temperatures as high as 230°F.

**4.24** Information on maintaining cable under continuous pressure after installation is covered in the 637 Division of Bell System Practices.

### RODENTS

**4.25** Rodent damage of telephone cable is confined primarily to aerial and buried plant. Rodent damage in underground is not a major problem.

**4.26** ***Aerial Plant:*** Cable with reinforced self-supporting or PASP sheath can be used in areas where squirrel damage has been experienced. Although the outer polyethylene is not immune to squirrel attack, the underlying steel should prevent immediate penetration. The steel may corrode in time, but the core will remain protected by the inner jacket of polyethylene. Cable guards can be used to protect existing alpeth sheath in such areas.

**4.27** In areas where low frequency interference or probability of mechanical damage requires the use of aerial tape armor, the armor will also provide the necessary rodent protection.

**4.28** ***Buried Plant:*** ASP or PASP sheath provides rodent protection under moderate conditions. Where rodent conditions are severe, the use of supplementary UM- or MP-type protection is warranted.

**4.29** If buried tape armor protection is required due to low frequency interference, rocky soil, or probability of mechanical damage, the armor will also provide the necessary rodent protection.

### BIRDS AND INSECTS

**4.30** Cable with reinforced self-supporting, PASP, or tolpeth K sheath should be used in areas that are known to be subject to damage by birds, beetles, or other insects.

**FIRE HAZARDS**

**4.31** Polyethylene is more susceptible to heat damage from fire than is lead sheath because of the difference in melting points.

**4.32** Cables should not be placed in aerial locations where fires and heat damage to the cable are likely to occur. However, if cables must be placed in such an area, the preferred aerial sheaths are lead or PASP.

**4.33** Tests show that once ignited, the outer polyethylene jacket will continue to burn and can release flaming drops. A single aerial cable burns slowly, and an encircling band of metal such as a lashed cable support stops the combustion.

**BUILDINGS**

**4.34** Because of fire hazards, the use of polyethylene sheathed cable in buildings should be kept to a minimum. When they are installed in riser shafts, the 1978 National Electrical Code requires that they be enclosed in noncombustible conduit or the riser shaft must be fireproof and fire stopped at each floor. When polyethylene-sheathed cables are installed in plenums, they must be enclosed in conduit. Do not use polyethylene-jacketed cables in central offices. Where polyethylene cables are used as entrance cables to a CO, they should be terminated in fire-resistant cables within the shortest distance possible. Alvyn sheath is preferred in buildings.

**4.35** Flame-resistant PVC is used for the outer jacket of cable sheaths intended for installation in open riser shafts in buildings and at all locations in central office equipment rooms. PVC is used in the following applications where flame resistance is desirable:

(a) Cables for open riser shafts—ABAM- or ABMM-type terminating cables or CDMM pulp-insulated cable.

(b) Terminating cables for CO protector frames and for tie cables between CO equipment frames

(c) Stubs for 300-type connectors used in central offices.

**4.36** The PVC compound used for cable jacket consists primarily of polyvinyl chloride resin, plasticizers, flame retardant, stabilizers, and colorants.

**4.37** PVC under ordinary conditions does not support combustion; it burns when held in a flame, but extinguishes when the flame is removed.

**4.38** PVC hardens at low temperatures and softens at high temperatures to a greater degree than polyethylene. PVC sheath withstands normal transportation and handling during installation at temperatures down to 0°F.

***Caution: Do not pressurize PVC sheath.***

**4.39** ♦PVC sheath expands excessively when pressurized. Expansion begins when pressure is applied and depends on the ambient temperature and internal pressure. At 75°F sheath diameter may increase as little as 1 percent, but within 4 days a 10 percent increase can occur at 100°F and a 15 percent increase at 130°F. At 130°F sheath diameters can increase as much as 30 percent in 18 months.♦

**LIGHTNING**

**4.40** The effect of a lightning stroke on or near a cable depends on a number of factors. The more significant of these are:

(a) Magnitude of the stroke

(b) Distance of stroke from cable (buried and underground cable)

(c) Earth resistivity

(d) Resistance of the metallic shield

(e) Core-to-sheath and conductor-to-conductor dielectric strengths

(f) Proximity of cable to other conducting structures (tree roots, etc).

**4.41** To avoid lightning damage when cables are installed in ducts or buried in severe lightning areas, metallic shields of adjacent lengths must be electrically bonded at each end as they are placed. Provisions for obtaining bond wires are covered in the 626 Division of Bell System Practices.

**4.42** The principles and remedial measures involved in protecting the cable and telephone equipment against extraneous power circuits and lightning or other voltages are discussed in the 876 Division of Bell System Practices covering cable placing.

**4.43** In selecting a cable sheath for a lightning-prone environment, several factors should be considered:

(a) PIC cores have much higher dielectric strength than pulp cores.

(b) Buried plant is more critical because, in addition to the immediate lightning effect, water may enter through lightning-caused holes in the jacket.

(c) Duct cable is generally less susceptible to damage because other structures in the vicinity will shield the cable.

(d) ➧For cables with an inner jacket, the dc core-to-sheath dielectric strength is greater than 20kV. For cables without an inner jacket, the dc core-to-sheath dielectric strength is greater than 1.5kV for pulp-insulated cable; 10kV for 19- or 22-gauge PIC cables or 5kV for 24- or 26-gauge PIC cable. Figure 17 may be used as a guide selection for the appropriate sheath.➧ Where several sheaths are offered, consideration of temperature exposure, mechanical protection, service requirements, etc, will determine the best choice.

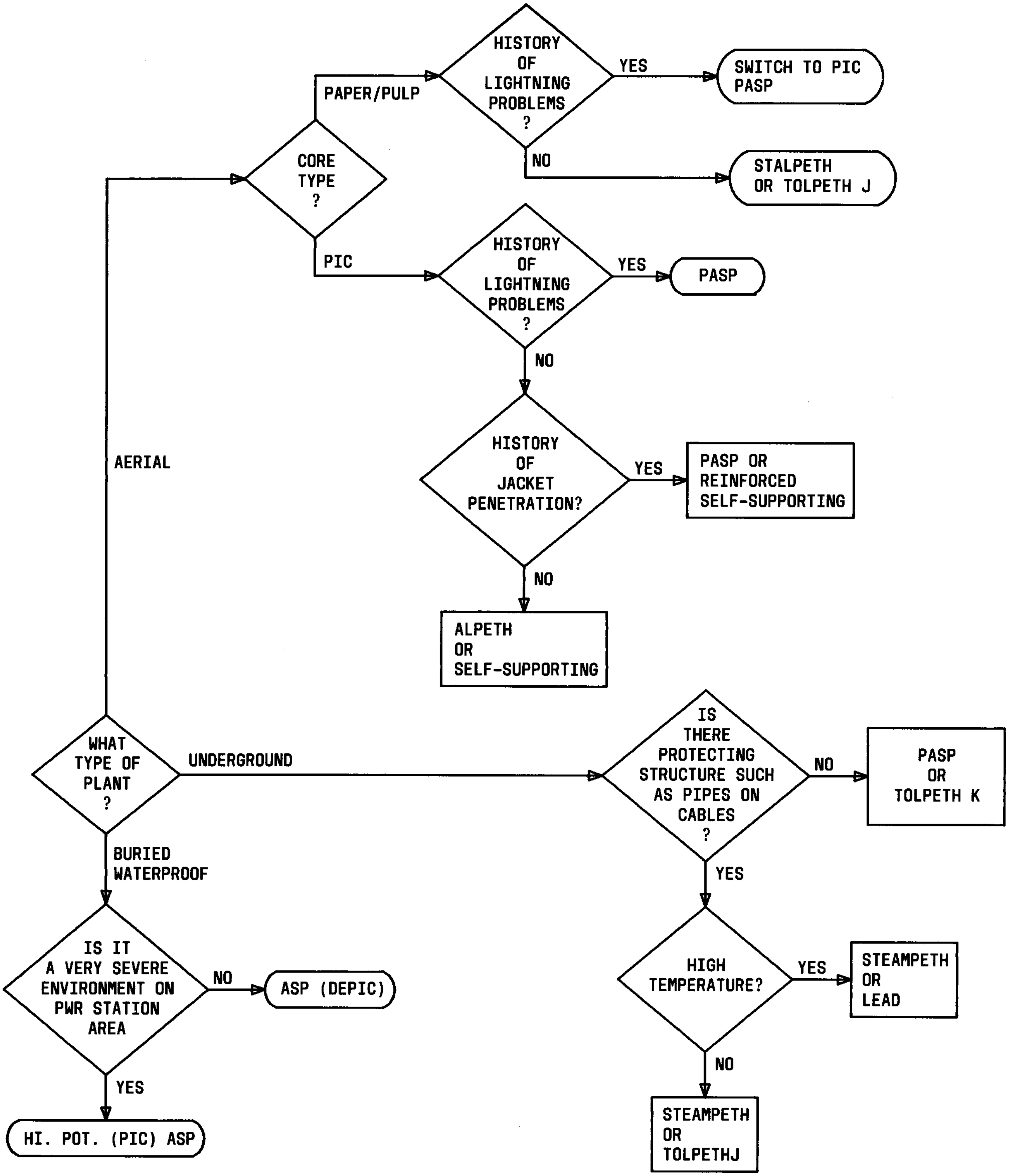



Fig. 17—Sheath Selection Chart for Lightning Considerations

**4.44** Field experience indicates that damage from power contacts to plastic sheaths is much less than that which occurs with lead sheaths.

**4.45** Sheaths with inner jackets provide the best protection because, in addition to their high dielectric strength, they provide a backup moisture barrier.

**4.46** If PIC cores are selected for dielectric strength, PIC-pulp junctions should be protected to avoid extensive damage to the pulp core.

**4.47** When ARPAP is used, the inner aluminum should not be grounded or bonded.

## 5. FACTORY MARKINGS AND AIR PRESSURE

### SHEATH MARKINGS

**5.01** ***Length and manufacturer identification*** markings have been furnished since 1968, and ***date of sheathing*** and ***cable code markings*** since 1972. These markings are printed on the outer jacket of coded PIC cables. CA-1727, lightguide, and coded pulp cable have all markings except cable code. Tolpeth J and K and coaxial cable sheaths (such as lead PJ, lepeth, and lepeth PJ) are not marked in this manner.

**5.03** The ***length marking*** (Fig. 18) on the outer jackets consists of a five-digit number (eg, 24622) and the word ***feet.*** ***("Feet"*** is omitted on cable manufactured by outside suppliers for Western Electric.) This marking is bracketed by solid-inked areas which help to make the marking more conspicuous to the user. Each marking is placed at two-foot intervals along the cable; eg, 24622 feet, 24624 feet, etc. The actual length is never less than the length indicated by the marking or never more than 1 percent greater than the length indicated by the marking.

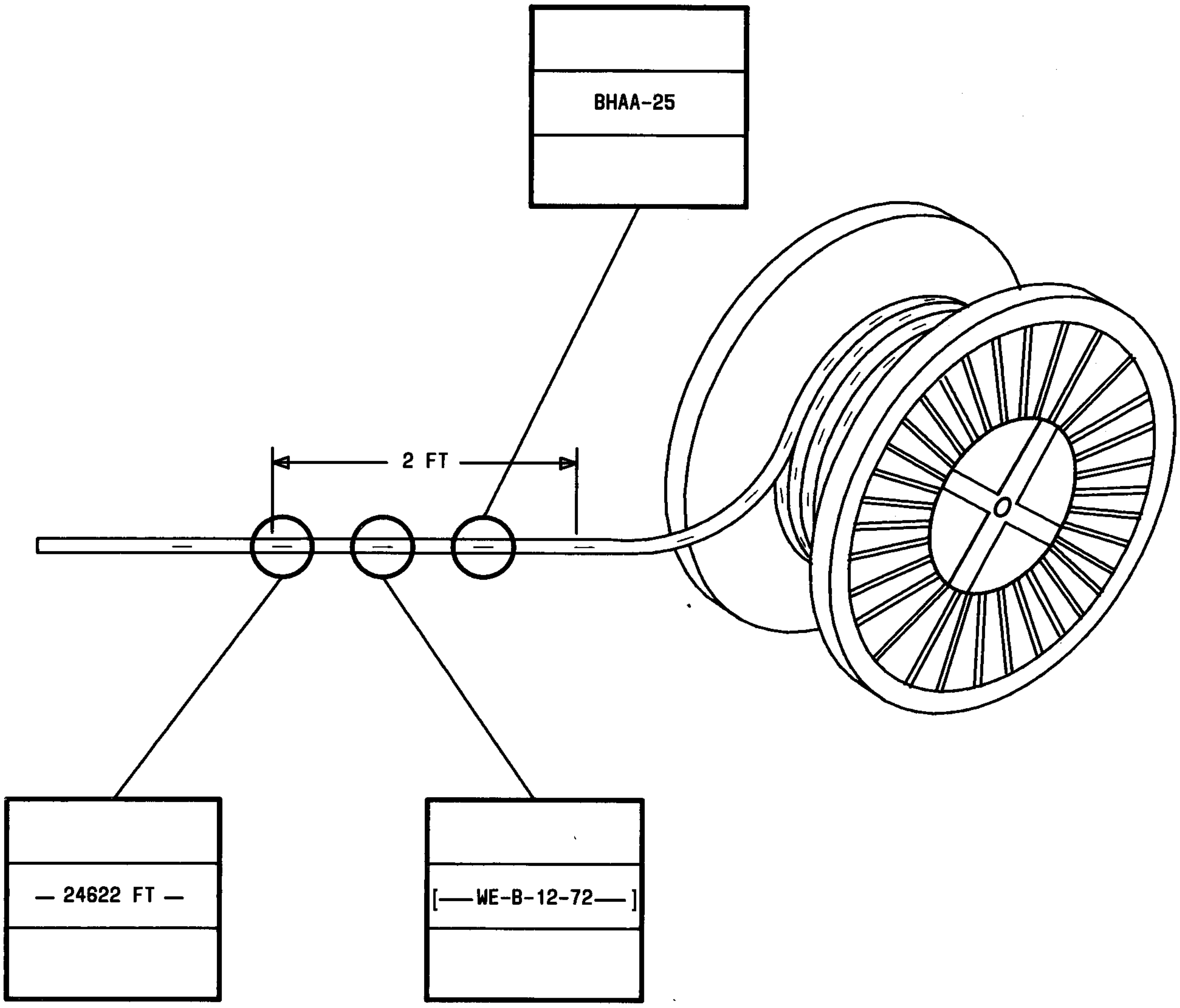



Fig. 18—Manufacturer Footage Marking

**5.04** The ***manuafacturer identification*** and ***date of sheathing marking*** (Fig. 18) are printed on the outer polyethylene jackets at two-foot intervals along the cable. Each marking consists of the name or trademark of the manufacturer hyphenated to the month number and the last two digits of the year of the date of sheathing. For cables of Western Electric manufacture, the marking consists of the letters (WE) hyphenated to the initial letter of the manufacturing location (eg, WE-B-12-71). The initial letters of the manufacturing locations are as follows:

A = Atlanta

B = Baltimore

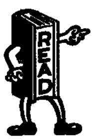
O = Omaha

P = Phoenix

K = Kearny (no longer used)

**5.05** The code marking on the outer polyethylene jacket consists of four letters hyphenated to the pair size (eg, BHAA-25). Armored cable with an outer polyethylene jacket includes the armoring code (eg, BHAA-25-BT). This marking is repeated at two-foot intervals along the cable.

**5.06** The markings are applied with white ink during the cable jacketing operation. If these markings are inaccurate or illegible, a second series of markings is applied with yellow ink.




***When both white and yellow markings are used on a cable, the yellow markings apply.***

**5.07** The first length marking on the ***inside end*** of the cable is stenciled on the reel head in the form "INSIDE END MARK...." The ***final*** length marking is on the ***outside end*** of the cable. The cable length is the difference between the two lengths.

***Example:***

| | |
|---|---|
| Inside End Marking | 28874 (ft) or 24624 |
| Outside End Marking | 24624 (ft) or 28874 |
| Cable Length | 4250 (ft) or 4250 |

***Note:*** The marking is never reset to zero along the cable length.

**5.08** On self-supporting PIC cables, the markings are applied on the polyethylene jacket—not the support strand jacket.

**FACTORY AIR PRESSURE**

**5.09** ***Exchange Type Cable:***

- ***PAP or PASP Sheath***—All PAP and PASP cable sheath are pressurized at the factory to ensure that the inner jacket is airtight. All cable lengths are shipped under pressure to their destinations.
- ***Stalpeth Sheath***—All cable lengths are shipped under pressure.
- ***Alpeth, Self-supporting, and Reinforced Self-supporting Sheaths***—Not available under pressure.
- ***ASP Sheath***—This sheath is used only on waterproof cable cores which have filling compound in the core. These cables are not pressurized.
- ***Steampeth Sheath***—All cable lengths are shipped under pressure.

**5.10** ***Toll Type Cable***—All types of air core toll cables are shipped under pressure.

**5.11** ***Alvyn Sheath Cable***—Not available under pressure.

**5.12** ***All cable shipped as pressurized cable*** from Western Electric factories or service centers is expected to arrive at its destination under pressure. ***Cables received*** from Western Electric Company, Inc. ***with no detectable pressure*** should be repressurized in the field to see if they will hold pressure. If the cable will not hold pressure, contact Western Electric Company, Inc to discuss appropriate action which may include returning the cable.

**5.13** ***Check cable pressure*** on arrival and during various stages of installation. A drop in pressure after the cable has been received may be due to either damage or diffusion. A uniform drop in any of the reels in a shipment indicates pressure loss by diffusion.

**5.14** The average temperature of the cable during transit and storage, the end capping procedure, and the diameter over the sheath affect the diffusion rate. It is therefore impractical to determine accurately the pressure loss due to diffusion or to end cap leaks. As a general guide, if the air pressure on a reel in the field is less than 5 psi (corrected to 60°F), see Section 637-400-504. The cable should be repressurized and tested before placing.

## 6. SHEATH SELECTION

**6.01** As a general guide, the selection of standard sheaths may be made in accordance with Table D. Use Table D in conjunction with the field of use as covered in Part 3.

## TABLE D

## SELECTION GUIDE FOR PLASTIC SHEATHS

| TYPE OF SHEATH | FIELD OF USE | | | | | | |
|---|---|---|---|---|---|---|---|
| | AERIAL | UNDER-GROUND | BURIED | INDOOR (FLAME-RESIS-TANT SHEATH) | HIGH TEMPER-ATURE AREAS | GNAWING, PECKING, OR ABRASIVE DAMAGE | GOPHER INFESTED AREAS |
| Alvyn | | | | X | | | |
| Alpeth | X | Note 1 | | | | | |
| Self-Supporting | X | | | | | | |
| Reinforced Self-Supporting | X | | | | | X | |
| Stalpeth | X | X | | | | | |
| Bonded Stalpeth | X | X | | | | | |
| Tolpeth J | X | X | | | | | |
| Steampeth | | X | | | X | | |
| PAP | Note 2 | Note 1 | | | | | |
| ARPAP (Note 4) | | Note 1 | X | | | | Note 3 |
| PASP | Note 2 | Note 1 | X | | | X | X |
| Tolpeth K | Note 2 | Note 1 | X | | | | X |
| ASP | | Note 1 | X | | | | Note 3 |
| Bonded ASP | | Note 1 | X | | | | Note 3 |
| Crossply (Note 5) | X | X | X | | | | |

*Note 1:* In relatively short lengths.

*Note 2:* Where lightning exposure or other local conditions warrant.

*Note 3:* Suitable protective covering required.

*Note 4:* Used only on DEPIC LOCAP T2 cables.

*Note 5:* Lightguide cables only.