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Standard
Material Requirements

Material Requirements for Polyolefin Cold-Applied Tapes for Underground or Submerged Pipeline Coatings

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Foreword

This standard was originally issued by NACE International Group Committee T-10 on Underground Corrosion Control as "Material Requirements in Prefabricated Plastic Films for Pipeline Coatings." The original standard and the 1989 revision were prepared by Task Group T-10D-5 of Unit Committee T-10D on Protective Coating Systems. The standard was reaffirmed by Unit Committee T-10D in 1995. While the original standard addressed extruded polyethylene coatings and wax-type coatings as well as cold tapes, documents such as NACE Standards RP0185, "Extruded Polyolefin Resin Coating Systems for Underground or Submerged Pipe," and RP0375, "Wax Coating Systems for Underground Piping Systems" are now available for these two types of coatings. Therefore, the current standard covers only polyolefin cold-applied tapes.

The purpose of the standard is to establish material requirements for three types of cold-applied polyolefin tapes and their multilayered tape systems used for pipeline coatings. This standard provides a basis for identification of these pipeline coatings by specifiers and users.

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Section 1: General

1.1 Material requirements are given for three types of polyolefin-based, cold-applied tapes used in coating pipelines. Materials covered include pressure-sensitive and butyl-laminate tapes. These products are divided into two categories: (a) inner layer (Types 1 and 2), and (b) outer layer/mechanical protection (Type 3). Inner-layer tapes (Types 1 and 2) may be used with or without outer-layer tapes (Type 3) as described in this standard.

Polyolefin tapes may be applied at fixed coating plants or at the pipeline right-of-way. Tapes are applied by hand or machine, according to the purchaser's and manufacturer's recommendations. A general description of each of these materials is given, followed by tables containing their physical properties and test methods.

1.2 This standard is based on 30 years of experience in service and on the properties of currently used polyethylene-based, cold-applied tapes. It is acknowledged that tapes based on polyolefin resins other than polyethylene may provide similar service performance and properties and may meet the material requirements for pipeline coatings. The properties tabulated do not in themselves constitute the only criteria for the selection of materials for use as pipeline coatings. They do, however, state the material characteristics necessary for identification of those polyethylene tapes with proven performance records. The number of properties chosen to be listed in each of the tables for nominal values of materials in common use is not intended to be limiting.

1.3 Cold-applied polyolefin tapes for pipeline coatings should have inherent pipeline coating properties as stated in NACE Standard RP0169 (latest revision).[1]

Section 2: Types of Polyolefin Tapes

2.1 Inner-Layer Tapes: Type 1

2.1.1 Pressure-Sensitive Tapes: Polyolefin tapes in this category are composed of films such as polyethylene that carry an elastomer-based adhesive characterized as pressure sensitive. Table 1 lists the typical values for the properties of Type 1 tapes. Pressure-sensitive tapes are used for corrosion protection. These tapes are classified as inner-layer tapes of the multiple-layered tape coating system. The tapes should be used in conjunction with the manufacturer's recommended primers. The pressure-sensitive nature of the adhesive system allows some tapes to be used without a primer under certain conditions. The manufacturer of the tape should be consulted for this application.

2.2 Inner-Layer Tapes: Type 2

2.2.1 Laminated Tapes: Polyolefin tapes in this category are laminates of films such as polyethylene, and elastomer-based adhesives such as butyl rubber. These tapes are used in conjunction with the manufacturer's recommended primers. These laminated tapes are used for the corrosion protection of metallic pipe, and they are classified as the inner-layer tapes of the multiple-layered tape coating systems. Table 2 lists the typical values of the properties of Type 2 tapes.

2.3 Outer-Layer Tapes: Type 3

2.3.1 Type 3 is a tape whose primary function is to provide mechanical protection. This type of tape consists of a layer of polyethylene, laminated with elastomer/resin-based adhesives, which adheres to the inner-layer tapes and to itself at the overlaps. Type 3 outer-layer tapes are applied as a mechanical protective layer on top of the inner-layer tapes. Table 3 lists the typical values of the properties of Type 3 tapes.

[1] NACE Standard RP0169 (latest revision), "Control of External Corrosion on Underground or Submerged Metallic Piping Systems" (Houston, TX: NACE International).

Section 3: Multiple-Layer Tape Systems

3.1 Typical values of the properties of a multiple-layer polyethylene tape system for coating underground and submerged pipelines are shown in Table 4. The rationale of the multiple-layer tape system is as follows:

3.1.1 The corrosion protection inner-layer polyethylene tape is completely covered during the aboveground exposure period. The outer-layer polyethylene tape completely covers and protects the corrosion protective layer from ultraviolet (UV) rays, moisture, and mechanical damage prior to construction and after the pipe is installed underground. (For plant coating, the outer-layer tapes should be formulated so they resist UV damage while the lengths of coated pipe are stored aboveground prior to installation underground.)

3.1.2 The primary function of the inner-layer tape is corrosion protection, while the primary function of the outer-layer tape is mechanical protection. The corrosion protection and mechanical protection properties inherent in each layer add to the total functional characteristics of the multiple-layer tape systems.

3.1.3 Although a two-layered polyethylene tape system is sufficient for normal conditions, consideration should be given to the use of more than two layers where operating and design conditions are more demanding than normal conditions. More than two layers may consist of a combination of two or more layers of the inner-layer and/or outer-layer tapes.

TABLE 1
Typical Property Values of Type 1
Pressure-Sensitive Tapes (Inner Layer)

Property	Nominal Range	Test Method[A]
Thickness (total)	250 to 635 mm (10 to 25 mils)	ASTM[B] D 1000
Tensile Strength	26 to 79 N/10-mm width (15 to 45 lb/in. width)	ASTM D 1000
Elongation at Break	100 to 400%	ASTM D 1000
Adhesion to Stainless Steel	6.6 to 9.9 N/10-mm width (60 to 90 oz/in. width)	ASTM D 1000
Adhesion to Primed Steel	6.6 to 10.9 N/10-mm width (60 to 100 oz/in. width)	ASTM D 1000
Dielectric Strength Breakdown	18,000 to 22,000 V/mm (450 to 550 V/mil)	ASTM D 1000
Insulation Resistance	450,000 to 550,000 Megohms	ASTM D 1000; ASTM D 257
Water Vapor Transmission Rate	0.025 to 0.035 g/24 h/100 cm^2 (0.15 to 0.25 g/24 h/100 $in.^2$)	ASTM E 96

[A] See Appendix A for titles of test methods.
[B] American Society for Testing and Materials (ASTM), 1916 Race St., Philadelphia, PA 19103.

TABLE 2
Typical Property Values of Type 2
Laminated Tapes (Inner Layer)

Property	Nominal Range	Test Method[A]
Thickness (total)	250 to 1,650 mm (10 to 65 mils)	ASTM D 1000
Tensile Strength	18 to 88 N/10-mm width (10 to 50 lb/in. width)	ASTM D 1000
Elongation at Break	60 to 400%	ASTM D 1000
Adhesion to Primed Steel	16 to 27 N/10-mm width (150 to 250 oz/in. width)	ASTM D 1000
Dielectric Strength	18,000 to 22,000 V/mm (450 to 550 V/mil)	ASTM D 1000
Insulation Resistance	400,000 to 600,000 Megohms	ASTM D 257
Water Vapor Transmission Rate	0.025 to 0.035 g/24 h/100 cm^2 (0.15 to 0.25 g/24 h/100 $in.^2$)	ASTM E 96

[A] See Appendix A for titles of test methods.

TABLE 3
Typical Property Values of Type 3
Mechanical Protection (Outer Layer)

Property	Nominal Range	Test Method[A]
Thickness (total)	250 to 1,000 mm (10 to 40 mils)	ASTM D 1000
Tensile Strength	35 to 114 N/10-mm width (20 to 65 lb/in. width)	ASTM D 1000
Elongation at Break	100 to 500%	ASTM D 1000
Dielectric Strength	18,000 to 22,000 V/mm (450 to 550 V/mil)	ASTM D 1000
Adhesion to Backing and Inner Layer	4.4 to 8.9 N/10-mm width (40 to 80 oz/in. width)	ASTM D 1000

[A] See Appendix A for titles of test methods.

TABLE 4
Typical Property Values of Multiple-Layer Systems
(Inner Layer with Outer Layer)[A]

Property	Nominal Value (Two Layers)[B]	Test Method[C]
Thickness (total)	1,250 mm (50 mils)	ASTM D 1000
Dielectric Strength	32,000 V/mm (800 V/mil)	ASTM D 1000
Cathodic Disbondment (30 days)	50-mm diameter (2-in. diameter)	ASTM G 8
Impact Resistance		
Falling Weight	3.4 J (30 in.-lb)	ASTM G 14
Falling Limestone	No holidays after 30 drops.	ASTM G 13
Penetration Resistance	20% at 22°C (72°F) 30% at 60°C (140°F)	ASTM G 17
Operating Temperature Range	-30°C to 90°C (-22°F to 194°F)	Not applicable

[A] May be applied in one or more layers each of inner and outer layer tapes. (Refer to AWWA C214 (latest revision), "Tape Coating Systems for the Exterior of Steel Water Pipelines" (Denver, CO: American Water Works Association).
[B] One layer each of inner- and outer-layer tapes: 500-µm (20-mil) inner layer; 750-µm (30-mil) outer layer. Refer to AWWA C214.
[C] See Appendix A for titles of test methods.

Appendix A
ASTM Standards Listed in Tables 1 through 4

(Note: The latest revisions of these standards should be used.)

ASTM D 257, "Standard Test Methods for DC Resistance or Conductance of Insulating Materials"

ASTM D 1000, "Standard Test Method for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications"

ASTM E 96, "Standards Test Methods for Water Vapor Transmission of Materials"

ASTM G 8, "Standard Test Methods for Cathodic Disbonding of Pipeline Coatings"

ASTM G 13, "Standard Test Method for Impact Resistance of Pipeline Coatings (Limestone Drop Test)"

ASTM G 14, "Standard Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test)"

ASTM G 17, "Standard Test Method for Penetration Resistance of Pipeline Coatings (Blunt Rod)"

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