NEMA Standards Publication FB 1-2014

Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

Published by

National Electrical Manufacturers Association
1300 North 17th Street, Suite 900
Rosslyn, VA 22209

www.nema.org

© 2014 National Electrical Manufacturers Association. All rights, including translation into other languages, reserved under the Universal Copyright Convention, the Berne Convention for the Protection of Literary and Artistic Works, and the International and Pan American copyright conventions.
NOTICE AND DISCLAIMER

The information in this publication was considered technically sound by the consensus of persons engaged in the development and approval of the document at the time it was developed. Consensus does not necessarily mean that there is unanimous agreement among every person participating in the development of this document.

The National Electrical Manufacturers Association (NEMA) standards and guideline publications, of which the document contained herein is one, are developed through a voluntary consensus standards development process. This process brings together volunteers and/or seeks out the views of persons who have an interest in the topic covered by this publication. While NEMA administers the process and establishes rules to promote fairness in the development of consensus, it does not write the document and it does not independently test, evaluate, or verify the accuracy or completeness of any information or the soundness of any judgments contained in its standards and guideline publications.

NEMA disclaims liability for any personal injury, property, or other damages of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, application, or reliance on this document. NEMA disclaims and makes no guaranty or warranty, express or implied, as to the accuracy or completeness of any information published herein, and disclaims and makes no warranty that the information in this document will fulfill any of your particular purposes or needs. NEMA does not undertake to guarantee the performance of any individual manufacturer or seller’s products or services by virtue of this standard or guide.

In publishing and making this document available, NEMA is not undertaking to render professional or other services for or on behalf of any person or entity, nor is NEMA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances. Information and other standards on the topic covered by this publication may be available from other sources, which the user may wish to consult for additional views or information not covered by this publication.

NEMA has no power, nor does it undertake to police or enforce compliance with the contents of this document. NEMA does not certify, test, or inspect products, designs, or installations for safety or health purposes. Any certification or other statement of compliance with any health- or safety-related information in this document shall not be attributable to NEMA and is solely the responsibility of the certifier or maker of the statement.
Foreword

This Standards Publication provides practical information concerning construction, test, performance, and manufacture of fittings, cast metal boxes, and conduit bodies for conduit, tubing, and cable assemblies. It is intended for use by the electrical industry to provide guidelines for the manufacture and proper application of these products, and to promote the benefits of repetitive manufacture and widespread product availability.

One of the primary purposes of this Standards Publication is to encourage the manufacture and utilization of products that function in accordance with this standard. While some sections of this publication are intended to eliminate misunderstandings between manufacturers and users, all sections, when applied properly, contribute to safety in one way or another.

The proper manufacture of fittings, cast metal boxes, and conduit bodies is, however, only one consideration in promoting the safe use of electricity. Other safety considerations involve the joint efforts of the system designer, the various equipment manufacturers, the installer, and the user. Information is provided in this standard, and in NEMA Standards Publications FB 2.10 and FB 2.20, to assist in proper selection and use.

The following factors are vital in a safe electrical system and should be considered by the user in the selection and application of equipment covered by the publication:

a) Environmental conditions
b) System design
c) Equipment selection and application
d) Installation
e) Operating practices
f) Maintenance

This Standards Publication has been published with a view to promoting the safety of persons and property when products conforming to it are selected, installed, and maintained in accordance with the National Electrical Code® (NEC).

NEMA Standards Publications are periodically reviewed to meet changing conditions and technical progress, and the latest edition shall be utilized. Comments from the users of this Standards Publication are welcome and should be sent to:

Senior Technical Director, Operations
National Electrical Manufacturers Association
1300 North 17th Street, Suite 900
Rosslyn, VA 22209

© 2014 National Electrical Manufacturers Association
At the time of publication, the Conduit Fittings Section of NEMA had the following members:

Adalet, a Division of Scott Fetzer
AFC Cable Systems, Part of Atkore International
Appleton Group
Arlington Industries, Inc.
Bridgeport Fittings, Inc.
Calpipe Industries, Inc.
Crouse-Hinds by Eaton
Eaton’s B-Line Business
ERICO
Hubbell Incorporated
IPEX Management Inc.
Legrand/Pass & Seymour
Producto Electric Corporation
Progressive Machine Die, Inc.
Steel Electric Products Company, Inc.
Thomas & Betts, a Member of the ABB Group

Cleveland, OH
New Bedford, MA
Rosemont, IL
Scranton, PA
Bridgeport, CT
Rancho Dominguez, CA
Syracuse, NY
Highland, IL
Solon, OH
Shelton, CT
Mississauga, ON, Canada
Syracuse, NY
Orangeburg, NY
Walton Hills, OH
Brooklyn, NY
Memphis, TN
CONTENTS

Foreword .................................................................................................................. i

Section 1 GENERAL .............................................................................................. 1
1.1 SCOPE ............................................................................................................... 1
1.2 NORMATIVE REFERENCES ........................................................................... 1
1.3 UNITS OF MEASUREMENT .......................................................................... 2
1.4 DEFINITIONS .................................................................................................... 3

Section 2 GENERAL REQUIREMENTS ................................................................ 6
2.1 GENERAL ......................................................................................................... 6
2.1.1 Applicability ............................................................................................... 6
2.1.2 Assembly and Mechanical Protection ....................................................... 6
2.1.3 Materials ..................................................................................................... 6
2.1.4 Thread Form and Dimensions .................................................................... 7
2.1.5 Resistance to Corrosion ............................................................................. 7
2.1.6 Electrical Protection .................................................................................. 7
2.1.7 Environmental Classifications .................................................................... 7
2.1.8 Marking ....................................................................................................... 8
2.2 FITTINGS—General ......................................................................................... 8
2.2.1 Functionality ............................................................................................... 8
2.2.2 Wall Thickness ............................................................................................ 8
2.2.3 Connectors .................................................................................................. 8
2.2.4 Couplings ................................................................................................... 9
2.2.5 Thread Form and Dimensions .................................................................... 9
2.3 CAST METAL BOXES, JUNCTION BOXES, PULL BOXES and CONDUIT BODIES—
   General ............................................................................................................. 9
2.3.1 Openings ..................................................................................................... 9
2.3.2 Conduit Bodies Used as Fittings ............................................................... 9
2.3.3 Conduit Bodies Used as Boxes ................................................................. 9
2.3.4 Conduit Entries .......................................................................................... 9
2.3.5 Wall Thickness ........................................................................................... 10
2.3.6 Resistance to Corrosion .......................................................................... 10

Section 3 SPECIFIC REQUIREMENTS .................................................................. 14
3.1 GENERAL ......................................................................................................... 14
3.1.1 Applicability ............................................................................................... 14
3.1.2 Functionality ............................................................................................... 14
3.1.3 Offset and Angle Fittings ........................................................................... 14
3.2 FITTINGS—SPECIFIC .................................................................................... 14
3.2.1 Fittings for Threaded and Unthreaded Non-flexible Metal Circular Raceways (Rigid
   Metal Conduit, Intermediate Metal Conduit, and Electrical Metallic Tubing) ...... 14
3.2.2 Fittings for use with Flexible Metal Conduit ............................................. 15
3.2.3 Fittings for Use with Armored Cable ....................................................... 15
3.2.4 Fittings for Use with Metal-clad Cable .................................................... 16
3.2.5 Fittings for Use with Mineral-insulated Cable ......................................... 16
3.2.6 Fittings for use with Liquidtight Flexible Metal Conduit....................... 16
3.2.7 Fittings for Use with Liquidtight Flexible Nonmetallic Conduit .............. 17
3.2.8 Locknuts Provided with Fittings .............................................................. 17
3.2.9 Conduit Locknuts ...................................................................................... 18
3.2.10 Bushings ................................................................................................... 17
3.2.11 Marking ..................................................................................................... 18
3.2.12 Ground Clamps ........................................................................................ 18

© 2014 National Electrical Manufacturers Association
3.2.13 Pulling, Strain Relief, and Support Grips .......................................................... 18
3.2.14 Reducing Washers .............................................................................................. 18
3.2.15 Service-entrance Heads, Caps ............................................................................ 18
3.2.16 Sill Plates ............................................................................................................ 18
3.2.17 Bushings for Use in Metal Studs ......................................................................... 19
3.2.18 Closure Plugs and Plates .................................................................................... 19

3.3 OUTLET BOXES, CONDUIT BODIES, JUNCTION BOXES, PULL BOXES, AND COVERS—SPECIFIC .............................................................. 19
3.3.1 Marking ............................................................................................................... 19
3.3.2 Cast Metal Outlet Boxes ...................................................................................... 19
3.3.3 Conduit Bodies ..................................................................................................... 21
3.3.4 Junction and Pull Boxes ....................................................................................... 21

Section 4 DESIGN TESTS ................................................................................................. 29
4.1 GENERAL .................................................................................................................... 29
4.1.1 Design Tests ......................................................................................................... 29
4.1.2 Test Sampling ....................................................................................................... 29
4.1.3 Nonmetallic Materials ......................................................................................... 29
4.2 MECHANICAL PROTECTION .................................................................................... 29
4.2.1 Assembly Test (2.1.2.2) ...................................................................................... 29
4.2.2 Rod Entry Test (2.2.3.5) ..................................................................................... 29
4.2.3 Mechanical Performance Testing Sequences ....................................................... 29
4.3 ELECTRICAL PROTECTION ................................................................................... 30
4.3.1 Fault Current Test (2.1.6.1) ............................................................................... 30
4.3.2 Electrical Continuity Test (2.1.6.2) .................................................................... 30
4.4 ENVIRONMENTAL CLASSIFICATION .................................................................. 30
4.4.1 Wet Locations Test (2.1.7.1) .............................................................................. 30
4.4.2 Concrete Test (2.1.7.2) ..................................................................................... 30
4.4.3 Oil Spray Test (2.1.7.3) ..................................................................................... 30
4.4.4 Type-rated Fittings and Boxes (2.1.7.4) .............................................................. 30

Section 5 MANUFACTURING STANDARDS .................................................................. 31
5.1 THREADS FOR FITTINGS, CAST METAL BOXES, AND CONDUIT BODIES .......... 31
5.1.1 Fittings and Conduit Entries with Internal Tapered Threads ................................. 31
5.1.2 Fittings and Conduit Entries with Internal Straight Threads ................................. 31
5.1.3 Fittings with External Straight Threads ............................................................... 32
5.1.4 Fittings with External Tapered Threads ............................................................... 32
5.2 KNOCKOUT DIMENSIONS ....................................................................................... 32
5.3 DIMENSIONS OF FLAT SURFACES SURROUNDING KNOCKOUTS ...................... 32

Appendix A FAMILY TREE OF THE CONDUIT FITTINGS MANUFACTURING INDUSTRY .... 40
Appendix B GAUGING PRACTICE ............................................................................... 41
Appendix C ALTERNATIVE KNOCKOUT DIMENSIONS ........................................... 42

Figures
Figure 1 Tangential-type Screw ..................................................................................... 24
Figure 2 Radial-type Screw ........................................................................................... 24
Figure 3 Basic Dimensions of Internal Straight Pipe Threads for Locknuts for Use with Electrical Connectors Having Type NPT Short Tapered External Threads or Type NPSM Straight External Threads ................................................................. 25
Figure 4 Basic Dimensions and Dimensions of Internal Straight Pipe Threads for Conduit Locknuts .. 26
Figure 5 Configuration of Single-gang FS and FD Box Face ........................................... 27
Figure 6 Straight Pull Type C ......................................................................................... 28
Figure 7 Angle Pull Entry Opposite Removable Cover Type LB ................................... 28
Figure 8 Flat Surfaces Surrounding Knockouts ............................................................ 36

© 2014 National Electrical Manufacturers Association
Figure 9  NPT Male to NPT Female Thread Engagement Trade Sizes ½ and ¾;
14 Threads per Inch (Based on Male NPT Thread Gauging of L₁ + 0 [Flush]) ....................37
Figure 10 NPT Male to NPT Female Thread Engagement Trade Sizes 1, 1¼, 1½, and 2;
11½ Threads per Inch (Based on Male NPT Thread Gauging of L₁ + 0 [Flush]) ....................37
Figure 11 NPT Male to NPT Female Thread Engagement Trade Sizes 2½, 3, 3½, 4, 5, and 6;
8 Threads per Inch (Based on Male NPT Thread Gauging of L₁ + 0 [Flush]) ....................38

Tables
Table 1  Trade Size and Metric Designators.................................................................5
Table 2  Standard Assembly Torque Values for Conduit and Cable Fittings .......................11
Table 3  Inside Diameter of Throats and End Stops for Fittings and Bushings ......................11
Table 4  Thickness of Zinc Corrosion Protective Coating ..............................................12
Table 5  Wall Thickness of Fittings .............................................................................12
Table 6  Metal Thickness .............................................................................................12
Table 7  Minimum Thread Projection of Box Connectors ..............................................13
Table 8  Minimum Wall Thickness at Tapped Holes for Conduit ..................................13
Table 9  Diameter of Plug Go-gauge ...........................................................................22
Table 10  Radius of Bend of Angle Fittings ....................................................................22
Table 11  Outside Diameter of Flexible Metal Conduit Fitting of the Screw-in–Type ..........22
Table 12  Armored Cable Bushing Dimensions .............................................................23
Table 13  Distance from Removable Cover to Opposite Wall with Raceway Opening ........23
Table 14  Number of Turns Past L₁ Gauging Notch of Working NPT Plug Gauge for NTC Threaded
Conduit Entries ........................................................................................................33
Table 15  Number of Turns Past L₁ Gauging Notch of Working NPT Plug Gauge for NTCM Threaded
Conduit Entries ........................................................................................................33
Table 16  Minimum Depth to Integral Bushings ..............................................................34
Table 17  Gauging Requirements for External Tapered Threads for Conduit Fittings for Use with
Threaded Rigid Metal Conduit Couplings, Threaded Intermediate Metal Conduit Couplings,
or Other Electrical Fittings Having Tapered or Straight Internal Threads (Cut Threads—for
Ordinary Location Applications Only) .........................................................................35
Table 18  Maximum Number of Threads in the Wall of a Cast Metal Box Having Through-threaded
Entries .........................................................................................................................35
Table 19  Compatibility of Knockout Dimensions with Locknuts, Bushings, and Metal Conduit (IMC
or Rigid) to Assure Coordination** ..........................................................................39
Section 1
GENERAL

1.1 SCOPE

This Standards Publication covers fittings that are a part of electrical raceway systems designed for use as intended by the requirements of the National Electrical Code® (NEC), NFPA 70. Specifically, this standard covers fittings for use with non-flexible tubular raceways: Rigid and Intermediate Metal Conduit and Electrical Metallic Tubing. Also included are fittings for use with flexible conduit and cable raceways, including: Flexible Metal Conduit and liquidtight flexible conduits, Armored Cable, Metal Clad Cable, Tray Cable, Mineral Insulated Cable, Flexible Cord, Nonmetallic Sheathed Cable, and Service Entrance Cable. The Family Tree of the Conduit Fittings Industry is provided for reference in Appendix A.

This standard also includes cast metal outlet boxes and covers, as well as conduit bodies and covers, which when designed for the purpose, serve as a box intended to house conductor splices and/or wiring devices; and cast metal junction boxes, pull boxes, and covers.

This standard does not include standard conduit couplings of the type provided with lengths of Rigid and Intermediate Metal Conduit, or threaded conduit nipples, or threaded or unthreaded factory-made bends derived from Rigid and Intermediate Metal Conduit or Electrical Metallic Tubing.

This standard does not apply to fittings, boxes, or enclosures that are for use in Class I, Division 1; Class II, Division 1; Class III, Division 1; Class I, Zones 0, 1, 2; Zones 20, 21, or 22 hazardous (classified) locations. Exceptions are those ordinary (unclassified) location fittings and enclosures that are specifically permitted by the NEC in these locations.