NEMA TC*10 93 ■ 6470247 0509385 633 ■

NEMA STANDARDS PUBLICATION NO. TC 10

nema

PVC Plastic Communications Duct and Fittings for Underground Installation

NEMA

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

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

NEMA Standards Publication No. TC 10-1993

PVC PLASTIC COMMUNICATIONS DUCT AND FITTINGS FOR UNDERGROUND INSTALLATION

Published by

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

©1993 by National Electrical Manufacturers Association

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

TABLE OF CONTENTS

		Page
	Foreword	i
	Scope	i
Section 1	REFERENCED STANDARDS AND DEFINITIONS	
	Referenced Standards	1
	Definitions and Abbreviations	1
Section 2	GENERAL REQUIREMENTS	
	Materials	3
	Nominal Sizes	3
	Dimensions	3
Section 3	PERFORMANCE REQUIREMENTS	
	Qualification Tests for Joints	17
	Quality Control Tests	17
Section 4	TEST METHODS	
	Conditioning, Test Conditions & Sampling	19
	Dimensions	19
	Duct Stiffness	19
	Leakage of Joints	19
	Duct Impact Resistance	
Section 5	MARKINGS	21
Appendix A	SOCKET BOTTOM AND SOCKET ENTRANCE GO NO-GO GAGE FOR BELLED END DIMENSIONS SHOWN IN TABLE 2-2	
	Socket Bottom Go No-Go Gage	23
	Socket Entrance Go No-Go Gage	24
Appendix B	SUGGESTED JOINING METHODS	
	Solvent Cement Joining of PVC Conduit Materials	25
	Materials	25
	Joint Preparations	25
	Application of Cement	25
	Assembly of Joint	25
	Appearance of Joint	26
	Application of Cement and Assembly for Severe Service Conditions Where Maximum Strength and Leaktight Joints Are Essential	26
	Joint Preparation	26
	Application of Cement	26
	Assembly of Joint	26
	Appearance of Joint	26
	Set Time	26

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

FOREWORD

This standards publication for PVC plastic communications duct for underground installation is intended to:

a. List dimensions and other significant requirements
b. Set forth some of the properties of this product 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

The Polymer Raceway Products Section of NEMA, through its members, has worked (and continues to work) closely with such organizations as ASTM, the Plastic Pipe Institute, appropriate government agencies, testing laboratories and others in the periodic review and revision of these standards for any changes necessary to remain current. Proposed or recommended revisions should be submitted to:

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

Publication No. TC 10-1993 revises and supersedes the NEMA Standards Publication *PVC Plastic Communications Duct and Fittings for Underground Installation*, Publication No. TC 10-1990. Prior to publication, the NEMA Standards, Suggested Standards for Future Design, and Authorized Engineering Information which appear in this publication unchanged since their appearance in TC 10-1990 were reaffirmed.

SCOPE

These standards cover the following types of plastic communications duct and fittings having a nominal size of 3-1/2 or 4 inches and intended for the underground installation of communication wire and cable:

Type B—Designed for burial encased in concrete

Type C—Designed for direct burial without encasement in concrete and may also be used for all concrete encased applications

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

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Section 1
REFERENCED STANDARDS AND DEFINITIONS

1.1 REFERENCED STANDARDS

In this publication, reference is made to the standards listed below. Copies are available from the indicated sources.

ASTM
1916 Race Street
Philadelphia, PA 19103

D 618-1961 (R1990)	*Conditioning Plastics and Electrical Insulating Materials for Testing*
D 883-1991	*Definitions of Terms Relating to Plastics*
D 1600-1991	*Abbreviations of Terms Relating to Plastics*
D 1784-1990	*Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds*
D 2122-1990	*Determining Dimensions of Thermoplastic Pipe and Fittings*
D 2412-1987	*Test for External Loading Properties of Plastic Pipe by Parallel-Plate Loading*
D 2444-1984	*Test for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)*
D 2564-1991	*Specifications for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings*
D 4396-1984 (R1990)	*Specifications for Rigid Poly (Vinyl Chloride) (PVC) and Related Plastic Compounds for Non-Pressure Piping Products*
F 402-1988	*Recommended Practice for Safe Handling of Solvent Cements Used for Joining Thermoplastic Pipe and Fittings*
F 412-1991	*Definitions of Terms Relating to Plastic Piping Systems*

NFPA
P.O. Box 9101
Quincy, MA 02269-9904

NFPA 325M (1984)	*Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids*

1.2 DEFINITIONS AND ABBREVIATIONS

Definitions for plastic communications duct and fittings shall be in accordance with ASTM D 883, or ASTM F 412, or both, and abbreviations shall be in accordance with ASTM D 1600, unless otherwise specified.

1.2.1 Qualification Tests

A qualification test is a non-repetitive evaluation conducted on an existing, altered, or new product to determine acceptability.

1.2.2 Quality Control Tests

A quality control test is an in-plant test that is conducted on a given test frequency to determine whether a product is in accordance with the specification requirements.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Section 2
GENERAL REQUIREMENTS

2.1 MATERIALS

2.1.1 Duct and Fittings

Plastic communication duct and fittings shall be made from: Poly (Vinyl Chloride) (PVC) plastic compound which meets cell classification PVC 11232 (with a minimum tensile strength of 4000 psi) as defined in ASTM D 4396, or of cell classification 12234B of ASTM 1784.

Reworked material may be used, provided that the duct or fittings produced meet all of the requirements of these standards.

2.1.2 Solvent Cements

PVC solvent cements, in accordance with ASTM D 2564, should be used with PVC systems.

2.2 NOMINAL SIZES

The nominal sizes of duct and fittings shall be 3-1/2 and 4 inches.

2.3 DIMENSIONS

2.3.1 Measurement

Dimensions shall be measured in accordance with ASTM D 2122, unless otherwise specified.

2.3.2 Duct Dimensions

a. *Diameter; Out-of-Roundness and Wall Thickness*—Dimensions shall be in accordance with Table 2-1.

b. *Duct Length*—The laying length, excluding the belled end or coupling, shall be 20 ft ±1 in (609.6 ±25.4 mm) unless otherwise specified.

c. *Average Outside Diameter*—The average outside diameter at any cross section on the length of the duct shall be determined by the use of a vernier circumferential wrap tape in accordance with Section 6.2.2 of ASTM D 2122.

d. *Out-of-Roundness*—Out-of-roundness shall be computed by obtaining the minimum and maximum diameters of a cross section of the duct. The difference between the minimum and maximum measurements shall not exceed the tolerance shown in Table 2-1. The out-of-roundness tolerance in Table 2-1 shall apply only at the point of manufacture.

e. *Wall Thickness*—The wall thickness of duct shall be in accordance with the requirements of Table 2-1.

2.3.3 Belled End Dimensions

a. *Dimensions*—The dimensions of integral belled ends shall conform to the requirements of Table 2-2.

b. *Centering*—Belled ends shall be centered to provide a visible shoulder around the entire circumference of the duct.

c. *Wall Thickness*—The wall thickness of an integral bell shall be considered satisfactory if formed from duct which meets the requirements of these standards.

2.3.4 Fitting Dimensions

a. Fitting dimensions shall be in conformance with the applicable table in this standard.

b. The belled ends on fabricated fittings shall conform to the requirements of Table 2-2.

c. Fabricated fittings, including bends and sweeps, shall be made from duct or sleeve stock that meets all of the dimensional and physical requirements of the specification.

Table 2-1
DUCT DIMENSIONS

	Outside Diameter			Minimum Wall Thickness*		
Nominal Duct Size Inches	Average Diameter in (mm)	Average Diameter Tolerance in (mm)	Total Allowed Out-of-Roundness in (mm)	Type B PVC in (mm)	Type C PVC in (mm)	Minimum Inside Diameter in (mm)
3-1/2	3.830 (97.28)	±0.005 (0.13)	0.050 (1.27)	0.079 (2.01)	0.129 (3.28)	3.450 (87.63)
4	4.350 (110.49)	±0.005 (0.13)	0.050 (1.27)	0.091 (2.31)	0.145 (3.76)	3.930 (99.82)

*The relationship between these minimum wall thicknesses and performance is based on compounds having a modulus of elasticity of 500,000 psi (3447 MPa) for PVC. Other compounds might require greater wall thicknesses to meet the performance requirements of these standards.

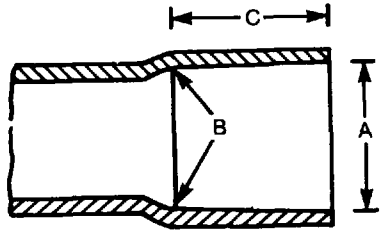
Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

NEMA TC*10 93 ■ 6470247 0509392 873 ■

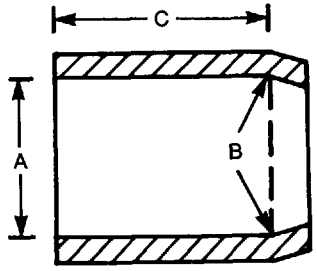
Table 2-2
BELLED END DIMENSIONS



A Socket Entrance Inside Diameter				B Socket Bottom Inside Diameter			C Socket Depth
Nominal Duct Size, Inches	Average Diameter in (mm)	Average Diameter Tolerance in (mm)	Total Out-of-Roundness in (mm)	Average Diameter in (mm)	Average Diameter Tolerance in (mm)	Total Out-of-Roundness in (mm)	in (mm)
3-1/2	3.855 (97.92)	±0.005 (±0.13)	0.050 (1.27)	3.835 (97.41)	±0.005 (±0.13)	0.050 (1.27)	2.75+0.25-0 (69.9+6.4-0)
4	4.380 (111.25)	±0.005 (±0.13)	0.050 (1.27)	4.355 (110.62)	±0.005 (±0.13)	0.050 (1.27)	3.00+0.25-0 (72.2+6.4-0)

Note: Metal circular Go No-Go plug gages machined to the minimum and maximum inside diameters may be used to check dimensions A and B. These gages are detailed in Appendix A.

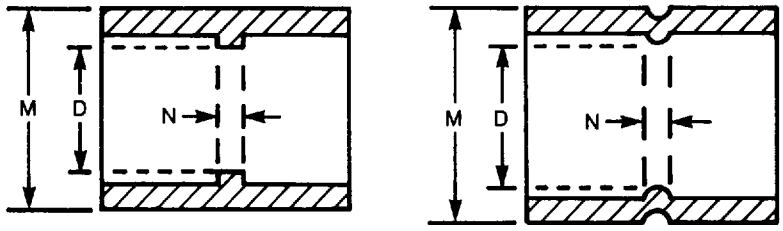
Table 2-3
FITTING SOCKETS



Dimesions					
	A Socket Entrance Inside Diameter		B Socket Bottom Inside Diameter		C Socket Depth
Nominal Duct Size, Inches	Average Inside Diameter in (mm)	Out-of-Roundness in (mm)	Average Inside Diameter in (mm)	Out-of-Roundness in (mm)	Inside Diameter in (mm)
3-1/2	3.855 ± 0.005 (97.92±0.13)	0.050 (1.27)	3.835 ± 0.005 (97.41 ± 0.13)	0.050 (±1.27)	2.75+0.250-0 (69.9+6.4-0)
4	4.380 ± 0.005 (111.25±0.13)	0.050 (1.27)	4.355 ± 0.005 (110.62 ± 0.13)	0.050 (±1.27)	3.00+0.250-0 (76.2+6.4-0)

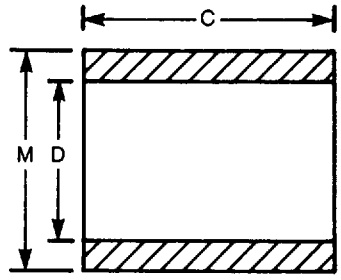
Note: All fitting sockets shall be in accordance with Table 2-3 unless otherwise specified.

Table 2-4
MOLDED AND FABRICATED COUPLINGS



Nominal Size, Maximum Inches	Dimensions M Minimum in (mm)	D Minimum in (mm)	N in (mm)
3-1/2	4-1/4 (108)	3.450 (87.63)	7/64 (2.8)
4	4-3/4 (121)	3.930 (99.82)	7/64 (2.8)

Table 2-5
SLEEVE COUPLINGS

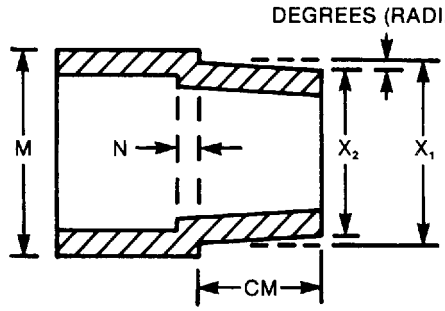


Nominal Size, Maximum Inches	Dimensions M C in (mm)	D in. (mm)	in. (mm)
3-1/2	4-1/4 (108)	6 ± 1/8 (152.4 ±3)	3.842 ± 0.005 (97.59 ± 0.13)
4	4-3/4 (121)	6 ± 1/8 (152.4 ±3)	4.365 ± 0.005 (110.87 ± 0.13)

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Table 2-6
ADAPTER TO TYPE I FIBER CONDUIT COUPLING, 4 INCHES



(THIS DRAWING APPLIES TO TABLES 2-6 AND 2-7)

	Dimensions					
Nominal Size, Maximum Inches	M Minimum in (mm)	N Nominal in (mm)	CM Nominal in (mm)	X_1 Nominal in (mm)	X_2 in (mm)	Degrees (Radians)
4	4-3/4 (121)	11/64 (4.4)	1-15/16 (49.2)	4-3/4 (121)	4-1/2 (114)	2(0.035)

Table 2-7
ADAPTER TO ASBESTOS-CEMENT CONDUIT COUPLING

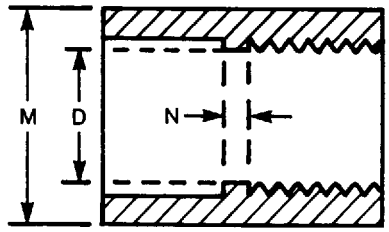
Note: See figure for table 2-6.

	Dimensions				
Nominal Size, Inches	M Maximum in (mm)	N Minimum in (mm)	CM in (mm)	X_2 in (mm)	Degrees (Radians)
3-1/2 B a/c	4-1/4 (108)	11/64 (4.4)	1.12 (28.4)	3.90 (99)	1-3/4 (0.031)
4 B a/c	4-3/4 (121)	11/64 (4.4)	1.25 (31.8)	4.40 (111)	1-3/4 (0.031)
3-1/2 C a/c	4-1/4 (108)	11/64 (4.4)	1.81 (46)	4.03 (102)	1-3/4 (0.031)
4 C a/c	4-3/4 (121)	11/64 (4.4)	2.00 (50.8)	4.52 (114.8)	1-3/4 (0.031)

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

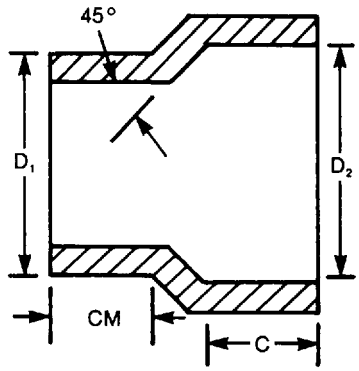
Not for Resale

Table 2-8
FEMALE THREADED ADAPTERS



Nominal Size, Maximum Inches	Dimensions M Minimum in (mm)	D Minimum in (mm)	N Minimum Number in (mm)	of Threads
3-1/2	4-1/2 (114)	3-7/16 (87.3)	1/8 (3)	5 Full
4	5-1/8 (130)	3-15/16 (100)	1/8 (3)	5 Full

Table 2-9
CAST IRON "D" ADAPTER



Nominal Size, D_1 Inches	Dimensions Nominal in (mm)	D_2 Nominal in (mm)	CM C in (mm)	in (mm)
4	4.3500 ± .005 (110.49 ±0.13)	5-15/32 (138.9)	3-5/8 (92.1)	3±1/8 (76.2 ±3)

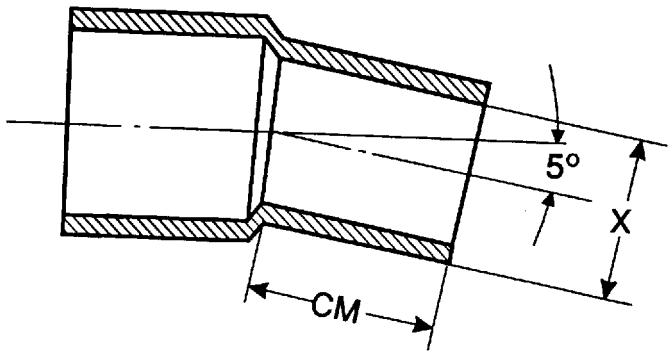
Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Table 2-10
5 DEGREE ANGLE COUPLINGS

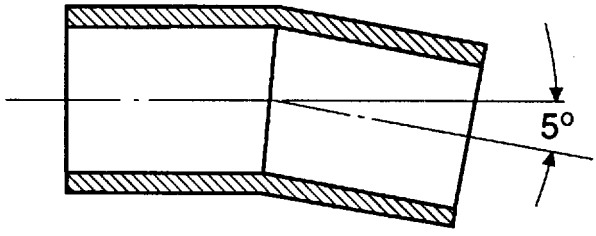
Nominal Size, Inches	Fabricated Socket X Spigot Dimensions M Maximum in (mm)	N Minimum in (mm)	L Minimum in (mm)
3-1/2	4-1/4 (108)	7/64 (2.8)	6 (152.4)
4	4-3/4 (121)	7/64 (2.8)	6 (152.4)

Socket by Spigot



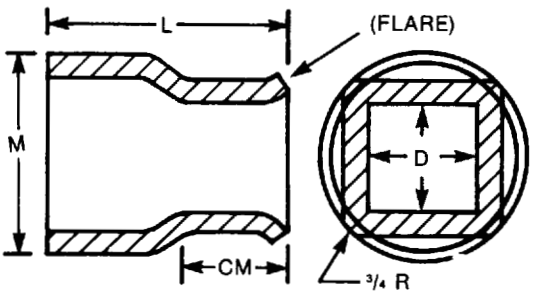
Nominal Size, Inches	Molded Socket X Spigot Dimensions A Maximum in (mm)	C Minimum in (mm)	L Maximum in (mm	M Maximum in (mm)
4	4-3/8 (111.1)	2 (50.8)	4-1/2 (114.3)	4-3/8 (111.1)

Socket by Socket



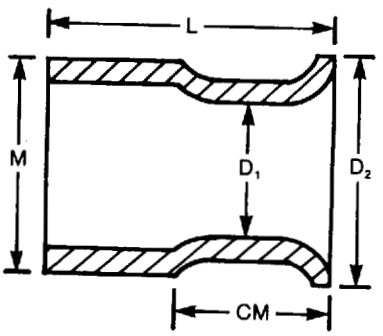
Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 2-11
SQUARE END BELL



Nominal Size, Maximum Inches	Dimensions M Minimum in (mm)	L D in (mm)	Minimum in (mm)	CM in (mm)
4	4-7/8 (123.8)	6(152.4)	4-1/4 ± 1/8 (108.0 ±3)	2-1/2 (64)

Table 2-12
ROUND END BELL

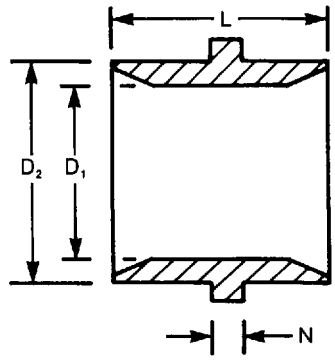


Nominal Size, Maximum Inches	Dimensions M Minimum in (mm)	L Minimum in (mm)	CM Maximum in (mm)	D_1 Maximum in (mm)	D_2 in (mm)
4	4-7/8 (123.8)	6 (152.4)	2-1/2 (63.5)	3-15/16 (100)	5-3/4 (146)

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

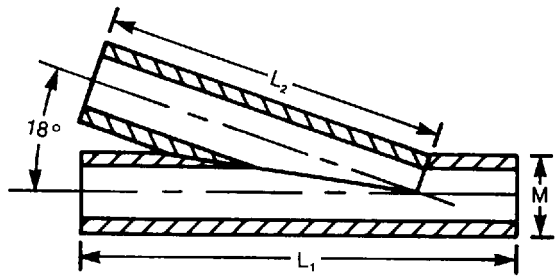
Not for Resale

Table 2-13
INTERNAL JOINING COUPLING



Nominal Size, Inches	Dimensions			
	D_1 Minimum in (mm)	D_2 Nominal in (mm)	N in (mm)	L Nominal in (mm)
3-1/2	3.25 (82.6)	3.50 (88.9)	3/16 (4.8)	2-1/2 (63.5)
4	3.93 (99.8)	4.00 (101.6)	3/16 (4.8)	2-15/16 (74.6)

Table 2-14
WYE BRANCH

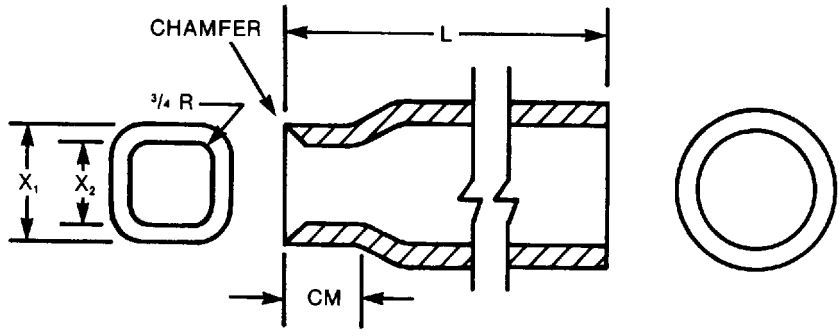


Nominal Size, Inches	Dimensions		
	M Maximum in. (mm)	L_1 Minimum in. (mm)	L_2 Minimum in. (mm)
3-1/2	4-1/4 (108)	20 (508)	17 (432)
4	4-3/4 (121)	20 (508)	17 (432)

Note: Belled ends or couplings optional.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 2-15
SQUARE CLAY ADAPTER

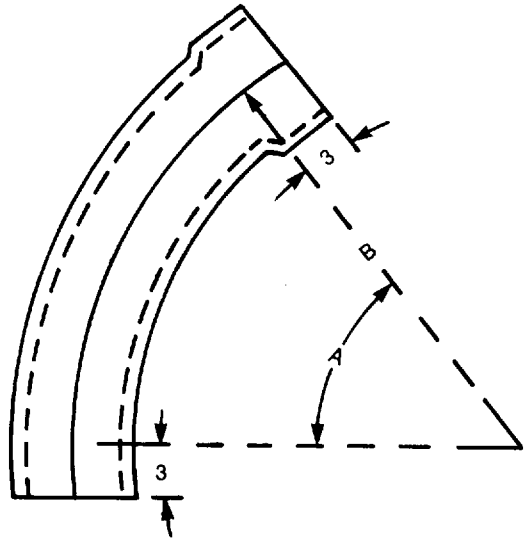


Nominal Size Inches	Clay Size Inches	Dimensions X_1 Maximum in (mm)	X_2 Minimum in (mm)	L Nominal in (mm)	CM Minimum in (mm)
3-1/2	3-1/4	3.38 (85.9)	3 (76)	12, 18, 24 (305, 457, 610)	3/4 (19)
3-1/2	3-1/2	3.65 (91.7)	3-1/4 (82.6)	12, 18, 24 (305, 457, 610)	3/4 (19)
4	4	3.80 (96.5)	3-3/8 (85.7)	12, 18, 24 (305, 457, 610)	3/4 (19)

Note: Alternate construction—May have belled end or coupling attached.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 2-16
BENDS AND SWEEPS

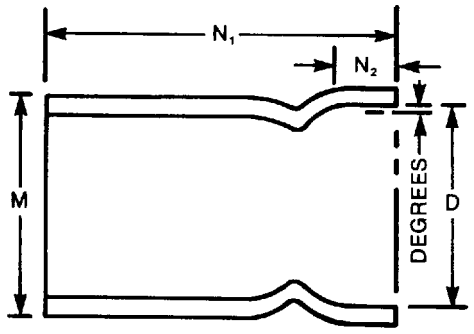


Nominal Size, Inches	Dimensions A Degree of Curvature (Radian)	Dimensions B Radius of Curvature ft (cm)
3-1/2 and 4	5 (0.08)	4, 12 (120, 360)
	11-1/4 (0.196)	3, 4, 12-1/2 (90, 120, 375)
	22-1/2 (0.393)	2, 3, 4, 9, 12, 15 (60, 90, 120, 270, 360, 450)
	30 (0.524)	2, 3, 4, 6, 9, 10, 12, 15 (60, 90, 120, 180, 270, 300, 360, 450)
	45 (0.785)	2, 3, 4, 6, 9, 12-1/2, 15 (60, 90, 120, 180, 270, 375, 450)
	90 (1.571)	1-1/2, 2, 2-1/2, 3, 4, 6, 9, 10, 15 (45, 60, 75, 90, 120, 180, 270, 300, 450)

Note: Bends and sweeps shall be constructed from either Type B, or C stock.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 2-17
(FABRICATED) ADAPTER TO ASBESTOS CEMENT CONDUIT SPIGOT END

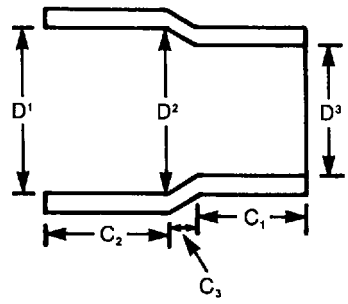


Nominal Size, Maximum Inches	Dimensions M Nominal in (mm)	N_2 in (mm)	N_1 Nominal in (mm)	D in (mm)	Degrees (Radians)
3-1/2 B a/c	4-1/4 (108)	1.12 (28.4)	5 (127)	3.94 ± 0.005 (100.3 ± 0.13)	1-3/4 (0.031)
4 B a/c	4-3/4 (121)	1.25 (31.8)	6 (152.4)	4.45 ± 0.005 (113 ± 0.13)	1-3/4 (0.031)
3-1/2 C a/c	4-1/4 (108)	1.81 (46)	5 (127)	4.09 ± 0.005 (103.9 ± 0.13)	1-3/4 (0.031)
4 C a/c	4-3/4 (121)	2.00 (50.8)	6 (152.4)	4.59 ± 0.005 (116.6 ± 0.13)	1-3/4 (0.031)

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Table 2-18
3-1/2 × 4 INCH EXTERNAL ENLARGING COUPLING



Dimensions							
C_1 Maximum in (mm)	Nominal in (mm)	C_2 Tolerance in (mm)	C_3 Nominal in (mm)	D_1 Nominal in (mm)	D_2 Nominal in (mm)	D_3 Nominal in (mm)	D Tolerance in (mm)
3.00 (76.2)	3.00 (76.2) -0 (-0.00)	+1/4 (+6.85) -0 (-0.00)	3/4 (19.05)	4.380 (111.25)	4.355 (110.62)	3.842 (97.59)	±0.005 (±0.13)

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Section 3
PERFORMANCE REQUIREMENTS

3.1 QUALIFICATION TESTS FOR JOINTS

Joints between conduit and tubing and their respective fittings made by methods recommended by the product manufacturer shall not leak when tested in accordance with 4.4.

If water tight joints are needed, see Appendix B.

3.2 QUALITY CONTROL TESTS

3.2.1 Conditioning

At the time of production, measurements and performance tests can be made at the temperature within the factory. In case of disagreement, specimens shall be conditioned per 4.1.1.

3.2.2 Workmanship

Duct and fittings shall be homogeneous throughout and free from visible cracks, holes, burrs, foreign inclusions, or other defects that could damage cables.

3.2.3 Duct Impact Resistance

The minimum impact resistance values for Types B and C underground duct shall be as shown in Table 3-1 when tested in accordance with 4.5.

Impact resistance tests are quality control tests intended to verify that the conduit has been properly extruded. The tests are not intended to represent field conditions.

The test criteria, when applied to the conduit within 48 hours of manufacture, have been found by experience to be adequate for handling, transport, and installation. The actual impact resistance strength is generally higher, but varies because it is dependent on specific formulation, specific extruder, and specific extrusion procedures. Changes in formulation to obtain maximum impact resistance may result in lesser values in other parameters such as deflection resistance.

Exposure of PVC conduit to ultraviolet (UV) radiation will result in a measurable decrease in impact resistance. Therefore, impact resistance values are applicable only at time of manufacture and are not applicable for yard-aged conduit. However, initial impact values set by the standards are higher than necessary for normal handling.

Table 3-1
MINIMUM IMPACT RESISTANCE—ALL SIZES

Test Temp.	Type B Ft-lb (J)	Type C Ft-lb (J)
73.4°F (23°C)	50 (68)	100 (135)
32°F (0°C)	25 (34)	50 (68)

3.2.4 DUCT STIFFNESS

The minimum duct stiffness values for Types B and C underground duct shall be as shown in Table 3-2 when tested in accordance with 4.3.

Table 3-2
DUCT STIFFNESS

Nominal Sizes Inches	F Y (kPa) Type B (kPa)	Type C (kPa)
All	30 (207)	120 (827)

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Section 4
TEST METHODS

4.1 CONDITIONING, TEST CONDITIONS, AND SAMPLING

4.1.1 Conditioning Test Specimens

When conditioning is required, the test specimens shall be conditioned in accordance with Procedure A in ASTM D 618 at 73.4°F ±3.6°F (23°C ±2°C). Shorter time periods shall be permitted for quality control testing if it can be shown that specimens have reached equilibrium.

4.1.2 Test Conditions

Tests shall be conducted at 73.4°F ±3.6°F (23°C ±2°C) unless otherwise specified.

4.1.3 Sampling

Samples shall be selected at random.

4.2 DIMENSIONS

4.2.1 Maximum and Minimum Outside Diameter (Out-of-Roundness)

The outside diameter of conduit and tubing shall be measured in accordance with Section 9 of ASTM D2122. Out-of-roundness tolerances shall apply only at the point of manufacture. Out-of-roundness is not a requirement applicable for conduit that has been packaged and placed in yard storage.

4.2.2 Outside Diameter (Average)

The average outside diameter at any cross section on the length of conduit shall be as measured by the use of a vernier circumferential tape in accordance with Section 9 of ASTM D 2122.

4.2.3 Wall Thickness

The maximum and minimum wall thickness shall be measured with a micrometer at an end of conduit to the nearest 0.001 inch (0.02 mm) in accordance with Section 6 of ASTM D 2122.

4.3 DUCT STIFFNESS

The duct stiffness (F/ΔY) shall be determined at 5 percent inside diameter deflection in accordance with ASTM D 2412.

Each specimen shall be placed so that the minimum wall thickness is uppermost (adjacent to the top bearing plate). The vertical inside diameter shall be measured before compressing the specimen.

Three specimens, each 6 ±1/8 in. (152.40 ±3.17 mm) long, shall be cut from each sample. The specimens shall be compressed at the rate of 1/2 in. (12.70 mm) per minute and the load recorded at the vertical deflection equivalent to 5 percent of the original inside diameter of the specimens.

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

Duct Stiffness, Pounds/Inch/Inch = F/ΔY (Kilopascals)

Where:

F = Load in pounds per inch of length recorded at 5 percent vertical deflection in inches

Y = Vertical deflection of inside diameter in inches

4.4 LEAKAGE OF JOINTS

Two pieces of duct shall be joined together by a method recommended by the manufacturer. Solvent cemented joints shall be allowed to stand for 24 hours at room temperature prior to testing. The specimen shall be subjected to an internal or external pressure of 25 psi (172.4 kPa), using water as the medium, for one hour.

4.5 DUCT IMPACT RESISTANCE

Five specimens, each 6 +1/4, -0 in. (152.4 +6, -0 mm) long shall be tested in accordance with Section 10 of ASTM D 2444, using a 20-pound Tup B (±4 oz) and flat plate holder B. All samples shall pass. If one fails, another five specimens shall be tested. If 9 out of 10 specimens pass the test, the duct shall be considered to have met the requirements of this standard.

For the 32°F (0°C) impact test, no more that 15 seconds shall elapse from the time of removal of the specimen from the conditioning medium until completion of that test.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

--`,,`-`-`,,`,,`,`,,`---

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Section 5
MARKING

5.1 MARKING

All required markings shall be legible and so applied as to remain legible under normal handling and installation practices.

Duct and fittings shall be clearly marked with the following.

a. Manufacturer's name or trademark
b. Nominal size
c. Material; PVC
d. NEMA TC-10
e. Type B or Type C
f. Any additional marking deemed necessary by the manufacturer

Bends and sweeps shall, in addition, be marked to show the degree and radius of curvature.

Note: Abbreviations may be used where necessary.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Appendix A
SOCKET BOTTOM AND SOCKET ENTRANCE GO NO-GO GAGE FOR BELLED END DIMENSIONS SHOWN IN TABLE 2-2

A.1 SOCKET BOTTOM GO NO-GO GAGE

The socket bottom Go No-Go gage may be machined from 1/4 inch (6 mm) thick steel into a full circle gage according to the following dimensions:

Total Length of Connector, Inches	Duct Size, Inches	Go Gage		No-Go Gage	
		Diameter In. (mm)	Marking In (mm)	Diameter In. (mm)	Marking In. (mm)
5	3-1/2	3.829–3.830 (97.26–97.28)	3.830 (97.28)	3.841–3.842 (97.56–97.59)	3.841 (97.56)
5	4	4.349–4.350 (110.46–10.49)	4.350 (110.49)	4.361–4.362 (110.77–110.79)	4.361 (110.77)

The gage may be used on line by the operator to continually check the dimension at the bell end bottom. The Go end should go to the bottom of the socket. The No-Go end should not go to the bottom of the socket. The Go end may be identified by green paint. The No-Go end may be identified by red paint. The dimension of each gage may be marked on the gage. See Figure A.1-1.

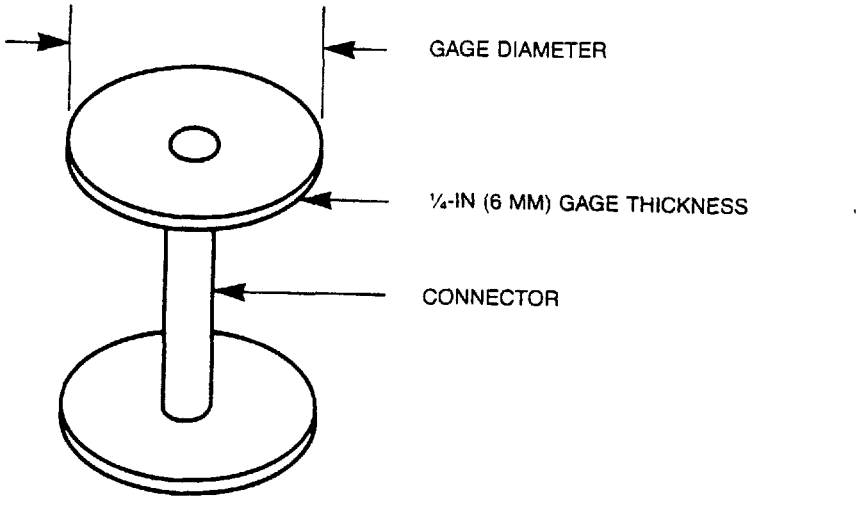


Figure A.1-1
SOCKET BOTTOM GO NO-GO GAGE

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

A.2 SOCKET ENTRANCE GO NO-GO GAGE

The socket entrance Go No-Go gage may be machined from 1/4 in (6mm) thick steel into a full circle gage according to the following dimensions.

Total Length of Connector, Inches	Duct Size, Inches	Go Gage		No-Go Gage	
		Diameter In (mm)	Marking In (mm)	Diameter In (mm)	Marking In (mm)
5	3-1/2	3.849–3.850 (97.76–97.79)	3.850 (97.79)	3.861–3.862 (98.07–98.09)	3.861 (98.07)
5	4	4.374–4.375 (111.10–111.12)	4.375 (111.12)	4.386–4.387 (111.40–111.43)	4.386 (111.40)

The gage may be used on line by the operator to continually check the dimensions of the socket entrance inside diameter. The Go end should enter the socket entrance of the bell. The No-Go end should not enter the socket entrance of the bell. The Go end may be identified by green paint. The No-Go end may be identified by red paint.

The dimension of each gage may be marked on the gauge.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

APPENDIX B
SUGGESTED JOINING METHODS

B.1 SOLVENT CEMENT JOINING OF PVC CONDUIT

These procedures cover the joining of PVC conduit and fittings by means of solvent cements, sometimes called solvent welding. The procedures generally apply to any PVC conduit and fitting products. Manufacturers should supply special instructions for their own products, if and when it is deemed necessary.

The procedures described herein can be used to produce strong, reliable joints in PVC conduit systems either in shop operations or in the field. In cases where watertight joints are required, see B.3.4, however, skill and knowledge on the part of the mechanic are required to produce such joints. This skill and knowledge can be obtained by making joints under the guidance of skilled mechanics and testing the joints until good quality joints are obtained. It is the responsibility of the contractor to assure that his mechanics can properly perform this work.

B.2 MATERIALS

B.2.1 Conduit

The conduit should meet the requirements of this standard.

B.2.2 Fittings

The fittings should meet the requirements of this standard.

B.2.3 Cement

The solvent cement should meet the requirements of ASTM D 2564 or it shall be in accordance with the manufacturer's recommendations.

B.2.3.1 SELECTION OF SOLVENT CEMENT

Heavy-bodied cements are generally recommended for use with conduit 2 inches (2" = 51 mm) and larger and for noninterference joints.

B.2.3.2 STORAGE OF CEMENT

PVC solvent cements should be stored in a cool place except when actually in use at the job site.

These cements have a limited shelf life when not stored in hermetically sealed containers. The cement manufacturer should be consulted for specific recommendations on storage conditions and shelf life.

B.2.3.3 PRECAUTIONS

Solvent cements may be toxic, flammable or otherwise hazardous. The precautionary recommendations of the cement manufacturer should be followed.

B.2.3.4 BRUSH OR APPLICATOR SIZE

The cement should be applied with a natural bristle or nylon brush using a 1-3/4 in. (44.5m) wide brush for the 3-1/2 in. size and a 2 in. (50.8 mm) wide brush for the 4 in. size. Dauber-type applicators as supplied with cement will generally cover entire size range.

B.3 JOINT PREPARATIONS

Before applying cement, the surfaces to be joined should be wiped clean and free of dirt, oil, grease or moisture.

B.4 APPLICATION OF CEMENT

PVC solvent cement is fast drying and, therefore should be applied as quickly as possible, consistent with good workmanship. It may be necessary for two workers to perform this operation for larger sizes of conduit. Under conditions of high atmospheric humidity, quick application is important to minimize the condensation of moisture from the air on the cement surface. Use of a slower drying cement will minimize moisture condensation.

A thin, uniform coating of cement should be applied to the inside surface of the fitting socket lightly enough to prevent the formation of a bead of cement at the interior shoulder of the fitting. Next a full, uniform coating of cement should be applied to the outside surface of the conduit to the depth of the fitting socket.

B.5 ASSEMBLY OF JOINT

Immediately after applying the coat of cement to the conduit, insert the conduit into the fitting socket until it bottoms at the fitting shoulder. Turn the conduit 90 degrees during insertion to distribute the cement evenly. Hold the conduit in place for about 1 minute to prevent backing out in the case of tight interference fit joints. Wipe any excess cement away from the outside of the joint.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

B.6 APPEARANCE OF JOINT

A well-made joint will show a full bead of cement around its entire perimeter. Gaps in the bead may indicate a defective joint due to lack of an adequate quantity of cement.

B.7 APPLICATION OF CEMENT AND ASSEMBLY FOR SEVERE SERVICE CONDITIONS WHERE MAXIMUM STRENGTH AND LEAKTIGHT JOINTS ARE ESSENTIAL

B.7.1 Additional Materials

B.7.1.1 CHEMICAL CLEANERS

a. Methyl ethyl ketone (MEK)
b. Methyl isobutyl ketone (MIBK)
c. Tetrahydrofurane (THF)
d. Commercial cleaner as recommended by the cement manufacturer

Care should be taken in handling and disposal of these materials and recommendations of the cleaner manufacturer should be followed.

For your information, suggested hazard identification ratings of the recommended chemical cleaners follow.

Identification Cleaner	Flammability	Hazard Health	Reactivity
Methyl Ethyl Ketone (MEK)	1	3	0
Methyl Isobutyl Ketone (MIBK)	2	3	0
Tetrahydrofurane (THF)	2	3	1

For more specific information, refer to NFPA 325M and ASTM F402 (1988).

B.7.1.2 MECHANICAL CLEANERS

a. Fine abrasive paper or cloth (100 grit or finer).
b. Clean, oil-free steel wool.

B.8 JOINT PREPARATION

The surfaces to be joined should be wiped clean and free of dirt, oil, grease and moisture. The gloss from the mating surfaces should be removed with a chemical or mechanical cleaner listed in B.7.1. If a mechanical deglossing procedure is used, wipe all abrasive or plastic particles from the surfaces so treated.

B.9 APPLICATION OF CEMENT

PVC solvent cement is fast drying and, therefore, should be applied as quickly as possible, consistent with good workmanship. It may be necessary for two workers to perform this operation for larger sizes of conduit. Under conditions of high atmospheric humidity, quick application is important to minimize the condensation of moisture from the air on the cement surface.

First, apply a full even coating of cement to the surface of the conduit to the depth of the fitting socket. Next apply a thin uniform coating of cement to the interior of the fitting socket. Then apply a second full coating of cement to the outside of the conduit.

B.10 ASSEMBLY OF THE JOINT

Assemble immediately, observing the precautions given in B.5.

B.11 SET TIME

Handle newly-assembled joints carefully until the cement has gone through the set period. The recommended set periods are related to temperatures as follows.

60°F–100°F	30 minutes
40°F– 60°F	1 hour
20°F– 40°F	2 hours
0°F– 20°F	4 hours

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Appendix C
THERMAL EXPANSION

C.1 Table C.1-1 shows the change in length, per 100 feet of conduit for a given temperature change.

Table C.1-1
EXPANSION CHARACTERISTICS OF PVC RIGID NONMETTALIC CONDUIT
(COEFFICIENT OF THERMAL EXPANSION = 3.38×10^{-5} IN-IN/°F)

Temperature Change in °F	Length Change in Inches per 100 Ft of PVC Conduit	Temperature Change in °F	Length Change in Inches per 100 Ft of PVC Conduit
5	0.2	105	4.2
10	0.4	110	4.5
15	0.6	115	4.7
20	0.8	120	4.9
25	1.0	125	5.1
30	1.2	130	5.3
35	1.4	135	5.5
40	1.6	140	5.7
45	1.8	145	5.9
50	2.0	150	6.1
55	2.2	155	6.3
60	2.4	160	6.5
65	2.6	165	6.7
70	2.8	170	6.9
75	3.0	175	7.1
80	3.2	180	7.3
85	3.4	185	7.5
90	3.6	190	7.7
95	3.8	195	7.9
100	4.1	200	8.1

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

NEMA STANDARDIZATION BACKGROUND

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 the purchaser 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.

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, dimensions, tolerances, safety, operating characteristics, performance, rating, testing, and the service for which they are designed.

(Standardization Policies and Procedures, p. 1)

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. 6)

Categories of Standards

National Electrical Manufacturers Association Standards are of three classes, which have received the affirmative vote of at least two-thirds of the Subdivision votes cast in the affirmative or negative:

1. NEMA Standard, which relates to a product, process, or procedure commercially standardized and subject to repetitive manufacture.
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.
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. 5)

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 received the affirmative vote of at least two-thirds of the Subdivision votes cast in the affirmative or negative.

(Standardization Policies and Procedures, pp. 5)

Identification of Status

Standards in NEMA Standards Publications are identified as "NEMA Standard," "Suggested Standard for Future Design," or "Adoptive Standard." These indicate the status of the standard. A statement incorporating the auxiliary verb "shall" indicates that compliance with a requirement is mandatory for compliance with the standard. These classes of standards are identified in the foreword or throughout the text.

The material identified as "Authorized Engineering Information" is designated similarly. Statements incorporating other auxiliary verbs such as "should," "may," etc. refer to the authorized engineering information and not to procedures required for compliance with the standard.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

POLYMER RACEWAY SECTION
OF THE
NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

MEMBER COMPANIES

Applied Extrusion Technology
Newark, DE 19713

Arnco Corporation
Elyria, OH 44035

CANTEX, Inc.
Mineral Wells, TX 76067

Champion Fiberglass, Inc.
Spring, TX 77383

Custom Plastics, Inc.
Elk Grove Village, IL 60007

Electrical Materials Company
Genoa City, WI 53128

Erico, Inc.
Solon, OH 44139

FRE Composites, Inc.
St. Andrews, Quebec J0V 1X0

Heyco Molded Products
Kenilworth, NJ 07033

Hubbell, Inc./Kellems Division
Stonington, CT 06378

Integral Corporation
Dallas, TX 75233

J-M Manufacturing Company, Inc.
Stockton, CA 95206

Lamson & Sessions Company
Cleveland, OH 44122

Pacific Western Extruded Plastics, Inc.
Eugene, OR 97440

Panduit Corporation
Lockport, IL 60441-7607

Petroflex, N.A.
Gainesville, TX 76240

Plexco
Bensonville, IL 60106

Queen City Plastics, Inc.
Charlotte, NC 28241

Smith Fiberglass Products, Inc.
Wichita, KS 67217

Thomas & Betts Corporation
Bridgewater, NJ 08807-0993

Underground Devices, Inc.
Northbrook, IL 60062

United Fiberglass of America, Inc.
Springfield, OH 45501

The Wiremold Company
West Hartford, CT 06133-0639

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale