

NEMA RV 3-2012

Application and Installation Guidelines for Flexible and Liquidtight Flexible Metal and Nonmetallic Conduits



NEMA RV 3-2012

Application and Installation Guidelines for Flexible and Liquidtight Flexible Metal and Nonmetallic Conduits

Published by:

National Electrical Manufacturers Association

1300 North 17th Street, Suite 1752
Rosslyn, VA 22209

www.nema.org

© Copyright 2012 by the 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.

TABLE OF CONTENTS

| | Page |
|--|---------------|
| FOREWORD | v |
| Section 1 APPLICATION GUIDELINES FOR FLEXIBLE METAL CONDUIT | 1 |
| 1.1 Construction | 1 |
| 1.1.1 General | 1 |
| 1.1.2 Conduit..... | 1 |
| 1.2 Grounding and Bonding | 1 |
| 1.3 Equipment Grounding Conductor | 1 |
| 1.4 Codes and Standards | 1 |
| 1.4.1 <i>National Electrical Code</i> [®] | 1 |
| 1.4.2 Related <i>NEC</i> [®] Articles | 2 |
| 1.4.3 Underwriters Laboratories (UL) Standards and Directories..... | 5 |
| Section 2 APPLICATION GUIDELINES FOR LIQUIDTIGHT FLEXIBLE METAL AND NONMETALLIC CONDUIT | 7 |
| 2.1 Construction | 7 |
| 2.1.1 General | 7 |
| 2.1.2 Material | 7 |
| 2.1.3 Fittings | 7 |
| 2.2 Grounding | 8 |
| 2.3 Marking | 8 |
| 2.4 Codes And Standards | 8 |
| 2.4.1 <i>National Electrical Code</i> [®] | 8 |
| 2.4.2 Related <i>NEC</i> [®] Articles | 10 |
| 2.4.3 Underwriters Laboratories (UL) Standards and Directories..... | 12 |
| Section 3 INSTALLATION GUIDELINES FOR FLEXIBLE METAL CONDUIT AND LIQUIDTIGHT FLEXIBLE METAL CONDUIT | 15 |
| 3.1 Installation Considerations | 15 |
| 3.1.1 General | 15 |
| 3.1.2 Special Considerations for LFMC | 15 |
| 3.1.3 Overall Length of Conduit | 15 |
| 3.2 Securing and Supporting FMC and LFMC | 16 |
| 3.2.1 Supporting..... | 17 |
| 3.2.2 Unsupported | 17 |
| 3.3 Terminating Flexible Metal Conduit | 17 |
| 3.3.1 Fitting Selection | 17 |
| 3.3.2 Conduit Preparation and Assembly | 17 |
| 3.3.3 Cutting Conduit | 18 |
| 3.3.4 Inserting Conduit..... | 18 |
| 3.3.5 Seating A Securement Clamp | 18 |
| 3.3.6 Tightening Torque..... | 19 |
| 3.3.7 Attachment to Unthreaded Entries..... | 19 |
| 3.3.8 Attachment to Threaded Entries | 20 |
| 3.4 Terminating Liquidtight Flexible Metal Conduit | 20 |
| 3.4.1 Fitting Selection | 20 |
| 3.4.2 Conduit Preparation and Assembly | 20 |
| 3.5 Verification of Installation | 22 |
| Section 4 INSTALLATION GUIDELINES FOR LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC) | 23 |
| 4.1 Installation Considerations | 23 |

| | | |
|------------|---|-----------|
| 4.1.1 | General | 23 |
| 4.1.2 | Types..... | 23 |
| 4.2 | Securing and Supporting Lfnc..... | 23 |
| 4.2.1 | Supported | 23 |
| 4.2.2 | Unsupported | 23 |
| 4.3 | Terminating LFNC | 24 |
| 4.3.1 | Fitting Selection | 24 |
| 4.3.2 | Environmental Considerations..... | 25 |
| 4.3.3 | Required Marking on Fittings..... | 25 |
| 4.3.4 | Grounding | 26 |
| 4.3.5 | Conduit Preparation and Fittings Assembly Technique | 26 |
| 4.3.6 | Attachment to Boxes or Enclosures and Support | 27 |
| 4.4 | Verification of Installation | 28 |

ANNEX A NEMA Engineering Bulletin No. 93: Length Limitations for FMC and LFMC A-1

Tables

| | | |
|----------|--|----|
| Table 1 | Standard Assembly Torque Values for Type FMC Fittings | 19 |
| Table 2 | Standard Assembly Torque Values for Type LFMC Fittings | 21 |
| Table 3 | Markings for Fittings for Use with Liquidtight Flexible Nonmetallic Conduit..... | 25 |
| Table 4 | Assembly Torque Values for LFNC Fittings | 27 |
| Table 5 | Overall Conduit Length for Given Offset and Lateral Distance (1/2)..... | 32 |
| Table 6 | Overall Conduit Length for Given Offset and Lateral Distance (3/4)..... | 32 |
| Table 7 | Overall Conduit Length for Given Offset and Lateral Distance (1)..... | 33 |
| Table 8 | Overall Conduit Length for Given Offset and Lateral Distance (1-1/4)..... | 33 |
| Table 9 | Overall Conduit Length for Given Offset and Lateral Distance (1-1/2)..... | 34 |
| Table 10 | Overall Conduit Length for Given Offset and Lateral Distance (2)..... | 34 |

FIGURES

| | | |
|-------------------|---|----|
| Figure 3-1 | Determination of Overall Length of Conduit Installed in a Traveling Vertical Loop with Offset | 16 |
| Figure 3-2 | Tangent Length | 16 |
| Figure 4-1 | Typical Designs of FMC Fittings, Clamp Type | 28 |
| Figure 4-2 | Typical Designs of FMC Fittings, Direct-Bearing Screw Type | 29 |
| Figure 4-3 | Typical Designs of FMC Fittings, Screw-In Type | 29 |
| Figure 4-4 | Typical Designs of Liquidtight Flexible Metal Conduit Fittings | 30 |
| Figure 4-5 | Typical Designs of Liquidtight Flexible Nonmetallic Conduit Fittings | 31 |
| Figure 4-6 | Flexible Metal Conduit Securement Clamp | 35 |

Foreword

These application and installation guidelines offer practical information on correct usage and industry recommended practices for the installation of Flexible Metal Conduit (Type FMC) and Liquidtight Flexible Metal Conduit (Type LFMC) in accordance with the *National Electrical Code*[®] (*NEC*[®]).

These guidelines have been developed by the NEMA Building Wire and Cable Group and Dues Center's Flexible Metal Conduit Technical Committee, which has committed to periodically reviewing them for any revisions necessary to address changing conditions, product listing and installation requirements, and technical progress. Comments for proposed revisions are welcomed and should be submitted to:

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

At the time of approval, the NEMA Building Wire and Cable Group and Dues Center's Flexible Metal Conduit Technical Committee had the following members:

AFC Cable Systems, Inc., A part of Atkore International—New Bedford, MA
Anamet Electrical, Inc.—Mattoon, IL
Electri-Flex Company—Roselle, IL
Encore Wire Corporation—McKinney, TX
International Metal Hose Company—Bellevue, OH
Southwire Company—Carrollton, GA