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NEMA STANDARDS PUBLICATION NO. TC 5

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Corrugated Polyolefin Coilable Plastic Utilities Duct

NEMA

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION ■ 2101 L STREET, N.W., WASHINGTON, D.C. 20037

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CORRUGATED POLYOLEFIN COILABLE PLASTIC UTILITIES DUCT

Published by:

National Electrical Manufacturers Association
2101 L Street, N.W.
Washington, DC 20037

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Foreword

The purpose of these standards for corrugated polyolefin coilable plastic utilities duct for underground use is:

1. To define dimensions and other significant requirements.
2. To inform producers, distributors, engineers, code officials, and users about some of the properties of these products and to assist in selecting and obtaining the proper product for a particular need.

User needs have been considered throughout the development of these standards. Test methods and performance values have been related as closely as possible to end-use applications.

The Plastic Conduit, Duct, and Accessories Section of NEMA, through its members, has worked (and continues to work) closely with such organizations as the American Society for Testing and Materials, the Plastic Pipe Institute, Underwriters Laboratories, Inc., appropriate government agencies, and others in the periodic review and revision of these standards for any changes necessary to keep them up-to-date with advancing technology. Proposed or recommended revisions should be submitted to:

Vice President, Engineering
National Electrical Manufacturers Association
2101 L Street, N.W.
Washington, DC 20037

Publication No. TC 5-1990 revises and supersedes the NEMA Standards Publication for *Corrugated Polyolefin Coilable Plastic Utilities Duct*, Publication No. TC 5-1983. Prior to publication, the NEMA Standards, Suggested Standards for Future Design, and Authorized Engineering Information that appear in this publication unchanged since their appearance in TC 5-1983 were reaffirmed.

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Scope

These standards cover requirements and methods of tests for materials, dimensions, workmanship, and so forth, of corrugated polyolefin coilable electrical plastic duct intended for the installation of cables or wires either in the factory or in the field.

NOTE – The values stated in U.S. customary units are to be regarded as the standard.

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Section 1
REFERENCED STANDARDS

In this publication, reference is made to the following standards and other publications listed below. Copies are available from the indicated source.

American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103

D 618-61 (R1981)	*Standard Methods of Conditioning Plastics and Electrical Insulating Materials for Testing*
D 883 REV A-89	*Standard Definitions of Terms Relating toPlastics*
D 1238-89	*Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer*
D 1248-84 (R1989)	*Specifications for Polyethylene Plastics Molding and Extrusion Materials*
D 1600 REV A-86	*Standard Abbreviations of Terms Relating to Plastics*
D 1693-70 (R1988)	*Standard Test Method for Environmental Stress-cracking of Ethylene Plastics*
D 2412-87	*Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-plate Loading*
D 2444-84	*Test for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)*
D 4101-82 (R1988)	*Standard Specification for Propylene Plastic Injection and Extrusion Materials*
F 412 REV B-89	*Standard Definitions of Terms Relating to Plastic Piping Systems*

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Section 2
GENERAL

2.1 DEFINITIONS

Corrugated polyolefin coilable plastic utilities duct is a plastic duct which is intended for underground use and which can be manufactured and coiled or reeled in continuous transportable lengths and uncoiled for further processing or installation or both, without adversely affecting its properties or performance.

NEMA Standard 5-20-1974.

2.2 NOMINAL SIZES

The nominal sizes of coilable plastic duct shall be 1¼, 1½, 2, 2½, 3, 3½, 4, and 5 inches.

NEMA Standard 5-20-1974.

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Section 3
MATERIALS, DIMENSIONS, AND WORKMANSHIP

3.1 MATERIALS

The duct shall be manufactured from one of the following polyolefins:

1. High-density polyethylene.
2. Copolymer polypropylene.

The high-density polyethylene shall meet the requirements given in ASTM D 1248, Type III, Class C, and, in addition, shall have a maximum melt index of 0.50 when tested in accordance with ASTM D 1238, Condition E, and an environmental stress crack resistance of zero failures in 24 hours when tested in accordance with ASTM D 1693, Condition B.

The polypropylene shall meet the requirements given in ASTM D4101 and shall contain at least 1 percent carbon black or ultraviolet stabilizers or both. In addition, it shall have an environmental stress crack resistance of zero failures in 1000 hours when tested in accordance with ASTM D 1693, Condition B.

Reworked material may be used provided that the duct produced meets all of the requirements of these standards.

NEMA Standard 5-20-1974.

3.2 DIMENSIONS

Coilable plastic duct shall have the dimensions shown in Table 3-1.

NEMA Standard 3-5-1990.

Table 3-1
DIMENSIONS

Nominal Size, Inches	Minimum Inside Diameter	Minimum Bend Radius*	Minimum Wall Thickness
		in. (mm)	
1 ¼	1.44 (36.6)	7 (178)	0.020 (0.51)
1 ½	1.65 (41.9)	8 (203)	0.020 (0.51)
2	2.00 (50.8)	9 (229)	0.020 (0.51)
2 ½	2.50 (63.5)	10 (254)	0.020 (0.51)
3	2.95 (74.9)	13 (330)	0.020 (0.51)
3 ½	3.45 (87.6)	14 (356)	0.020 (0.51)
4	3.95 (100.3)	16 (406)	0.020 (0.51)
5	4.95 (125.7)	20 (508)	0.020 (0.51)

*Applies to the duct. The type of cable to be used will determine actual minimum bend radius as installed.

3.3 WORKMANSHIP

Coilable plastic duct shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other defects. It shall be as uniform as practicable in color, opacity, density, and other physical properties.

NEMA Standard 5-17-1971.

3.4 FACTORY-MADE JOINTS

One factory-made joint per 500 ft. (152 m) of duct may be made provided the product meets the performance requirements of these standards.

NEMA Standard 3-8-1978.

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Section 4
PERFORMANCE TESTS

4.1 CONDITIONING TEST SPECIMENS

When conditioning is required, the test specimen shall be conditioned in accordance with Procedure A in ASTM D 618 at 73.4±3.6°F (23±2°C) and 50 ± 5 percent relative humidity for not less than 48 hours prior to the test unless otherwise specified.

NEMA Standard 3-8-1978.

4.2 TEST CONDITIONS

Tests shall be conducted at 73.4 ±3.6°F (23±2°C) and 50±5 percent relative humidity unless otherwise specified.

NEMA Standard 3-8-1978.

4.3 DUCT STIFFNESS

Three 6-in. (152 mm) long specimens conditioned in accordance with 4.1 shall be tested using the apparatus described in ASTM D 2412. The specimens shall be compressed at the rate of ½ in. (13 mm) per minute and the load recorded at the vertical deflection equivalent to 5 percent of the original inside diameter of the specimen.

The duct stiffness at 5 percent vertical deflection shall be determined as follows:

$$\text{Duct Stiffness, psi} = \frac{F}{Y}$$

Where:

F = Load pounds per inch (kilograms per 25.4 mm) of length recorded at 5 percent vertical deflection in inches (mm).

Y = Vertical deflection of inside diameter in inches (mm).

The minimum duct stiffness shall be 130 psi (897.3 kPa).

4.4 COMPRESSION AND RECOVERY

Three 6-in. (152-mm) long specimens conditioned in accordance with 4.1 shall be tested using the apparatus described in ASTM D 2412. The specimens shall be compressed at the rate of ½ in. (13 mm) per minute until the distance between the plates has been decreased by 50 percent of the original inside diameter of the duct. When the load is removed, the specimens shall recover to at least 80 percent of their original diameter within 10 minutes.

There shall be no evidence of splitting or cracking of any of the specimens.

NEMA Standard 3-8-1978.

4.5 IMPACT TEST

4.5.1 Room Temperature Test

Ten 6-in. (152-mm) specimens on the surfaces of which there are no cracks, tears, or other imperfections shall be cut from finished lengths of each size of coilable plastic duct to be tested. The specimens, the test apparatus, and the surrounding air shall be in thermal equilibrium with one another at a temperature of 73.4±3.6°F (23±2°C) during the test. The test apparatus and method shall be as described in 4.5.3.

4.5.2 Low Temperature Test

Ten 6-in. (152-mm) specimens on the surface of which there are no cracks, tears, or other imperfections shall be cut from finished lengths of each size of coilable plastic duct to be tested. The specimens shall then be conditioned at a temperature of 32±3.6°F (0±2°C) for 5 hours. The test apparatus shall be at a room temperature of 73.4±3.6°F (23±2°C). The samples shall be removed from the cold chamber and immediately tested for impact in accordance with 4.5.3. The time between removal of the sample from the cold chamber and completion of impact shall not exceed 15 seconds.

4.5.3 Test Method

The specimens shall be tested in accordance with ASTM D 2444, using a 20-lb. (9-kg) tup B and flat plate holder B.

The minimum impact strength shall be in accordance with Table 4-1. The duct does not meet the requirements of this standard if a crack or tear longer than 1/32 in. (0.8 mm) appears on the outer surface of more than three of the ten specimens.

4.6 LOW TEMPERATURE HANDLING TEST

Ten 30-in. (762-mm) specimens shall be conditioned at a temperature of –4±3.6°F (–20±2°C) for 5 hours. The specimens shall be removed from the cold chamber and each one of them shall be dropped from a height of about 5 ft. (1.5 m) onto a concrete floor twice in quick succession. During the first drop, the specimen shall make an angle of approximately 45° with the floor so that one end of it reaches the floor first. During the second drop, the specimen shall fall parallel to the floor.

Right after the drop test, each specimen shall be bent to the appropriate bending radii shown in Table 3-1.

The duct does not meet the requirements of this standard if it shatters or chips, or if a crack or tear longer

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than 1/32 in. (0.8 mm) appears on the outer surface of more than three of the ten specimens.

NEMA Standard 3-8-1978.

4.7 AXIAL PULL TEST ON FACTORY-MADE JOINTS

Two 18-in. (457-mm) lengths of each size of duct shall be joined using the manufacturer's recommended procedure. A static axial load of 60 lb. (27 kg) shall be applied to each joint for 5 minutes.

The joint shall not become separated or damaged.

NEMA Standard 3-8-1978.

Table 4-1
MINIMUM IMPACT STRENGTH

Nominal Size, Inches	Height of the Face of the Weight above the Specimen before the Weight is Released	
	Room-temperature Test, 73.4°F (23°C)	Low-temperature Test, −4°F(−20°C)
	ft. (m)	ft. (m)
1¼	1½ (0.46)	¾ (0.23)
1½	1½ (0.46)	¾ (0.23)
2	2 (0.61)	1 (0.30)
2½	2 (0.61)	1 (0.30)
3	4 (1.22)	2 (0.61)
3½	6 (1.83)	3 (0.91)
4	6 (1.83)	3 (0.91)
5	6 (1.83)	3 (0.91)

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Section 5
INSTALLATION

5.1 INSTALLATION PROCEDURES

For proper installation, refer to procedures recommended by the manufacturer.

Authorized Engineering Information 5-17-1971.

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Section 6
MARKING

6.1 MARKING

Each length of duct shall be clearly and durably marked at least every 10 ft. (3 m) with the material designation (HDPE for high-density polyethylene or PP for polypropylene), nominal size of the duct, and name and/or trademark of the manufacturer.

NEMA Standard 3-8-1978.

NOTE—The marking may be shown on the packaging instead of on the duct. (Note approved as Authorized Engineering Information.)

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Appendix A
INSTALLATION PRACTICES

It is recommended that the products described by these standards be installed in accordance with the manufacturer's recommendation.

Authorized Engineering Information 3-5-1990.

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NEMA STANDARDIZATION

The purpose of NEMA Standards, their classification and status, are set forth in certain clauses of the NEMA *Standardization Policies and Procedures* manual and are referenced below.

Purpose of Standards

National Electrical Manufacturers Association standards are adopted in the public interest and are designed to eliminate misunderstandings between the manufacturer and the purchaser and to assist purchasers in selecting and obtaining the proper product for their particular needs. Existence of a National Electrical Manufacturers Association standard does not in any respect preclude any member or nonmember from manufacturing or selling products not conforming to the standard. *(Standardization Policies and Procedures, p. 1)*

Definition of a Standard

A standard of the National Electrical Manufacturers Association defines a product, process, or procedure with reference to one or more of the following: nomenclature, composition, construction, dimensions, tolerances, safety, operating characteristics, performance, rating, testing, and the service for which they are designed.

(Standardization Policies and Procedures, p. 2)

Dimensions

Where dimensions are given for interchangeability purposes, alternate dimensions satisfying the other provisions of the Standards Publication may be capable of otherwise equivalent performance.

(Standardization Policies and Procedures, p.8)

Categories of Standards

National Electrical Manufacturers Association Standards are of three classes:

1. NEMA Standard, which relates to a product, process, or procedure commercially standardized and subject to repetitive manufacture, which standard has been approved by at least 90 percent of the members of the Subdivision eligible to vote thereon;
2. Suggested Standard for Future Design, which may not have been regularly applied to a commercial product, but which suggests a sound engineering approach to future development, which standard has been approved by at least two-thirds of the members of the Subdivision eligible to vote thereon.
3. Adoptive Standard, which is adopted in whole or in part from the standards of another organization, either domestic, regional, or international.

(Standardization Policies and Procedures, pp. 7 & 16)

Authorized Engineering Information

Authorized Engineering Information consists of explanatory data and other engineering information of an informative character not falling within the classification of NEMA Standard or Suggested Standard for Future Design, which standard has been approved by at least two-thirds of the members of the Subdivision eligible to vote on the standard.

(Standardization Policies and Procedures, pp. 7 & 16)

Official Standards Proposal

An Official Standards Proposal is an official draft of a proposed standard which is formally recommended to an outside organization(s) for consideration, comment, and/or approval, and which has been approved by at least 90 percent of the members of the Subdivision eligible to vote thereon.

(Standardization Policies and Procedures, pp. 7 & 16)

Identification of Status

Standards in NEMA Standards Publications are identified in the foreword or following each standard as "NEMA Standard" or "Suggested Standard for Future Design." These indicate the status of the standard. These words are followed by a date which indicates when the standard was adopted in its present form by the Association.

The material identified as "Authorized Engineering Information" and "Official Standards Proposal" is designated similarly.

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PLASTIC CONDUIT, DUCT AND ACCESSORIES SECTION OF THE NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

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Mineral Wells, TX 76067

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