TC 2-83 6470247 0004085 0 A-07-07

NEMA STANDARDS PUBLICATION/NO. TC 2-1983

nema

Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)

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

© 1984 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	ii
Section 1	REFERENCED STANDARDS	1
Section 2	DEFINITIONS AND ABBREVIATIONS	
	General	2
Section 3	APPLICATIONS, MATERIALS, AND SIZE	
	Applications	3
	Materials	3
	Dimensions and Lengths	3
	Joints	3
	Color	3
Section 4	PERFORMANCE REQUIREMENTS	
	Flattening (PVC Only)	6
	Crushing Resistance (PVC and PE)	6
	Extrusion Quality (PVC Only)	6
	Impact Resistance (PVC and PE)	6
	Leakage at Joints (PVC and PE)	6
	Bending at Joints (PE)	6
	Axial Pull Test on Joints (PE)	6
	Workmanship	6
	Low-Temperature Impact Resistance (PVC and PE)	6
Section 5	TEST METHODS	
	Conditioning, Test Conditions, and Sampling	8
	Dimensions	8
	Flattening (PVC Only)	8
	Crushing Resistance (PVC and PE)	8
	Extrusion Quality (PVC Only)	8
	Impact Resistance (PVC and PE)	8
	Leakage at Joints (PVC and PE)	9
	Bending at Joints (PE)	9
	Axial Pull Test on Joints (PE)	10
	Low-Temperature Impact Resistance (PVC and PE)	10
Section 6	MARKINGS	
	General	11
Appendix	SUGGESTED JOINING METHODS	
	Solvent Cement Joining of PVC Conduit	A-1
	Procedure for Butt-Fusion Joining of PE Conduit	A-2
	Procedure for Threading PE Conduit	A-3
	Procedure for Installing PE Drive-On Joints	A-4

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

The purpose of this Standards Publication for electrical plastic conduit (EPC) and electrical plastic tubing (EPT) for above-ground and below-ground use is:

1. To list dimensions and other significant requirements.
2. To set forth 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 and revision of these standards.

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, appropriate government agencies, Underwriters Laboratories Inc., 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:

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

Publication No. TC 2-1983 revises and supersedes the NEMA Standards Publication for *Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80),* Publication No. TC 2-1978. 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 2-1978 were reaffirmed.

Scope

These standards cover the following types of electrical plastic conduit and tubing. The designation "PVC" refers to polyvinyl chloride; "PE" refers to polyethylene. The designations "40" and '80" refer to Schedules 40 and 80, respectively, of iron pipe dimensions.

EPT-PVC —Electrical plastic tubing for Type I applications.

EPC-40-PE —Electrical plastic conduit for Type II applications.

EPC-40-PVC —Electrical plastic conduit for Type II and III applications.

EPC-80-PVC —Electrical plastic conduit for Type IV 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

ELECTRICAL PLASTIC TUBING (EPT) AND CONDUIT (EPC-40 AND EPC-80)

Section 1
REFERENCED STANDARDS

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

American National Standards Institute
1430 Broadway
New York, NY 10018

National Fire Protection Association
Battery March Park
Quincy, MA 02269

ANSI/NFPA 70-84 *National Electrical Code*

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

D 618-81	*Conditioning Plastics and Electrical Insulating Materials for Testing, Standard Methods of*
D 883-80c (1982)	*Plastics, Definitions of Terms Relating to*
D 1600-81	*Plastics, Abbreviations of Terms Relating to*
D 1784-81	*Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds, Specifications for*
D 2122-81	*Dimensions of Thermoplastic Pipe and Fittings, Determining*
D 2564-80	*Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings, Specifications for*
D 3350-82	*Polyethylene Plastics Pipe and Fittings Materials, Specifications for*
F 412-82a	*Definitions of Terms Relating to Plastic Piping Systems*

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

TC 3-1978(R 1982) *PVC Fittings for Use with Rigid PVC Conduit and Tubing*

Underwriters Laboratories Inc.
333 Pfingsten Road
Northbrook, IL 60062

UL 514-1981	*Electrical Outlet Boxes and Fittings*
UL 514B-1983	*Fittings for Conduit and Outlet Boxes*
UL 514C-1981	*Non-Metallic Outlet Boxes, Flush-Device Boxes and Covers*
UL 651-1981	*Rigid Nonmetallic Electrical Conduit*

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
DEFINITIONS AND ABBREVIATIONS

2.1 GENERAL

Definitions for electrical plastic tubing (EPT) and electrical plastic conduit (EPC) shall be in accordance with ASTM F-412 and D 883, and abbreviations shall be in accordance with ASTM D 1600, unless otherwise indicated.

NEMA Standard 9-25-1975.

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
APPLICATIONS, MATERIALS, AND SIZE

3.1 APPLICATIONS

Type I —Designed to be encased in concrete when installed.

Type II —Designed for underground installation without encasement in concrete.

Type III—Designed for normal-duty applications above ground.

Type IV —Designed for heavy-duty applications above ground.

NEMA Standard 3-9-1967.

3.2 MATERIALS

Electrical plastic conduit and tubing shall be made from:

1. Polyvinyl-chloride (PVC) plastic compound which meets cell classification PVC 12233-A, B, or C as defined in ASTM D 1784,[1] or

2. Polyethylene (PE) plastic compound which meets cell classification PE 334420 C or E as defined in ASTM D 3350-82[2].

NEMA Standard 9-25-1975.

[1] Other homopolymer PVC compounds that have different cell classifications because one or more properties are superior to those of the compounds specified above may also be used.

[2] Other PE compounds having cell classifications with higher numbers may also be used.

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

Authorized Engineering Information 9-25-1975.

3.3 DIMENSIONS AND LENGTHS

Dimensions of EPC and EPT shall meet the requirements of Table 3-1 when determined in accordance with 5.2.

The length of EPC and EPT shall be in accordance with Article 347 of the latest edition of the *National Electrical Code*.

NEMA Standard 5-15-1978.

3.4 JOINTS

Joints should be made by a method recommended by the manufacturer (see Appendix).

NOTE—EPC-40-PVC couplings may be used to join EPC-80-PVC.

Authorized Engineering Information 9-25-1975.

3.5 COLOR

EPT-PVC, EPC-40 PVC, and EPC-80 PVC shall be gray in color.

EPC-40 PE shall be black in color.

NEMA Standard 1-17-1980.

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

Table 3-1
SIZES AND DIMENSIONS OF PVC AND PE CONDUIT AND TUBING

Nominal Size, Inches	Outside Diameter, Inches					Wall Thickness, Inches						Minimum Cross Sectional Area Square Inches, of EPC-80-PVC*
		PVC		PE		EPT-PVC		EPC-40-PVC and EPC-40-PE		EPC-80-PVC		
	Average	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	
½	0.840±0.004	0.848	0.832	0.855	0.825	0.080	0.060	0.129	0.109	0.167	0.147	0.22
¾	1.050±0.004	1.060	1.040	1.070	1.030	0.080	0.060	0.133	0.113	0.174	0.154	0.41
1	1.315±0.005	1.325	1.305	1.340	1.290	0.080	0.060	0.153	0.133	0.200	0.179	0.69
1¼	1.660±0.005	1.672	1.648	1.685	1.635	0.090	0.070	0.160	0.140	0.214	0.191	1.24
1½	1.900±0.006	1.912	1.888	1.930	1.870	0.100	0.080	0.165	0.145	0.224	0.200	1.71
2	2.375±0.006	2.387	2.363	2.410	2.340	0.120	0.100	0.174	0.154	0.244	0.218	2.87
2½	2.875±0.007	2.890	2.860	2.910	2.840	0.130	0.110	0.227	0.203	0.309	0.276	4.12
3	3.500±0.008	3.515	3.485	3.540	3.460	0.145	0.125	0.242	0.216	0.336	0.300	6.43
3½	4.000±0.008	4.050	3.950	4.045	3.955	0.165	0.145	0.253	0.226	0.356	0.318	8.65
4	4.500±0.009	4.550	4.450	4.550	4.450	0.170	0.150	0.265	0.237	0.377	0.337	11.2
5	5.563±0.010	5.613	5.513	5.618	5.508	...	...	0.289	0.258	0.420	0.375	17.8
6	6.625±0.011	6.675	6.575	6.690	6.560	...	...	0.314	0.280	0.484	0.432	25.8

*This column has been approved as Authorized Engineering Information.

(continued)

Not for Resale

6470247 0004092 8

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 3-1 (cont.)
SIZES AND DIMENSIONS OF PVC AND PE CONDUIT AND TUBING IN METRIC UNITS

Nominal Size, Inches	Outside Diameter, Millimeters					Wall Thickness, Millimeters						Minimum Cross Sectional Area, Square Millimeters, of EPC-80-PVC*
		Out of roundness				EPT-PVC		EPC-40-PVC and EPC-40-PE		EPC-80-PVC		
		PVC		PE								
	Average	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	
½	21.34±0.10	21.54	21.13	21.72	20.96	2.03	1.52	3.28	2.77	4.24	3.73	1.4
¾	26.67±0.10	26.94	26.42	27.18	26.16	2.03	1.52	3.38	2.87	4.42	3.91	2.4
1	33.40±0.13	33.66	33.15	34.04	32.77	2.03	1.52	3.89	3.38	5.08	4.55	4.4
1¼	42.16±0.13	42.47	41.86	42.80	41.53	2.29	1.78	4.06	3.56	5.43	4.85	8.0
1½	48.26±0.15	48.56	47.96	49.02	47.50	2.54	2.03	4.19	3.68	5.69	5.08	11.0
2	60.32±0.15	60.63	60.02	61.21	59.44	3.05	2.54	4.42	3.91	6.20	5.54	18.5
2½	73.02±0.18	73.41	72.64	73.91	72.14	3.30	2.79	5.77	5.16	7.85	7.01	26.6
3	88.90±0.20	89.28	88.52	89.92	87.88	3.68	3.18	6.15	5.49	8.53	7.62	41.5
3½	101.60±0.20	102.87	100.33	102.74	100.46	4.19	3.68	6.43	5.74	9.04	8.08	55.8
4	114.30±0.23	115.57	113.03	115.57	113.03	4.32	3.81	6.73	6.02	9.58	8.56	72.3
5	141.30±0.25	142.57	140.03	142.70	139.90	...	...	7.34	6.55	10.67	9.52	114.8
6	168.28±0.28	169.54	167.00	169.93	166.62	...	...	7.98	7.11	12.29	10.97	166.5

*This column has been approved as Authorized Engineering Information.

Section 4
PERFORMANCE REQUIREMENTS

4.1 FLATTENING (PVC ONLY)

There shall be no evidence of splitting, cracking, or breaking when PVC conduit or tubing is tested in accordance with 5.3.

NEMA Standard 3-9-1967.

4.2 CRUSHING RESISTANCE (PVC AND PE)

Specimens of PVC tubing and PVC and PE conduit shall not buckle under the load given in Table 4-1 when tested in accordance with 5.4. After loading, the minor axis measured inside of each loaded specimen shall be not less than that given in Table 4-1 in which it is indicated as a percentage of the inside diameter of the specimen measured before loading.

NEMA Standard 5-15-1978.

4.3 EXTRUSION QUALITY (PVC ONLY)

PVC conduit and tubing shall exhibit no evidence of flaking or surface deterioration when tested in accordance with 5.5.

NEMA Standard 3-9-1967.

4.4 IMPACT RESISTANCE (PVC AND PE)

No crack or tear longer than 1/32 in (0.8 mm) shall appear in seven out of ten specimens of EPC and EPT when tested in accordance with 5.6 using the values given in Table 4-2.

NEMA Standard 5-15-1978.

4.5 LEAKAGE AT JOINTS (PVC AND PE)

Joints between EPC or EPT and their respective fittings made by methods recommended by the product manufacturer should not leak when tested in accordance with 5.7.

NEMA Standard 3-9-1967.

4.6 BENDING AT JOINTS (PE)

Each method of joining lengths of EPC to the appropriate fittings shall result in a connection which is not damaged or separated by the test described in 5.8. This test shall also apply to PE joints made by thermal fusion. If failure of the conduit occurs prior to failure at the joint, the performance of the joint shall be considered to meet the requirements of this standard.

NEMA Standard 9-25-1975.

4.7 AXIAL PULL TEST ON JOINTS (PE)

Each method of joining lengths of EPC to the appropriate fitting shall result in a connection which is not damaged or separated by the test described in 5.9. This requirement shall also apply to PE joints made by thermal fusion. If failure of the conduit occurs prior to failure at the joint, the performance of the joint shall be considered to meet the requirements of this standard.

NEMA Standard 9-25-1975.

4.8 WORKMANSHIP

EPC and EPT shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other defects.

NEMA Standard 9-25-1975.

4.9 LOW-TEMPERATURE IMPACT RESISTANCE (PVC AND PE)

PVC tubing and PVC and PE conduit shall not shatter, chip, or crack when tested in accordance with 5.10.

NEMA Standard 5-28-1981.

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 4-1
LOAD FOR CRUSHING RESISTANCE

Nominal Size, Inches	EPT-PVC		EPC-40-PE		EPC-40-PVC		EPC-80-PVC	
	Load, lb (kg)	Minor Axis, Percentage of Inside Diameter	Load, lb (kg)	Minor Axis, Percentage of Inside Diameter	Load, lb (kg)	Minor Axis, Percentage of Inside Diameter	Load, lb (kg)	Minor Axis, Percentage of Inside Diameter
½	300 (136)	70	950 (431)	70	1000 (454)	70	2000 (907)	70
¾	300 (136)	70	750 (340)	70	1000 (454)	70	2000 (907)	70
1	300 (136)	70	650 (295)	70	1000 (454)	70	2000 (907)	70
1¼	300 (136)	70	500 (227)	75	1000 (454)	70	2000 (907)	70
1½	350 (159)	70	400 (181)	75	750 (340)	70	2000 (907)	70
2	450 (204)	70	300 (136)	75	700 (318)	70	1650 (748)	70
2½	425 (193)	70	350 (158)	75	1000 (454)	70	2000 (907)	70
3	450 (204)	70	500 (227)	75	1000 (454)	70	2000 (907)	70
3½	550 (249)	70	350 (158)	75	1000 (454)	70	2000 (907)	70
4	525 (238)	70	350 (159)	75	900 (408)	70	2000 (907)	70
5	...	...	350 (158)	75	850 (386)	70	2000 (907)	70
6	...	...	350 (158)	75	850 (386)	70	2000 (907)	70

Table 4-2
LOAD FOR IMPACT RESISTANCE

Nominal Size, Inches	Height of the Space Between the Bottom of the Weight and the Top of the Specimen Before the Weight is Released		
	EPT	EPC-40	EPC-80
	ft (m)	ft (m)	ft (m)
½	1½ (0.46)	2½ (0.77)	1¼ (0.38)
¾	2 (0.61)	4 (1.22)	1¼ (0.38)
1	4 (1.22)	5 (1.53)	2 (0.61)
1¼	6 (1.83)	6 (1.83)	2¼ (0.69)
1½	7½ (2.29)	7½ (2.29)	2½ (0.77)
2	9½ (2.90)	9½ (2.90)	4 (1.22)
2½	10½ (3.20)	10½ (3.20)	5½ (1.68)
3–6	11 (3.35)	11 (3.35)	7 (2.14)

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
TEST METHODS

5.1 CONDITIONING, TEST CONDITIONS, AND SAMPLING

5.1.1 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° ± 3.6°F (23° ± 2°C) and 50 ± 2 percent relative humidity for not less than 48 hours prior to the test.

5.1.2 Test Conditions

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

5.1.3 Sampling

Samples shall be selected at random.

NEMA Standard 5-15-1978.

5.2 DIMENSIONS

5.2.1 Outside Diameter (Out-of-Roundness)

The outside diameter of EPC and EPT shall be measured in accordance with Section 9 of ASTM D 2122. Out-of-roundness tolerances shall apply only at the point of manufacture.

5.2.2 Outside Diameter (Average)

The average outside diameter at any cross section on the length of EPC or EPT shall be the arithmetic average of all the diameters measured at that section, as determined in accordance with 5.2.1, or as measured by the use of a vernier circumferential tape in accordance with Section 9 of ASTM D 2122.

5.2.3 Wall Thickness

The maximum and minimum wall thickness shall be measured with a micrometer at both ends of EPC and EPT to the nearest 0.001 in (0.02 mm) in accordance with Section 6 of ASTM D 2122.

NEMA Standard 5-15-1978.

5.3 FLATTENING (PVC ONLY)

Three 2-in (51-mm) long specimens shall be flattened between parallel plates in a suitable press until the distance between the plates is 40 percent of the outside diameter of the product. The rate of loading shall be uniform and such that the compression is completed within 2 to 5 minutes. On removal of the load, the specimens shall be examined for evidence of splitting, cracking or breaking.

NEMA Standard 5-15-1978.

5.4 CRUSHING RESISTANCE (PVC AND PE)

Three 6-in (152-mm) long specimens shall be cut from lengths of each size of EPC and EPT. The inside diameter of each specimen shall be measured. Each specimen shall then be placed between a pair of 6-in (152-mm) or longer rigid flat steel plates which are horizontal and parallel to one another. One plate shall be moved toward the other at the rate of ½ in (13 mm) per minute until the load specified in Table 4-1 is applied to the specimen.

NEMA Standard 5-15-1978.

5.5 EXTRUSION QUALITY (PVC ONLY)

A 1-in (25.4-mm) long sample shall be cut cleanly from each nominal size of PVC conduit and tubing. Each sample shall be immersed in anhydrous acetone in a covered container for 20 minutes and then be examined.

NEMA Standard 5-15-1978.

Acetone is an extremely volatile liquid whose vapors form explosive mixtures with air. Hence, open flames, glowing cigarettes, and other sources of ignition must be kept away. Acetone and acetone PVC products are toxic, damaging to clothing, and rapidly absorb moisture from air, the skin, etc. They should not be allowed to touch the skin, nor should the vapors of these substances be inhaled. Because acetone with moisture in it is not effective in this test, the test is conducted with each specimen in its own covered container. Acetone can be dehydrated by filtering it through anhydrous calcium sulphate.

Authorized Engineering Information 3-9-1967.

5.6 IMPACT RESISTANCE (PVC AND PE)

Ten 6-in (152-mm) long specimens on the surfaces of which there are no cracks, tears, or other imperfections shall be cut from each nominal size of EPC and EPT. The specimens shall be tested separately while resting on a solid flat steel plate which is at least ½ in (13 mm) thick and which is firmly anchored with its upper surface horizontal. A right-circular steel cylinder with rounded edges as described in Table 5-1 shall be allowed to fall freely through a vertical guide from the height indicated in Table 4-2. The flat face of the weight shall strike the center of

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 5-1
WEIGHT FOR IMPACT TEST

Test Specimen	Impact Test Diameter in (mm)	Impact Test Weight lb (kg)
EPT-PVC	2 (51)	20 (9)
EPC-40-PE	2 (51)	20 (9)
EPC-40-PVC	2 (51)	20 (9)
EPC-80-PVC	6 (152)	75 (34)

NEMA Standard 5-15-1978.

the specimen once; provision shall be made to prevent the weight from striking the specimen more than once.

5.7 LEAKAGE AT JOINTS (PVC AND PE)

Two pieces of EPC or EPT 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 pressure of 25 psi (172.4 kPa), using water as the medium, for 1 hour.

NEMA Standard 5-15-1978.

5.8 BENDING AT JOINTS (PE)

Assemblies shall be made up according to procedures recommended by the product manufacturer. Each piece of conduit used in the assembly shall be at least 18 in (457 mm) long.

The assembly, with the coupling or joint at the center, shall be placed on supports which are 30 in (762 mm) apart as illustrated in Figure 5-1. The load indicated in Table 5-2 shall be suspended from the center of the coupling for 60 seconds, during which time the entire assembly shall be rotated through one complete revolution about its major axis. If the sample being tested is other than a coupling, the supports shall be separated by an additional distance [more than the 30 in (762 mm) mentioned] equal to the distance between the ends of the conduit in the box

Table 5-2
BENDING LOAD
REQUIREMENTS FOR CONDUIT JOINTS

Nominal Size, Inches	Bending Load lb (kg)
½	20 (9)
¾	35 (16)
1	50 (23)
1¼	75 (34)
1½	85 (39)
2	110 (50)
2½	110 (50)
3	110 (50)
3½	110 (50)
4	110 (50)
5	110 (50)
6	110 (50)

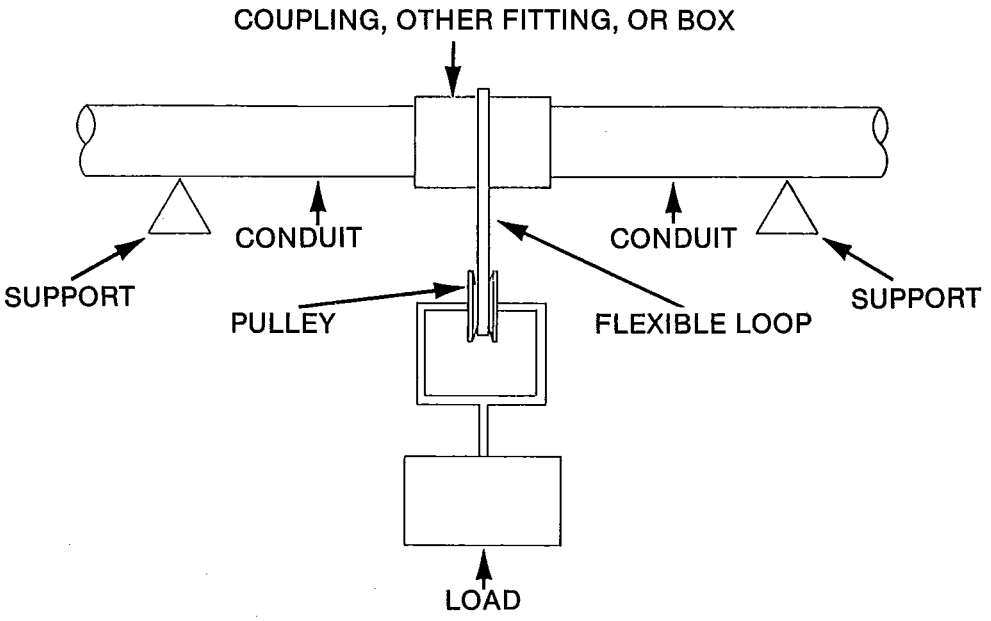


Figure 5-1
ARRANGEMENT FOR BENDING TEST

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

or fitting to give the required bending moments on the sample under test.

NEMA Standard 5-15-1978.

5.9 AXIAL PULL TEST ON JOINTS (PE)

Two 18-in (457-mm) lengths of each size of conduit shall be joined by each of the methods recommended by the manufacturer. Each assembly shall be tested separately with cylindrical plugs of metal or other suitable hard material inserted in its ends to prevent collapse of the conduit. Each plug shall fit snugly for its entire length. Each assembly shall be secured in the jaws of a power-driven testing machine on which the grips separate at a rate of ½ in (13 mm) per minute. The load applied to the assembly by the machine shall be increased to the level indicated in Table 5-3 and then held for 1 minute.

NEMA Standard 5-15-1978.

5.10 LOW-TEMPERATURE IMPACT RESISTANCE (PVC and PE)

One 30-inch (762-mm) long specimen shall be cut from sample lengths of each nominal size of EPC and EPT. The ends of each specimen shall be smooth and perpendicular to the longitudinal axis of the conduit. The specimens shall be exposed for 5 hours to circulating air maintained at a temperature of $-4.0 \pm 1.8°F$ ($-20 \pm 1°C$).

While still at the low temperature, each specimen is to be dropped on a concrete floor twice in quick succession from a height of 5 feet. During the first drop, the specimen is to make an angle of approximately 45 degrees with the floor so that one end of it reaches the floor first. During the second drop, the specimen is to fall parallel to the floor.

NEMA Standard 5-28-1981.

Table 5-3
AXIAL LOAD FOR PULL TEST ON CONDUIT JOINTS

Type of Couplings	Nominal Size, Inches	Axial Load lb (kg)
Threaded and fused PE	½	300 (136)
	¾	450 (204)
	1	600 (272)
	1¼	700 (318)
	1½	800 (363)
	2–4	1000 (454)
	5–6	1000 (454)
Drive-on PE	All	60 (27)

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 6
MARKINGS

6.1 GENERAL

The outer surface of every length of straight conduit and every elbow and other bend shall be marked with: (1) whichever of the following designations is appropriate: "PVC tubing" or "PVC conduit" or "high-density PE conduit" or "EPC-80-PVC;" (2) the nominal size of the conduit; and (3) the name or trademark of the manufacturer. Conduit marked "EPC-80-PVC" shall, in addition, be marked: "Use NEC Table 1, Chapter 9, for wire fill capacity area ———square inches." The markings shall be repeated at uniform intervals not to exceed 5 feet (1.5 m).

For conduit intended for use above ground, these markings shall be permanent. For conduit intended for underground use only, these markings shall be sufficiently durable so that they will remain legible until the material is installed.

NEMA Standard 5-15-1978.

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
SUGGESTED JOINING METHODS

A1.1 SOLVENT CEMENT JOINING OF PVC CONDUIT

A1.1.1 Scope

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, watertight joints in PVC conduit systems either in shop operations or in the field. 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 himself that his mechanics can properly perform this work.

A1.2.1 Materials

A1.2.1.1 Conduit

The conduit shall meet the requirements of this publication and the requirements of Underwriters Laboratories Inc. Publication No. UL 651 and any other applicable standards.

A1.2.1.2 Fittings

The fittings shall meet the requirements of NEMA Publication No. TC 3 or the Underwriters Laboratories Inc. Publication No. UL 514, or both.

A1.2.1.3 Cement

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

A1.2.1.3.1 Selection of Solvent Cement

Solvent cements are available in two general viscosity ranges. Light-bodied cements are recommended for use with conduit up through 2 inches (50.8 mm) in size and having relatively close fitting joints. Heavy-bodied cements are recommended for use with conduit 2½ inches (63.5 mm) and larger and for noninterference joints. The heavy-bodied cements may also be used with the smaller conduit sizes.

A1.2.1.3.2 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.

A1.2.1.3.3 Precautions

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

A1.2.1.3.4 Brush Size

The cement should be applied with a natural-bristle or nylon brush, using a ½-inch (13-mm) wide brush for conduit ½ inch (13 mm) and less in size, and a 1-inch (25-mm) wide brush for conduit ¾ inch to 2 (19 mm to 51 mm), inclusive, in size. For sizes above 2 inch (51 mm), the width of the brush shall be equal to at least ½ of the conduit size, except that a 2½-inch (64-mm) wide brush is adequate for conduits 6 inch (152 mm) and larger.

A1.3 Procedure

A1.3.1 Cutting the Conduit

Cut the conduit square with the axis using a fine-tooth hand saw with a miter box or other guide, or using a power saw and guide. Wheel cutters designed specifically for plastics may also be used. Remove all burrs from inside and outside the cut end. Take particular care to remove the ridge at the cut end if a wheel cutter is used.

A1.3.2 Test Fit the Joint

Wipe both the outside of the conduit and the socket of the fittings with a clean dry cloth to remove foreign matter. Mate the two parts without forcing. Measure and mark the socket depth of the fitting on the outside of the conduit (without scratching or damaging the surface of the conduit) to indicate when the conduit end will be bottomed. The conduit should enter the fitting, especially on sizes 3 inches (76.2 mm) and larger, for at least ⅓ of the socket depth. If the conduit will not enter the socket by this amount, the diameter may be reduced by sanding or filing. Extreme care should be taken not to gouge or flatten the conduit end when reducing the diameter.

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

A1.3.3 Application of Cement and Assembly for Normal Conduit Installations.

A1.3.3.1 Joint Preparations

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

A1.3.3.2 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.

Apply a thin, uniform coating of cement 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 apply a full, uniform coating of cement to the outside surface of the conduit to the depth of the fitting socket.

A1.3.3.3 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° turn 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.

A1.3.3.4 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.

A1.3.4 Application of Cement and Assembly for Severe Service Conditions Where Maximum Strength and Leaktight Joints Are Essential

A1.3.4.1 Additional Materials

A1.3.4.1.1 Chemical Cleaners

1. Methyl ethyl ketone (MEK)
2. Methyl isobutyl ketone (MIBK)
3. Tetrahydrofurane (THF)
4. Cyclohexanone
5. Acetone
6. Commercial cleaner as recommended by the cement manufacturer.

A1.3.4.1.2 Mechanical Cleaners

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

A1.3.4.2 Joint Preparation

The surfaces to be joined should be wiped clean and free of dirt, oil, grease and moisture. Remove the gloss from the mating surfaces with a chemical or mechanical cleaner listed in A1.3.4.1.1. If a mechanical deglossing procedure is used, wipe all abrasive or plastic particles from the surfaces so treated.

A1.3.4.3 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.

A1.3.4.4 Assembly of the Joint

Assemble immediately, observing the precautions given in A1.3.3.3.

A1.3.4.5 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°–100°F	30 minutes
40°– 60°F	1 hour
20°– 40°F	2 hours
0°– 20°F	4 hours

Authorized Engineering Information 5-15-1978.

A2 PROCEDURE FOR BUTT-FUSION JOINING OF PE CONDUIT

A2.1 Clean each conduit end, inside and outside, to remove dirt, water, grease and other foreign material.

A2.2 Cut the conduit square using a hand saw or a mechanical cut-off. Remove cuttings and burrs from conduit ends.

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

A2.3 Line up the conduit ends in the fusion machine so that they meet squarely and completely over the entire surface to be fused. Proper alignment is necessary to obtain uniform heating of the conduit ends and a uniform bead at the fused joint.

A2.4 Insert the heating plate between the aligned conduit ends. Bring and hold the conduit ends firmly but lightly in contact with the heating plate. Allow the conduit to soften about 1/16 inch (2 mm) back from the end of the conduit. Softening can be judged by appearance as the heated conduit material will flow and form a bead as the material softens. Excessive pressure against the plate while the material is heating will cause the molten material to flow away from the surfaces to be fused and will result in a poor joint.

NOTE—The temperature of the heating plate is very important and depends upon the resin from which the conduit is manufactured. It is recommended that in case of doubt as to the proper temperature for the heating plate, the conduit supplier should be contacted to determine the proper temperature. Most heating plates will be equipped with a temperature indicator. Some of these devices are not very accurate. In case of doubt, temperature indicating devices such as Tempilstiks should be used to check the temperature of the heating plate. Such devices as Tempilstiks are also useful to calibrate heat plates. These plates should be kept clean. The conduit supplier can recommend several suitable methods and products for this purpose.

A2.5 Carefully move the conduit ends away from the plate and remove the plate. If the softened material sticks to the plate, discontinue the joint, clean the heating plate, resquare the conduit ends and start over.

A2.6 Bring the heated conduit ends together with enough pressure to form a uniform upset flash around the entire circumference of the conduit. Relax the pressure on the conduit ends until the molten flash begins to pull inward, then reapply pressure to form a bead. This "working" of the softened conduit material may be done more than once depending upon the amount of softened material and the cooling rate, which is dependent upon air temperature. The final bead should be uniform around the conduit and will have a circular cross section. It is important to remember that some pressure is necessary when forming the bead, but excessive pressure will result in pushing too much of the molten material away from the face of the joint and will result in a poor joint. The final bead should be approximately 1/8 inch (3 mm) in diameter. The size of the bead will vary slightly with the diameter and wall thickness of the conduit.

A2.7 Allow the joint to cool and solidify until the bead feels hard; then remove from the lineup clamps. Visually inspect the joint for a uniform nonporous appearance.

NOTE—If the respective conduit ends are properly prepared and the heating plate is operated in the temperature range recommended for the conduit material, the joints will flex without breakage. Poorly prepared joints or those made with an overheated plate will be brittle and will not flex, even though the outward appearance of the joint would indicate that it was a good joint. If there is any doubt as to the temperature of the heating plate, check the heating plate for excessive temperature by either flexing the joint or by checking the temperature of the heating plate with a Tempilstik.

A2.8 Occasionally, it may be desirable to remove the flashing on the inside of the joint. Special tools are available for this purpose. The tool should be inserted into the conduit to the flashing and pressed firmly until the flash is removed. Then the tool and the cut-off flash should be removed from the conduit.

Authorized Engineering Information 5-15-1978.

A3 PROCEDURE FOR THREADING PE CONDUIT

A3.1 Clean each conduit end, inside and outside, to remove dirt, water, grease and other foreign material.

A3.2 Cut the conduit square using a handsaw or a mechanical cut-off. Remove cuttings and burrs from conduit ends.

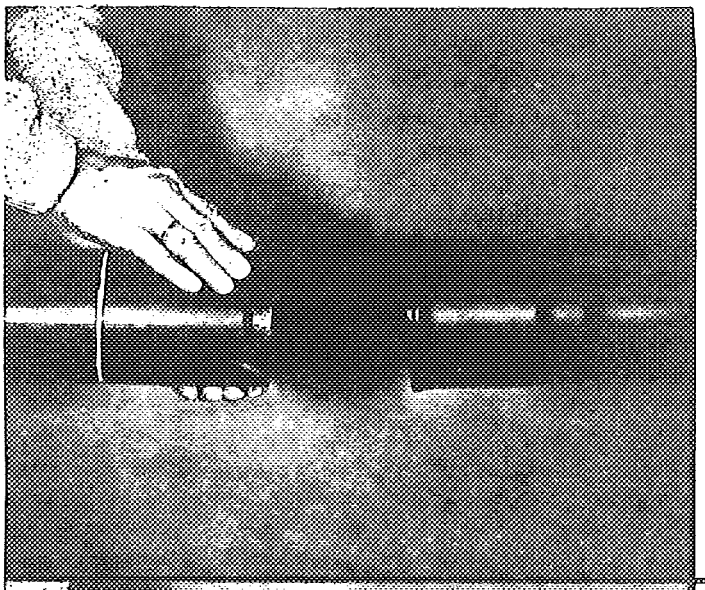
A3.3 Insert a mandrel fashioned of any convenient material. The mandrel will minimize deformation of the conduit wall while it is being threaded. The mandrel should fit the conduit closely, but snug fits are not necessary.

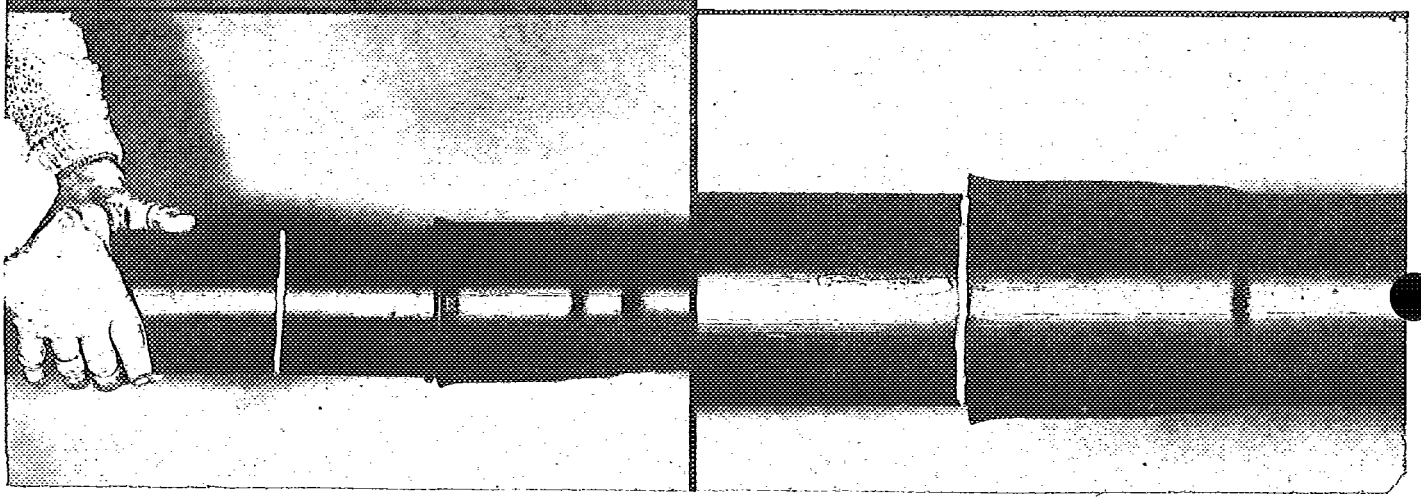
A3.4 Place a common, sharp iron conduit thread die on the end of the conduit containing the mandrel. Cut the threads by rotating the die in a normal manner. Because of the self-lubricating properties of polyethylene, thread lubricants will not be needed.

A3.5 Remove the die when sufficient thread has been cut, and then remove the mandrel.

Authorized Engineering Information 3-9-1967.

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





A4 PROCEDURE FOR INSTALLING PE DRIVE-ON JOINTS

A4.1 Clean the plain end of the conduit and the belled end socket of the mating conduit to remove dirt, grease and other foreign material.

A4.2 Place the O-ring gasket provided by the manufacturer around the plain end of the conduit. The O-ring should be located approximately ½ to ¾-inch (13 to 19 mm) from the end of the conduit.

A4.3 With the belled end held in position, push the plain end of the duct with the O-ring gasket into the belled end socket. The joint is complete when the circular marking around the conduit is even with the entrance of the belled socket.

Authorized Engineering Information 5-15-1978.

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

The purpose of NEMA Standards, their classification and status are set forth in certain clauses of the NEMA Bylaws, which are quoted 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 its particular need. 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.

(Bylaw—Art. V, Sec. 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.

(Bylaw—Art. V, Sec. 2, Subsection A)

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.

(NEMA Policy Memorandum 84-2, dated June 7, 1984)

Classes of Standards

National Electrical Manufacturers Association Standards are of two classes:

1. NEMA Standard, which relates to a product 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.

(Bylaw—Art. V, Sec. 2, Subsection B)

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.

(Bylaw—Art. V, Sec. 6, 1st Sentence)

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.

(Bylaw—Art. V, Sec. 4, Subsection A)

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.

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

PLASTIC CONDUIT, DUCT AND ACCESSORIES SECTION

OF THE

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

MEMBER COMPANIES

Can-Tex Industries
Mineral Wells, TX 76067

Carlon, Electrical Sciences, Inc.
Cleveland, OH 44122

Certainteed Corporation
Valley Forge, PA 19482

Challenger Electrical Materials, Inc.
Parkersburg, WV 26101

Formex Manufacturing, Inc.
Atlanta, GA 30362

Hercules Incorporated
Wilmington, DE 19899

Koch Fiberglass Products Company
Wichita, KS 67217

Midwest Plastic Fabricators, Inc.
Chagrin Falls, OH 44022

NVF Company
Fiber Glass Tubular Division
Houston, TX 77038

Robroy Industries, Inc.
Verona, PA 15147

A.O. Smith-Inland, Inc.
Little Rock, AR 72209

Underground Devices, Inc.
Glenview, IL 60025

Underground Products, Inc.
Troy, MI 48099-3230

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