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NEMA STANDARDS PUBLICATION

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POLYVINYL-CHLORIDE (PVC) EXTERNALLY COATED GALVANIZED RIGID STEEL CONDUIT AND INTERMEDIATE METAL CONDUIT

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

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Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

Published by

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FOREWORD

The purpose of this Standards Publication is to describe plastic coatings which are applied to galvanized rigid steel conduit and galvanized steel intermediate metal conduit. This Standard covers the properties and dimensions of these coatings and is intended as an aid for selecting and obtaining the proper coating for added corrosion protection in various applications of these electrical raceways.

Publication No. RN 1-1996 supersedes RN 1-1989. NEMA Standards and Authorized Engineering Information, which appears in this publication unchanged since its appearance in RN 1-1980, was reaffirmed. Metric designators and dimensions have been added. Information which has been revised is followed by the appropriate classification and the revision date.

User needs have been considered in the development of this Standards Publication.

This Standards Publication is reviewed periodically by the Steel Rigid Conduit and Electrical Metallic Tubing Section of NEMA for changes which may be necessary to keep it up-to-date with advancing technology. Proposed or recommended revisions should be submitted to:

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This Standards Publication was developed by the NEMA Steel Rigid Conduit and Electrical Metallic Tubing Section. Section approval of the standard does not necessarily imply that all section members voted for its approval or participated in its development. At the time it was approved, the Section was composed of the following members:

Allied Tube and Conduit Corporation—Harvey, IL
Beck Manufacturing, Inc. – Picoma Industries—Waynesboro, PA
LTV Steel Tubular Products Company—Youngstown, OH
OCAL, Inc.—Van Nuys, CA
Perma-Cote Industries—Uniontown, PA
Robroy Industries, Inc.—Verona, PA
Shamrock Conduit Products, Inc.—Barnesville, OH
Western Tube and Conduit Corporation—Long Beach, CA
Wheatland Tube—Collingswood, NJ

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Section 1
GENERAL

1.1 SCOPE

These standards cover continuous polyvinyl chloride exterior coatings, corrosion resistant interior coatings, and the galvanized steel conduit, galvanized steel intermediate metal conduit, threaded couplings, and elbows to which they may be applied.

1.2 REFERENCED STANDARDS

The following publications are adopted in whole or in part, as indicated by reference in this Standards Publication.

American National Standards Institute (ANSI)
11 West 42nd Street
New York, NY 10036

C80.1-1994 — *American National Standard for Rigid Steel Conduit-Zinc Coated*

C80.6-1994 — *American National Standard for Intermediate Metal Conduit*

American Society for Testing and Materials (ASTM)
100 Barr Harbor Drive
West Conshohocken, PA 19428

D149-97a — *Test Methods for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies*
This method describes a procedure for the determination of dielectric strength of solid, semi-solid, and liquid electrical insulating materials.

D638-97 — *Test Method for Tensile Properties of Plastics*
This test method is used to determine the tensile strength and the percent elongation of plastic coating compounds. A Type IV specimen is tested at a crosshead speed of 2 inches (50.8 mm) per minute.

D1790-94 — *Test Method for Brittleness Temperature of Plastic Film by Impact*
This method covers the determination of that temperature at which plastic film 0.25 mm (10 mils) or less in thickness exhibits a brittle failure.

D2240-97 — *Test Method for Rubber Property Durometer Hardness*
This method is used to determine the Shore A and Shore D hardness of PVC coating compounds.

G6-88 — *Test Method for Abrasion Resistance of Pipeline Coatings*
This method is used to determine the abrasion resistance of the applied coating material. It measures the time to loss of infinite resistance when the coating is subjected to an abrasive slurry.

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G10-83 *Test Method for Specific Bendability of Pipeline Coatings*
This test method is used to determine the bendability of coated conduit. It consists of bending a small-diameter specimen of coating pipe around a mandrel to produce a range of short-radius bends.

G23-96 *Practice for Operating Light-and Water-Exposure Apparatus (Carbon-Arc Type) for Exposure of Non-metallic Materials*
This recommended practice covers the basic principles and standard operating procedure for light- and water-exposure apparatus employing a carbon-arc light source.

Underwriters Laboratories, Inc. (UL)
333 Pfingsten Road
Northbrook, IL 60062

UL 6-1997 *Safety Standard for Rigid Metal Conduit*

UL 1242-1997 *Safety Standard for Intermediate Metal Conduit*

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Section 2
RIGID CONDUIT AND IMC

2.1 GALVANIZED RIGID STEEL CONDUIT

Galvanized rigid steel conduit, threaded couplings, and elbows are defined in and shall conform to American National Standard C80.1, and Underwriters Laboratories Standard 6.

If the threads are cut after the zinc coating has been applied, the threads shall be treated with a protective coating to prevent corrosion before installing.

Where unusually corrosive environments are encountered, it is recommended that threads be given additional protection suitable for the intended application.

2.2 INTERMEDIATE METAL CONDUIT

Galvanized steel intermediate metal conduit, threaded couplings, and elbows are defined in and shall conform to American National Standard C80.6 and Underwriters Laboratories Standard 1242.

2.3 INTERIOR COATINGS

Any supplemental interior coating shall be smooth and continuous and shall be unaffected by heat of the exterior coating process.

2.4 THREAD PROTECTORS

Thread protectors shall be used on the exposed threads of the coated conduit.

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Section 3
EXTERNAL COATINGS

3.1 THICKNESS

The thickness of polyvinyl chloride (PVC) coatings shall be a nominal 0.040 in. (1.02 mm). The tolerance on the coating thickness shall be +0.010 in. (0.25 mm) or -0.005 in. (0.13 mm).

3.2 COATING MATERIAL

The PVC coating shall have the properties specified in Table 3-1.

Table 3-1
PROPERTIES OF PVC COATINGS

Property	Minimum Requirement	ASTM Test Method
Hardness:		
Shore A	75	D 2240
Shore D	25	D 2240
Tensile Strength, psi	2000	D 638
Elongation, percent	200	D 638
Dielectric Strength, volts per mil	325	D 149
Brittleness temperature, degrees F	5	D 1790

3.3 APPLICATION OF COATING

3.3.1 Cleaning

The exterior surface that is to receive the coating shall be free of grease, oil, dirt, and other extraneous matter. The surface shall be cleaned in such a manner that the galvanized surface of the conduit is not harmed or eroded.

3.3.2 Priming

The cleaned exterior surface shall be primed with an adhesive suitable for use with the PVC coating material to be applied.

3.3.3 Coating

The PVC material shall be applied in powder, plastisol, or pellet form by a manufacturing method which will produce a finished product conforming to these standards.

3.4 ELBOWS

Coated elbows shall be used with coated conduit. The thickness of the coating on elbows shall be in accordance with Section 3.1.

3.5 COUPLINGS

Coated couplings shall be used with coated conduit. The thickness of the coating on couplings shall be at least equal to the thickness of the coating on the conduit.

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Each coated coupling shall have a flexible PVC sleeve which extends from each end of the coupling and which will overlap the PVC coating on the conduit when the coupling has been installed on the conduit. The length of the sleeve extension(s) shall be at least equivalent to the nominal conduit size for sizes up through NPS 2 (53). For sizes NPS 2-1/2 (63) through NPS 6 (155), the length of the sleeve extension(s) shall be at least 2 inches (50.8 mm).

The PVC sleeve shall be a nominal thickness of 0.040 in. (1.02 mm). The inside diameter (id) of the overlapping sleeve shall be less than the outside diameter (od) of the PVC-coated conduit.

3.6 WORKMANSHIP AND APPEARANCE

The PVC coating shall be free of blisters, bubbles, and pinholes. The PVC coating shall be continuous over the entire length of the conduit except at the threads, and shall be holiday-free at the time of manufacture.

A holiday is herein defined as an electrical discontinuity of less than 80,000 ohms equivalent resistance sensed with a cellulose sponge wet with a suitable electrolyte and measured with an appropriate low-voltage direct-current instrument. A suitable electrolyte is a solution containing tap water, 3.0 percent salt (sodium chloride), and 0.5 percent liquid detergent.

The inside of the PVC-coated conduit, couplings, and elbows shall be free of the PVC coating material.

All sleeve extensions shall be square cut.

3.7 PERFORMANCE REQUIREMENTS

Typical physical requirements for PVC-coated conduit are given in Table 3-2.

Table 3-2
TYPICAL PHYSICAL PROPERTIES OF PVC-COATED RIGID CONDUIT AND IMC

Property	Requirement*	Test Method
Abrasion resistance, hours	200, no failure	ASTM G 6
Bendability, radius in inches at 73.4° ± 1.8°F	9 (228.6 mm)	ASTM G 10
Artificial weathering, hours	Minimum 1000, no adverse effect	ASTM G 23

*The above requirements are based on testing a 0.040 in. (1.02 mm) PVC coating applied over NPS 3/4 (21) galvanized rigid steel conduit. See Section 1 for information on the ASTM test methods.

3.8 ADHESION

The adhesion of the PVC coating to the conduit shall be greater than the strength of the coating itself. This shall be determined by making two circumferential cuts, above 1/2 in. (12.7 mm) apart, through the plastic to the substrate. A third cut shall be made perpendicular to and crossing the circumferential cuts. The edge of the plastic shall be carefully lifted with a knife to form a plastic tab. This tab shall be pulled perpendicular to the conduit with a pair of pliers. The plastic tab shall tear rather than any additional coating film separating from the substrate.

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Section 4
CORROSION RESISTANT INTERNAL COATINGS (OPTIONAL)

4.1 THICKNESS

An interior coating shall be no more than 0.007 in. (0.18 mm) thick.

4.2 COATING MATERIAL

An interior coating may be of any thermoplastic or thermosetting material that meets the other requirements of this standard.

4.3 APPLICATION OF COATING

4.3.1 Cleaning

The interior surface to be coated shall be free of grease, oil, dirt, or other extraneous matter. If galvanized, the surface shall be cleaned in such a manner that the galvanized surface is not harmed or eroded.

4.3.2 Priming

If a primer is required, it shall be suitable for the coating material to be applied.

4.3.3 Coating

The methods used to apply an interior coating shall produce a finished product conforming to this standard.

4.4 ELBOWS/BENDABILITY

Interior coated elbows shall be used with interior coated conduit. The interior coating on conduit shall be capable of being field bent without cracking or flaking. (Requirement based on bending each trade size to minimum radius per ANSI C80.1.)

4.5 WORKMANSHIP AND APPEARANCE

An interior coating shall be free of blisters, bubbles, pinholes, etc., and shall be continuous over the entire length of the conduit.

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