



ANSI/NEMA MW 1000-2011

Magnet Wire



National Electrical Manufacturers Association
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Summary of Revisions MW 1000-2011

Amendments following the publication of MW 1000-2008, Revision 2-2010

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Note: Where text has been revised in more than one version, only the most recent is color-coded

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Summary of Revisions

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Amendments from Revision 2-2010 are indicated by a **blue** vertical line in left margin of revised page

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Part 2 PROPERTIES AND REQUIREMENTS

Specification Number		Thermal Class	Round	Rectangular and Square	Page No.
MW 2-C	Polyurethane for solderable applications (Single and Heavy) OBSOLETE EFFECTIVE DEC. 31, 2012	105	X	—	2
MW 3-C	Polyurethane with self-bonding overcoat for solderable applications (Types 1 and 2) OBSOLETE EFFECTIVE DEC. 31, 2012	105	X	—	3
MW 5-C	Polyester (Single and Heavy)	155	X	—	4
MW 6-C	Polyamide (Single and Heavy) OBSOLETE EFFECTIVE DEC. 31, 2012	105	X	—	5
MW 15-A	Polyvinyl Acetal (Single and Heavy)	105	X	—	6
MW 15-C	Polyvinyl Acetal (Single, Heavy, Triple and Quad)	105	X	—	7
MW 16-C	Polyimide (Single Heavy, Triple, and Quadruple)	240	X	—	8–9
MW 17-C	Polyvinyl acetal overcoated with polyamide (Single and Heavy) OBSOLETE EFFECTIVE DEC. 31, 2012	105	X	—	10
MW 18-A	Polyvinyl acetal (Heavy and Quadruple)	105	—	X	11
MW 18-C	Polyvinyl acetal (Heavy and Quadruple)	105	—	X	12
MW 19-C	Polyvinyl acetal with self-bonding overcoat (Types 1, 2 and 3)	105	X	—	13
MW 20-C	Polyimide (Heavy and Quadruple)	240	—	X	14
MW 24-A	Polyester (amide) (imide) overcoated with polyamide (Single and Heavy)	155	X	—	15
MW 24-C	Polyester (amide) (imide) overcoated with polyamide (Single, Heavy and Triple)	155	X	—	16
MW 26-C	Polyester (imide) for solderable applications (Single and Heavy)	155	X	—	17
MW 27-C	Polyester (imide) overcoated with polyamide for solderable applications (Single and Heavy)	155	X	—	18
MW 28-A	Polyurethane overcoated with polyamide for solderable applications (Single and Heavy)	130	X	—	19
MW 28-C	Polyurethane overcoated with polyamide for solderable applications (Single and Heavy)	130	X	—	20
MW 29-C	Polyurethane overcoated with polyamide and self-bonding overcoat for solderable applications (Types 1 and 2)	105	X	—	21
MW 30-C	Polyester (amide) (imide) (Single, Heavy, and Triple)	180	X	—	22
MW 31-C	Paper covered	90 or 105	X	—	23
MW 33-C	Paper covered bare rectangular and square	90 or 105	—	X	24

Specification Number		Thermal Class	Round	Rectangular and Square	Page No.
MW 35-A	Polyester (amide) (imide) overcoated with polyamideimide (Single and Heavy)	220	X	—	25
MW 35-C	Polyester (amide) (imide) overcoated with polyamideimide (Single, Heavy Triple, and Quad)	200	X	—	26
MW 36-A	Polyester (amide) (imide) overcoated with polyamideimide (Heavy and Quadruple)	220	—	X	27
MW 36-C	Polyester (amide) (imide) overcoated with polyamideimide (Heavy and Quadruple)	200	—	X	28
MW 37-C	Polyester (amide) (imide) overcoated with polyamideimide (Single, Heavy and Triple)	220	X	—	29
MW 38-C	Polyester (amide) (imide) overcoated with polyamideimide (Heavy and Quadruple)	220	—	X	30
MW 41-C	Glass fiber covered (Single and Double)	155	X	—	31
MW 42-C	Glass fiber covered (Single and Double)	155	—	X	32
MW 43-C	Glass fiber covered silicone treated (Single and Double)	200	—	X	33
MW 44-C	Glass fiber covered silicone treated (Single and Double)	200	X	—	34
MW 45-C	Polyester glass fiber covered (Single and Double)	155	X	—	35
MW 46-C	Polyester glass fiber covered (Single and Double)	155	—	X	36
MW 47-C	Polyester glass fiber covered silicone treated (Single and Double)	200	X	—	37
MW 48-C	Polyester glass fiber covered silicone treated (Single and Double)	200	—	X	38
MW 50-C	Glass fiber covered, high temperature organic varnish treated (Single and Double)	180	X	—	39
MW 51-C	Polyester glass fiber covered, High Temperature organic varnish treated (Single and Double)	180	X	—	40
MW 52-C	Glass fiber covered, high temperature organic varnish treated (Single or Double)	180	—	X	41
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MW 60-A	Aromatic polyamide paper covered (Paper)	220	—	X	43
MW 60-C	Aromatic polyamide paper covered (Paper)	220	—	X	44
MW 61-A	Aromatic polyamide paper covered (Paper)	220	X	—	45
MW 61-C	Aromatic polyamide paper covered (Paper)	220	X	—	46
MW 62-C	Aromatic Polyimide tape covered	220	—	X	47
MW 63-C	Aromatic Polyimide tape covered	220	X	—	48

MW 64-C	Aromatic Polyimide tape covered	240	—	X	49
MW 65-C	Aromatic Polyimide tape covered	240	X	—	50
MW 72-C	Polyester (amide) (imide) for Hermetic Applications (Heavy)	180	X	—	51
MW 73-A	Polyester (amide) (imide) overcoated with polyamideimide for Hermetic Applications (Heavy)	220	X	—	52
MW 73-C	Polyester (amide)(imide) overcoated with polyamideimide for Hermetic Applications (Heavy, Triple, and Quad)	200	X	—	53
MW 74-A	Polyester (amide) (imide) (Single and Heavy)	220	X	—	54
MW 74-C	Polyester (amide) (imide) (Single and Heavy)	200	X	—	55
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MW 76-C	Polyester (amide) (imide) overcoated with polyamide (Single, Heavy, and Triple)	180	X	—	58
MW 77-C	Polyester (imide) for solderable applications (Single and Heavy)	180	X	—	59
MW 78-C	Polyester (imide) overcoated with polyamide for solderable applications (Single and Heavy)	180	X	—	60
MW 79-C	Polyurethane for solderable applications (Single, Heavy and Triple)	155	X	—	61
MW 80-A	Polyurethane overcoated with polyamide for solderable applications (Single and Heavy)	155	X	—	62
MW 80-C	Polyurethane overcoated with polyamide for solderable applications (Single, Heavy, Triple)	155	X	—	63
MW 81-C	Polyamideimide (Single and Heavy)	220	X	—	64
MW 82-C	Polyurethane for solderable applications (Single, Heavy and Triple)	180	X	—	65
MW 83-C	Polyurethane overcoated with polyamide for solderable applications (Single, Heavy, Triple)	180	X	—	66
MW 102-A	Polyester (amide) (imide) overcoated with polyamideimide and self-bonding overcoat (Type 1 and Type 2)	180	X	—	67
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MW 130-C	Polyurethane with self-bonding overcoat (Type 1 and Type 2)	130	X	—	69
MW 131-C	Polyurethane with self-bonding overcoat (Type 1 and Type 2)	155	X	—	70
MW 135-C	Polyurethane overcoated with polyamide and self-bonding overcoat (Type 1 and Type 2)	130	X	—	71
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Q (MW 16-C) Polyimide Quadruple Film Insulated Round Copper Magnet Wire, Thermal Class 240 9

Part 2 PROPERTIES AND REQUIREMENTS LISTING BY THERMAL CLASS, INSULATION, COATING, AND FORM

Thermal Class	Insulation, Covering and Form	See Part 2, Section		
		Aluminum	Copper	Page No.
FILM INSULATED ROUND MAGNET WIRE				
105	Polyamide	-	MW 6-C	5
105	Polyvinyl acetal	MW 15-A	MW 15-C	6, 7
105	Polyvinyl acetal overcoated with polyamide	-	MW 17-C	10
105 Solderable	Polyurethane	-	MW 2-C	2
105 Solderable	Polyurethane and self-bonding overcoat	-	MW 3-C	3
105 Solderable	Polyurethane overcoated with polyamide and self-bonding overcoat	-	MW 29-C	21
105	Polyvinyl acetal and self-bonding overcoat	-	MW 19-C	13
130 Solderable	Polyurethane overcoated with polyamide	MW 28-A	MW 28-C	19, 20
130 Solderable	Polyurethane	-	MW 75-C	56
130 Solderable	Polyurethane with self-bonding overcoat	-	MW 130-C	69
130 Solderable	Polyurethane overcoated with polyamide and self-bonding overcoat	-	MW 135-C	71
155	Polyester	-	MW 5-C	4
155	Polyester (amide) (imide) overcoated with polyamide	MW 24-A	MW 24-C	15, 16
155 Solderable	Polyester (imide)	-	MW 26-C	17
155 Solderable	Polyester (imide) overcoated with polyamide	-	MW 27-C	18
155 Solderable	Polyurethane	-	MW 79-C	61
155 Solderable	Polyurethane overcoated with polyamide	MW 80-A	MW 80-C	62, 63
155 Solderable	Polyurethane with self-bonding overcoat	-	MW 131-C	70
155 Solderable	Polyurethane overcoated with polyamide and self-bonding overcoat	-	MW 136-C	72

Part 2

PROPERTIES AND REQUIREMENTS LISTING BY THERMAL CLASS, INSULATION, COATING, AND FORM

Thermal Class	Insulation, Covering and Form	See Part 2, Section		
		Aluminum	Copper	Page No.
180	Polyester (amide) (imide)	-	MW 30-C	22
180	Polyester (amide) (imide) overcoated with polyamide	MW 76-A	MW 76-C	57, 58
180	Polyester (amide) (imide) overcoated with polyamideimide and self-bonding overcoat	MW 102-A	MW 102-C	67, 68
180 Solderable	Polyester (imide)	-	MW 77-C	59
180 Solderable	Polyester (imide) overcoated with polyamide	-	MW 78-C	60
180 Hermetic	Polyester (amide) (imide)	-	MW 72-C	51
180 Solderable	Polyurethane	-	MW 82-C	63
180 Solderable	Polyurethane overcoated with Polyamide	-	MW 83-C	66
200	Polyester (amide) (imide) overcoated with polyamideimide	-	MW 35-C	26
200	Polyester (amide) (imide)	-	MW 74-C	55
200 Hermetic	Polyester (amide) (imide) overcoated with polyamideimide	-	MW 73-C	53
220	Polyester (amide) (imide) overcoated with polyamideimide	MW 35-A	-	25
220	Polyester (amide) (imide) overcoated with polyamideimide	-	MW 37-C	29
220	Polyester (amide) (imide)	MW 74-A	-	54
220 Hermetic	Polyester (amide) (imide) overcoated with polyamideimide	MW 73-A	-	52
220	Polyamideimide		MW 81-C	64
240 Hermetic	Polyimide	-	MW 16-C	8-9
FILM INSULATED RECTANGULAR AND SQUARE WIRE				
105	Polyvinyl acetal	MW 18-A	MW 18-C	11, 12
200	Polyester (amide) (imide) overcoated with polyamideimide	-	MW 36-C	28
220	Polyester (amide) (imide) overcoated with polyamideimide	MW 36-A	-	27
220	Polyester (amide) (imide) overcoated with Polyamideimide	-	MW 38-C	30
240	Polyimide	-	MW 20-C	14
FIBROUS COVERED ROUND MAGNET WIRE				
90 or 105	Paper covered	-	MW 31-C	23
155	Glass fiber covered	-	MW 41-C	31
155	Polyester glass fiber covered	-	MW 45-C	35
180	Glass fiber covered, high temperature organic varnish treated	-	MW 50-C	39
180	Polyester glass fiber covered, high temperature organic varnish treated	-	MW 51-C	40
200	Glass fiber covered, silicone treated	-	MW 44-C	34
200	Polyester glass fiber covered, silicone treated	-	MW 47-C	37

Part 2

PROPERTIES AND REQUIREMENTS LISTING BY THERMAL CLASS, INSULATION, COATING, AND FORM

Thermal Class	Insulation, Covering and Form	See Part 2, Section		
		Aluminum	Copper	Page No.
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220	Aromatic polyimide tape covered	-	MW 63-C	48
240	Aromatic polyimide tape covered	-	MW 65-C	50
FIBROUS COVERED RECTANGULAR & SQUARE MAGNET WIRE				
90 or 105	Paper covered	-	MW 33-C	24
155	Glass fiber covered	-	MW 42-C	32
155	Polyester glass fiber covered	-	MW 46-C	36
180	Glass fiber covered, high temperature organic varnish treated	-	MW 52-C	41
180	Polyester glass fiber covered, high temperature organic varnish treated	-	MW 53-C	42
200	Glass fiber covered, silicone treated	-	MW 43-C	33
200	Polyester glass fiber covered, silicone treated	-	MW 48-C	38
220	Aromatic polyamide paper covered	MW 60-A	MW 60-C	43, 44
220	Aromatic polyimide tape covered	-	MW 62-C	47
240	Aromatic polyimide tape covered	-	MW 64-C	49

Part 3

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Foreword

NEMA Standards Publication MW 1000-2011 supersedes NEMA Standards Publication MW 1000-2008, Revision 1-2009 and Revision 2-2010. It has been approved as an American National Standard.

The standards contained in this publication are periodically reviewed by the NEMA Magnet Wire Section for revisions considered to be necessary to keep them up to date with changes in technology. Proposed or recommended revisions should be submitted to:

Vice President, Technical Services
National Electrical Manufacturers Association
1300 North 17th Street, Suite 1752
Rosslyn, Virginia 22209

These standards were developed by the Magnet Wire Section of NEMA, working closely with representatives of various industries that use magnet wire. At the time they were approved, the Magnet Wire Section had the following members:

Bridgeport Insulated Wire Company—Bridgeport, CT
CONDUMEX—México, D.F.
Elektrisola, Inc.—Boscawen, NH
Essex Group, Inc.—Fort Wayne, IN
Magnekon—San Nicolas, NL, Mexico
MWS Wire Industries—Westlake Village, CA
Rea Magnet Wire Company, Inc.—Fort Wayne, IN
Rubadue Wire Company, Inc. —Greeley, CO

How to Use This Publication

First, review Part 1 for general information. Then, in Part 2, locate the specification for the type of insulation and conductor of interest. Part 2 is arranged in numerical order as shown beginning on page iii. The dimensions for each Part 2 MW type are provided in Part 1, beginning with Table 1-1. The specification in Part 2 will indicate the requirements to be met and will refer to the test procedures and corresponding test values to be attained in Part 3.

Part 1 (blue, if in print) of this publication deals with information common to all types of magnet wire, that is, ordering information, general material requirements, general test conditions, definitions and manufacturing data in support of thermal rating. This part also includes dimensions with metric equivalents for all bare, minimum insulation increase, and overall dimensions for all Part 2 MW specification requirements.

Part 2 (yellow, if in print) consists of product specifications requirements (other than dimensions) for magnet wire with different types of coatings and/or coverings. Insofar as possible, the product specifications are complete on one sheet since they are arranged to include only one insulation or covering per sheet. The title on each individual sheet identifies the product. (Example: MW 15-C, Polyvinyl Acetal Round Copper Magnet Wire. MW 15-A covers the aluminum version of the same generic product).

Part 3 (green, if in print) contains the test procedures to be followed and corresponding tables of specific test values to be attained in determining compliance with the requirements given in Part 2. The requirements are consolidated with the test procedures and testing parameters for a given property. An index of the main test paragraphs is given beginning on page ix, Part 3 Test Procedures, of the Table of Contents.

Appendix A (gray, if in print) provides a cross reference between test procedures in this Standards Publication and those published by the American Society for Testing and Materials (ASTM).

Appendix B (gray, if in print) consists of definitions, requirements, and recommended test procedures for reusable magnet wire packaging, standardized dimensions for spools and reels, and formatting for the labeling of magnet wire products.

Appendix C (gray, if in print) provides a cross reference between NEMA, cancelled J-W-1177 Federal, and IEC magnet wire specifications.

Appendix D (tan, if in print) provides the formulas for determining dimensional requirements of round film insulated magnet wire and dielectric breakdown, as well as cross-sectional area and resistance calculations.

Appendix E (gray, if in print) provides the dimensional criteria for ranges of sizes of rectangular bare, film, and fabric magnet wire products, setting the general rules and guidelines for various traditional yet non-standard rectangular magnet wire products.

Appendix F (gray, if in print) provides properties of selected refrigerants determined as suitable alternatives to refrigerant R22 in the Refrigerant Extraction test, clause 3.55.

Appendix G (gray, if in print) provides recommended winding tensions for round copper and aluminum magnet wire to ensure that wire as it is de-reeled, is not stretched beyond end user requirements

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Part 1 GENERAL

1.1 SCOPE

This publication is designed to present in concise and convenient form, all existing NEMA standards for magnet wire. It contains standards for round, rectangular, and square film insulated and/or fibrous covered copper and aluminum magnet wire for use in electrical apparatus. Included are the definitions, type designations, dimensions, constructions, performance, and test methods for magnet wire generally used in the winding of coils for electrical apparatus. Unless otherwise stated, a revision to a product specification in this standards publication does not affect compliance of product manufactured during the time a previous version of that specification was in effect.

1.2 NORMATIVE REFERENCES AND AUTHORIZED ENGINEERING INFORMATION (AEI)

The following references apply to Parts 1, 2, and 3 only. Reference is made to the current revision of each of the standards or Authorized Engineering Information (AEI) listed below:

American National Standards Institute

11 West 42nd Street
New York, NY 10036

American Society for Testing Materials

100 Barr Harbor Drive
West Conshohocken, PA 19428-2959

ASTM B 193	<i>Standard Test Method for Resistivity of Electrical Conductor Materials</i>
ASTM B 3	<i>Standard Specification for Soft or Annealed Copper Wire</i>
ASTM B 32	<i>Standard Specification for Solder Metal</i>
ASTM B 48	<i>Standard Specification for Soft Rectangular and Square Bare Copper Wire for Electrical Conductors</i>
ASTM D 149	<i>Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies</i>
ASTM D 1676	<i>Standard Methods for Testing Film-Insulated Magnet Wire</i>
ASTM D 1711	<i>Standard Terminology Relating to Electrical Insulation</i>
ASTM D 1932	<i>Standard Test Method for Thermal Endurance of Flexible Electrical Insulating Varnishes</i>
ASTM D 2307	<i>Standard Test Method for Relative Thermal Endurance of Film-Insulated Round Magnet Wire</i>
ASTM D 3353	<i>Standard Methods for Testing Fibrous-Insulated Magnet Wire</i>
ASTM D 5423	<i>Standard Specification for Forced-Convection Laboratory Ovens for Evaluation of Electrical Insulation</i>
ASTM E 29	<i>Standard Recommended Practice for Indicating Which Places of Figures Are to Be Considered Significant in Specified Limiting Values</i>
ASTM E 8	<i>Standard Methods of Tension Testing of Metallic Materials</i>

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ANSI/IEEE Std 1	<i>General Principles for Temperature Limits in the Rating of Electric Equipment and for the Evaluation of Electrical Insulation</i>
ANSI/IEEE Std 4	<i>Techniques for High Voltage Testing</i>