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ANSI/NEMA MW 1000-2020

American National Standard for Magnet Wire

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FOREWORD

ANSI/NEMA MW 1000-2020 supersedes ANSI/NEMA MW 1000-2018. It has been approved as an American National Standard.

This Standard is periodically reviewed by the NEMA Magnet Wire Section for revisions considered to be necessary to keep it up to date with changes in technology and regulations. See <http://www.MW1000.com> for additional information.

Proposed or recommended revisions should be submitted to:

Technical Director, Operations
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MW 1000 was developed by the Magnet Wire Section of NEMA, working closely with representatives of various industries that use magnet wire. At the time this edition was approved, the Magnet Wire Section had the following members:

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Elektrisola, Inc.	Boscawen, NH
Essex Furukawa	Fort Wayne, IN
Magnekón	San Nicolas, NL, México
MWS Wire Industries	Westlake Village, CA
New England Wire Technologies	Lisbon, NH
Rea Magnet Wire Company, Inc.	Fort Wayne, IN
Rubadue Wire Company, Inc.	Loveland, CO
Virginia Insulated Products, Inc.	Saltville, VA
Zeus Industrial products, Inc.	Orangeburg, SC

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 14. The dimensions for each Part 2 MW type are provided in Part 1, beginning with Table 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 of this publication deals with information common to all types of magnet wire: 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 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 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 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 provided, beginning on page 14, Part 3 Test Procedures, in the Table of Contents.

Annex A provides a cross reference between test procedures in this Standards publication and those published by the American Society for Testing and Materials (ASTM).

Annex B 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.

Annex C provides a cross reference between NEMA and IEC magnet wire specifications.

Annex D 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.

Annex E 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.

Annex F provides properties of selected refrigerants determined as suitable alternatives to refrigerant R22 in the Refrigerant Extraction Test, clause 3.55.

Annex G 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.

Annex H provides the test methods and requirements for fully insulated winding wire (FIW) referenced in specification MW 85-C in Part 2.

Annex I provides a standardized repeated (bi-directional) scrape resistance procedure for film insulated magnet wire.

Summary of Revisions

FOREWORD

Updated Foreword..... i
Updated Tables of Contentsiv

Part 1

1.2.1, revised to add two ASTM standards associated with new Note 3, clause 1.8 1
1.3, revised with new definition for "fully insulated wire" and revised definitions for "number of tapes" and "varnish" 4-5
1.4.1.2, revised for clarification and deletion of reference to NIST Handbook 100 6
1.4.1.3, deleted characteristics of aluminum requirements 6
1.5.1, Note 1 revised for clarification 7
1.5.2.3, revised for clarification..... 8
1.5.3, revised to align with conductor surface requirements and to define insulation requirements at joints 8
1.5.4, revised to improve wording..... 8
1.6.2, revised to indicate that results from any test can be affected by contaminants 9
1.6.3, revised to align with the IEC 60317-0 series of general requirements standards 9
1.6.7.2, revised to remove an incorrect table title reference.....11
1.8.1, revised with note recognizing ASTM E1877 as a screening method to obtain preliminary thermal class data 12
1.9.1, revised to add "FIW 3" in the Insulation Build column of the PIN table 13
Table 1, revised to delete the † footnote, given the addition of columns for dimensions for MW 16-C Quad..... 15-24
Table 3, revised to expand the wire size range to include 8-13.5 AWG 26-29
Table 8 (mm), revised to correct tolerance on bare wire thickness for wire with a full rounded edge or 0.51-mm radii 39

Part 2

MW 15-A, 15-C, 18-A, 18-C, 19-C, 86-A, 86-C, 87-A, 87-C revised to add a tolerance to the Heat Shock test temperature and for consistency in Heat Shock requirements 3, 4, 7, 8, 9, 67, 68, 69, 70

MW 19-C, 102-A, 102-C, 130-C, 131-C, 132-C, 135-C, 136-C, 137-C revised to add bond peel test requirements 9, 72, 73, 76-81

MW 16-A, specification added 5

MW 16-C, revised to remove Completeness of Cure requirement 6

MW 20-A, specification added 10

MW 20-C, revised to remove Completeness of Cure requirement 11

MW 33-A, 33-C, revised to align with MW 31-A and 31-C requirements 19, 20

MW 88-C, specification added 71

MW 102-A, MW 102-C revised to align with the MW 35 series 72, 73

MW 103-C, specification added 74

MW 122-C, specification added 75

Part 3

3.57, revised for clarification and improved wording 50-56

3.57.4, added with lap shear bond strength procedure 56

Annex C

Revised to remain current with NEMA and IEC Standards activities through 2020 C-1 – C-4

Annex H

Table H.8 revised to align test voltages with the latest edition of IEC 60317-0-7 H-14

Contents

FOREWORD i

**Part 1
General**

1.1. Scope1

1.2. References.....1

 1.2.1 Normative References1

 1.2.2 Other References2

1.3. Definitions3

1.4. Materials5

 1.4.1 Conductors—Round, Square, Rectangular, Copper, Aluminum5

1.5. Manufacturing7

 1.5.1 Application of Insulation.....7

 1.5.2 Intermediate Sizes8

 1.5.3 Joints8

 1.5.4 Packaging.....8

1.6. Test Conditions and Parameters9

 1.6.1 Safety Statement9

 1.6.2 Selection of Specimens9

 1.6.3 Ambient Conditions of Test.....9

 1.6.4 Power Frequency9

 1.6.5 Mandrels9

 1.6.6 Rectangular and Square Wire10

 1.6.7 Round Wire.....10

 1.6.8 Periodic Conformance11

 1.6.9 Retests.....11

1.7. Units of Measure11

1.8. Thermal Class of Magnet Wire11

 1.8.1 Film Insulation11

 1.8.2 Varnish12

1.9. Ordering Information12

 1.9.1 Product Identification Number12

 1.9.2 Minimum Ordering Data14

 1.10 De-Reeling (Winding) Tension14

Tables

Table 1	Dimensions for Bare and Film-Insulated Round Magnet Wire.....	15
Table 2	Round Copper Wire, Ultra-Fine Sizes by Resistance	25
Table 3	Dimensions for Round Film-Insulated Self-Bonding Magnet Wire.....	26
Table 4	Dimensions for Single Glass Fiber Covered Round Bare Single Film-Coated and Heavy Film-Coated Wire.....	30
Table 5	Dimensions for Double Glass Fiber Covered Round Bare Single Film-Coated and Heavy Film-Coated Wire.....	32
Table 6	Dimensions for Single Polyester Glass Fiber Covered Round Bare Single Film-Coated and Heavy Film-Coated Wire	34
Table 7	Dimensions for Double Polyester Glass Fiber Covered Round Bare Single Film-Coated and Heavy Film-Coated Wire	36
Table 8	Dimensions, Radii, and Cross-Sectional Area* for Standard ^a Rectangular Bare Wire.....	38
Table 9	Bare Rectangular Conductor Tolerances	40
Table 10	Film-Insulated Rectangular Magnet Wire Increase in Thickness and Width Due to Film Coating	40
Table 12	Heavy and Quad Film-Insulated Square Magnet Wire Increase in Dimensions Due to Film Coating.....	41
Table 12	Heavy and Quad Film-Insulated Square Magnet Wire Increase in Dimensions Due to Film Coating	
Table 13	Increase in Dimensions for Glass Fiber Covered Rectangular Magnet Wire.....	43
Table 15	Single Glass Fiber Covered, Heavy Film-Insulated Square Copper Magnet Wire— Minimum Increase and Maximum Overall Dimensions Due to Insulation.....	45
Table 16	Single Polyester Glass Fiber Covered Heavy Film-Insulated Square Copper Magnet Wire— Minimum Increase and Maximum Overall Dimensions Due to Insulation.....	46
Table 17	Double Glass Fiber Covered, Bare or Heavy Film-Insulated Square Copper Magnet Wire— Minimum Increase and Maximum Overall Dimensions Due to Insulation.....	47
Table 18	Double Polyester Glass Fiber Covered, Bare or Heavy Film-Insulated Square Copper Magnet Wire—Minimum Increase and Maximum Overall Dimensions Due to Insulation.....	48
Table 19	Comparison Between AWG and IEC R-40 Series Bare Wire Diameters	49
Table 20	Comparison Between NEMA and IEC Increases and Overall Diameters	51
Table 20	Comparison Between NEMA and IEC Increases and Overall Diameters	53
Table 21	Dimensions for Tape-Covered Round Magnet Wire.....	55
Table 22	Increase in Dimensions of Rectangular Wire Due to Tape Covering	57
Table 23	Dimensions for Tape-Covered Square Magnet Wire (Inch)	57
Table 24	Specification for Micrometer Anvil Diameter and Spindle Force	2
Table 25	Adherence, Flexibility, and Heat Shock: Elongation and Mandrel Diameters	4
Table 26	Minimum Percent Elongation, Square and Rectangular Wire.....	7
Table 27	Minimum Percent Elongation, Round Wire	7
Table 28	Springback—Mandrel Wrap Method.....	12
Table 29	Dielectric Breakdown, Minimum Voltage—Foil Method	16
Table 30	Twisted Pair Method: Tensions and Rotations	16

Table 31	Minimum Dielectric Breakdown Voltage—Twisted Pair Method	17
Table 32	Bend Method Mandrel Sizes	19
Table 33	Rate of Increase in Voltage—Cylinder Method	20
Table 34	Cylinder Method Test Loads	
Table 35	Minimum Dielectric Breakdown Voltage—Cylinder Method	22
Table 36	Dielectric Breakdown, Film-Insulated Rectangular and Square Magnet Wire	24
Table 37	Threshold Fault Current	25
Table 38	Test Voltages (DC Volts $\pm 5\%$) and Maximum Fault Count per 100 Feet	27
Table 39	Low-Voltage Continuity—Maximum Fault Count per 100 Feet	27
Table 40	Maximum Solder Immersion Times	31
Table 41	Thermoplastic Flow Test Loads	34
Table 42	Recommended Quantity of Specimens for Short-Term (24-Hour) Exposure Test	40
Table 43	Pressure Vessel Components	41
Table 44	Test Specimen Lengths and Weights for Long-Term Exposure Test	43
Table 45	Turns per Coil	46
Table 46	Typical Siphon Cup Dimensions	47
Table 47	Bond Test Parameters	51
Table 48	Helical Coil Preparation and Bond Retention	54
Table 49	Standard Scrape Resistance of Round Film-Insulated Magnet Wire MW 5, 15, 24, 28, 30, 35, 37, 72, 73, 74, 76, 78, 80, 81, 83, 86	60
Table 50	Reduced Scrape Resistance of Round Film-Insulated Magnet Wire MW 75, 77, 79, 82	61
Table 51	Scrape Resistance of Round Film-Insulated Magnet Wire MW 16-C	62

Part 2**Specifications Listing by MW Specification Number, Thermal Class Film Insulation, Coating Covering and Form**

Specification Number	Film Insulation, Coating, Covering, and Form	Thermal Class	Round	Rectangular and Square	Page No.
MW 5-C	Polyester (Single and Heavy)	155	X	—	2
MW 15-A	Polyvinyl Acetal (Single and Heavy)	105	X	—	3
MW 15-C	Polyvinyl Acetal (Single, Heavy, Triple, Quad)	105	X	—	4
MW 16-A	Polyimide (Single, Heavy)	260	X	—	5
MW 16-C	Polyimide (Single, Heavy, Triple, Quad)	240	X	—	6
MW 18-A	Polyvinyl Acetal (Heavy and Quad)	105	—	X	7
MW 18-C	Polyvinyl Acetal (Heavy and Quad)	105	—	X	8
MW 19-C	Polyvinyl Acetal with Self-bonding Overcoat (Types 1, 2, and 3)	105	X	—	9
MW 20-A	Polyimide (Heavy and Quad)	260	—	X	10
MW 20-C	Polyimide (Heavy and Quad)	240	—	X	11
MW 24-A	Polyester (amide)(imide) Overcoated with Polyamide (Single and Heavy)	155	X	—	12
MW 24-C	Polyester (amide)(imide) Overcoated with Polyamide (Single, Heavy, Triple)	155	X	—	13
MW 28-A	Polyurethane Overcoated with Polyamide for Solderable Applications (Single and Heavy)	130	X	—	14
MW 28-C	Polyurethane Overcoated with Polyamide for Solderable Applications (Single and Heavy)	130	X	—	15
MW 30-C	Polyester (amide)(imide) (Single, Heavy, Triple)	180	X	—	16
MW 31-A	Paper Covered	90 or 105	X		17
MW 31-C	Paper Covered	90 or 105	X	—	18
MW 33-A	Paper Covered Bare Rectangular and Square	90 or 105	—	X	19
MW 33-C	Paper Covered Bare Rectangular and Square	90 or 105	—	X	20
MW 35-A	Polyester (amide)(imide) Overcoated with Polyamideimide (Single and Heavy)	220	X	—	21
MW 35-C	Polyester (amide)(imide) Overcoated with Polyamideimide (Single, Heavy, Triple, Quad)	200	X	—	22
MW 36-A	Polyester (amide)(imide) Overcoated with Polyamideimide (Heavy and Quad)	220	—	X	23
MW 36-C	Polyester (amide)(imide) Overcoated with Polyamideimide (Heavy and Quad)	200	—	X	24
MW 37-C	Polyester (amide)(imide) Overcoated with Polyamideimide (Single, Heavy and Triple)	220	X	—	25
MW 38-C	Polyester (amide)(imide) overcoated with polyamideimide (Heavy and Quadruple)	220	—	X	26
MW 41-C	Glass Fiber Covered (Single and Double)	155	X	—	27
MW 42-C	Glass Fiber Covered (Single and Double)	155	—	X	28
MW 43-C	Glass Fiber Covered Silicone Treated (Single and Double)	200	—	X	29
MW 44-C	Glass Fiber Covered Silicone Treated (Single and Double)	200	X	—	30

Specification Number	Film Insulation, Coating, Covering, and Form	Thermal Class	Round	Rectangular and Square	Page No.
MW 45-C	Polyester Glass Fiber Covered (Single and Double)	155	X	—	31
MW 46-C	Polyester Glass Fiber Covered (Single and Double)	155	—	X	32
MW 47-C	Polyester Glass Fiber Covered Silicone Treated (Single and Double)	200	X	—	33
MW 48-C	Polyester Glass Fiber Covered Silicone Treated (Single and Double)	200	—	X	34
MW 50-C	Glass Fiber Covered, High-Temperature Organic Varnish Treated (Single and Double)	180	X	—	35
MW 51-C	Polyester Glass Fiber Covered, High-Temperature Organic Varnish Treated (Single and Double)	180	X	—	36
MW 52-C	Glass Fiber Covered, High-Temperature Organic Varnish Treated (Single or Double)	180	—	X	37
MW 53-C	Polyester Glass Fiber Covered, High-Temperature Organic Varnish Treated (Single and Double)	180	—	X	38
MW 54-C	Polyester Glass Fiber Covered and Varnish Treated Bare or Heavy Film-Insulated	155	X	—	39
MW 55-C	Polyester Glass Fiber Covered and Varnish Treated Bare or Heavy Film-Insulated	155	—	X	40
MW 60-A	Aromatic Polyamide Paper Covered (Paper)	220	—	X	41
MW 60-C	Aromatic Polyamide Paper Covered (Paper)	220	—	X	42
MW 61-A	Aromatic Polyamide Paper Covered (Paper)	220	X	—	43
MW 61-C	Aromatic Polyamide Paper Covered (Paper)	220	X	—	44
MW 64-A	Aromatic Polyimide Tape Covered	240	—	X	45
MW 64-C	Aromatic Polyimide Tape Covered	240	—	X	46
MW 65-A	Aromatic Polyimide Tape Covered	240	X	—	47
MW 65-C	Aromatic Polyimide Tape Covered	240	X	—	48
MW 72-C	Polyester (amide)(imide) for Hermetic Applications (Heavy)	180	X	—	49
MW 73-A	Polyester (amide)(imide) Overcoated with Polyamideimide for Hermetic Applications (Heavy)	220	X	—	50
MW 73-C	Polyester (amide)(imide) Overcoated with Polyamideimide for Hermetic Applications (Heavy, Triple, Quad)	200	X	—	51
MW 74-A	Polyester (amide)(imide) (Single and Heavy)	220	X	—	52
MW 74-C	Polyester (amide)(imide) (Single and Heavy)	200	X	—	53
MW 75-C	Polyurethane for Solderable Applications (Single and Heavy)	130	X	—	54
MW 76-A	Polyester (amide)(imide) Overcoated with Polyamide (Single and Heavy)	180	X	—	55
MW 76-C	Polyester (amide)(imide) Overcoated with Polyamide (Single, Heavy, Triple)	180	X	—	56

Specification Number	Film Insulation, Coating, Covering, and Form	Thermal Class	Round	Rectangular and Square	Page No.
MW 77-C	Polyester (imide) for Solderable	180	X	—	57
MW 78-C	Polyester (imide)	180	X	—	58
MW 79-C	Polyurethane for Solderable Applications (Single, Heavy and Triple)	155	X	—	59
MW 80-A	Polyurethane Overcoated with Polyamide for Solderable Applications (Single and Heavy)	155	X	—	60
MW 80-C	Polyurethane overcoated with polyamide for solderable applications (Single, Heavy, Triple)	155	X	—	61
MW 81-C	Polyamideimide (Single and Heavy)	220	X	—	62
MW 82-C	Polyurethane for solderable applications (Single, Heavy and Triple)	180	X	—	63
MW 83-C	Polyurethane overcoated with polyamide for solderable applications (Single, Heavy, Triple)	180	X	—	64
MW 84-C	Polyamideimide Film-Insulated	220		X	65
MW 85-C	Polyurethane Fully Insulated	180	X	—	66
MW 86-A	Polyvinyl Acetal (Single and Heavy)	120	X	—	67
MW 86-C	Polyvinyl Acetal (Single, Heavy, Triple)	120	X	—	68
MW 87-A	Polyvinyl Acetal (Heavy and Quad)	120	—	X	69
MW 87-C	Polyvinyl Acetal (Heavy and Quad)	120	—	X	70
MW 88-C	Polyvinyl Acetal With Self-Bonding Overcoat	120	—	X	71
MW 102-A	Polyester (amide)(imide) overcoated with polyamideimide, and self-bonding overcoat	180	X	—	72
MW 102-C	Polyester (amide)(imide) overcoated with polyamideimide, and self-bonding overcoat	180	X	—	73
MW 103-C	Polyester (amide)(imide) overcoated with polyamideimide, and self-bonding overcoat	180	X	—	74
MW 122-C	Polyamideimide with self-bonding overcoat	180	X	—	75
MW 130-C	Polyurethane with self-bonding overcoat (Type 1 and Type 2)	130	X	—	76
MW 131-C	Polyurethane with self-bonding overcoat (Type 1 and Type 2)	155	X	—	77
MW 132-C	Polyurethane with Self-Bonding Overcoat (Type 1 and Type 2)	180	X	—	78
MW 135-C	Polyurethane overcoated with polyamide and self-bonding overcoat (Type 1 and Type 2)	130	X	—	79
MW 136-C	Polyurethane overcoated with polyamide and self-bonding overcoat (Type 1 and Type 2) for Solderable Applications	180	X	—	80
MW 137-C	Polyurethane Overcoated with Polyamide and Self-Bonding Overcoat (Type 1 and Type 2) for Solderable Applications	180	X	—	81

Part 2
Specifications Listing by Thermal Class, Film Insulation, Coating, Covering and Form

Thermal Class	Film Insulation, Coating, Covering, and Form	See Part 2, Specification No.		
		Aluminum	Copper	Page No.
FILM-INSULATED ROUND MAGNET WIRE				
105	Polyvinyl Acetal	MW 15-A	MW 15-C	3, 4
105	Polyvinyl Acetal and Self-bonding Overcoat	-	MW 19-C	9
120	Polyvinyl Acetal	MW 86-A	MW 86-C	67, 68
120	Polyvinyl Acetal	MW 87-A	MW 87-C	69, 70
180	Polyvinyl Acetal Polyvinyl Acetal with self-bonding overcoat	-	MW 88-C	71
130 Solderable	Polyurethane Overcoated with Polyamide	MW 28-A	MW 28-C	14, 15
130 Solderable	Polyurethane	-	MW 75-C	54
130 Solderable	Polyurethane with Self-bonding Overcoat	-	MW 130-C	76
130 Solderable	Polyurethane Overcoated with Polyamide and Self-bonding Overcoat	-	MW 135-C	79
155	Polyester	-	MW 5-C	2
155	Polyester (amide)(imide) Overcoated with Polyamide	MW 24-A	MW 24-C	12, 13
155 Solderable	Polyurethane	-	MW 79-C	59
155 Solderable	Polyurethane Overcoated with Polyamide	MW 80-A	MW 80-C	60, 61
155 Solderable	Polyurethane with Self-bonding Overcoat	-	MW 131-C	77
155 Solderable	Polyurethane Overcoated with Polyamide and Self-bonding Overcoat	-	MW 136-C	80
180	Polyester (amide)(imide)	-	MW 30-C	16
180	Polyester (amide)(imide) Overcoated with Polyamide	MW 76-A	MW 76-C	55, 56
180	Polyester (amide)(imide) Overcoated with Polyamideimide and Self-bonding Overcoat	MW 102-A	MW 102-C	72, 73
180	Polyester (amide)(imide) overcoated with polyamideimide, and self-bonding overcoat	-	MW 103-C	74
180	Polyamideimide with self-bonding overcoat	-	MW 122-C	75
180 Solderable	Polyester (imide)	-	MW 77-C	57
180 Solderable	Polyester (imide) Overcoated with Polyamide	-	MW 78-C	58
180 Hermetic	Polyester (amide) (imide)	-	MW 72-C	49
180 Solderable	Polyurethane	-	MW 82-C	63
180 Solderable	Polyurethane Overcoated with Polyamide	-	MW 83-C	64
180 Solderable	Polyurethane Fully Insulated	-	MW 85-C	66
180 Solderable	Solderable Polyurethane with Self-bonding Overcoat	-	MW 132-C	78
180 Solderable	Solderable Polyurethane Overcoated with Polyamide and Self-bonding Overcoat	-	MW 137-C	81
200	Polyester (amide) (imide) Overcoated with Polyamideimide	-	MW 35-C	21
200	Polyester (amide)(imide)	-	MW 74-C	53
220 Hermetic	Polyester (amide)(imide) Overcoated with Polyamideimide	MW 73-A	-	51
220	Polyester (amide)(imide) Overcoated with Polyamideimide	-	MW 37-C	25
220	Polyester (amide)(imide)	MW 74-A	-	52

Thermal Class	Film Insulation, Coating, Covering, and Form	See Part 2, Specification No.		
		Aluminum	Copper	Page No.
220	Polyamideimide	-	MW 81-C	62
240 Hermetic	Polyimide	-	MW 16-C	6
260	Polyimide	MW 16-A	-	5
260	Polyimide	MW 20-A	-	10
FILM-INSULATED RECTANGULAR AND SQUARE WIRE				
105	Polyvinyl Acetal	MW 18-A	MW 18-C	7, 8
120	Polyvinyl Acetal	-	MW 88-C	71
200	Polyester (amide)(imide) Overcoated with Polyamideimide	-	MW 36-C	24
220	Polyester (amide)(imide) Overcoated with Polyamideimide	MW 36-A	-	23
220	Polyester (amide)(imide) Overcoated with Polyamideimide	-	MW 38-C	26
220	Polyamideimide	-	MW 84-C	65
240	Polyimide	-	MW 20-C	11
260	Polyimide	MW 20-A	-	10
FIBROUS COVERED ROUND MAGNET WIRE				
90 or 105	Paper Covered	MW 31-A	MW 31-C	17, 18
155	Glass Fiber Covered	-	MW 41-C	27
155	Polyester Glass Fiber Covered	-	MW 45-C	31
180	Glass Fiber Covered, High-Temperature Organic Varnish Treated	-	MW 50-C	35
180	Polyester Glass Fiber Covered, High-Temperature Organic Varnish Treated	-	MW 51-C	36
200	Glass Fiber Covered, Silicone Treated	-	MW 44-C	30
200	Polyester Glass Fiber Covered, Silicone Treated	-	MW 47-C	33
220	Aromatic Polyamide Paper Covered	MW 61-A	MW 61-C	43, 44
240	Aromatic Polyimide Tape Covered	MW 65-A	MW 65-C	47, 48
FIBROUS COVERED RECTANGULAR & SQUARE MAGNET WIRE				
90 or 105	Paper Covered	MW 33-A	MW 33-C	19, 20
155	Glass Fiber Covered	-	MW 42-C	20
155	Polyester Glass Fiber Covered	-	MW 46-C	32
180	Glass Fiber Covered, High-Temperature Organic Varnish Treated	-	MW 52-C	37
180	Polyester Glass Fiber Covered, High-Temperature Organic Varnish Treated	-	MW 53-C	38
155	Dimensions for Double Polyester Glass Fiber Covered		MW 54-C	39
155	Dimensions, Radii, and Cross-Sectional Area for Standard		MW 55-C	40
200	Glass Fiber Covered, Silicone Treated	-	MW 43-C	29
200	Polyester Glass Fiber Covered, Silicone Treated	-	MW 48-C	34
220	Aromatic Polyamide Paper Covered	MW 60-A	MW 60-C	41, 42
240	Aromatic Polyimide Tape Covered	MW 64-A	MW 64-C	45, 46

Part 3
Test Procedures

3.1 Safety Statement 1

Routine Tests

3.2 Dimensions 1

3.2.1 Round Wire..... 1

3.2.2 Rectangular and Square Wire 3

3.3 Adherence And Flexibility..... 3

3.3.1 Elongation and Mandrel Wrap Method 3

3.3.2 Mandrel Wrap Method 4

3.3.3 Elongation Method..... 4

3.3.4 Circumferential Cut and Elongation Method 5

3.3.5 Bend and Shot Dielectric Method 6

3.3.6 Flat and Edge Bend Method 6

3.3.7 Methods for Paper-Wrapped Magnet Wire 6

3.3.8 Bend Method 6

3.4 Elongation 6

3.5 Heat Shock 9

3.5.1 Procedure 9

3.5.2 Result..... 9

3.6 (Reserved) 9

3.7 Springback (Copper Conductors Only) 9

3.7.1 Mandrel Wrap Method 9

3.7.2 Deflection Method (All Rectangular and Round Sizes Larger than 14 AWG)..... 13

3.8 Dielectric Breakdown 14

3.8.1 Test Procedure—General 15

3.8.2 Foil Electrode Method..... 15

3.8.3 Twisted Pair Method 15

3.8.4 Wound Pair Method 18

3.8.5 Bend Method 18

3.8.6 Cylinder Method 19

3.8.7 Shot Box Electrode Method (Alternative to 3.8.2 Foil Electrode Method) 23

3.9 Continuity 24

3.9.1 General 24

3.9.2 High-Voltage Direct Current Continuity (14-44 AWG) 26

3.9.3 Low-Voltage Direct Current Continuity (45-56 AWG)..... 27

3.10 Dissipation Factor 28

3.10.1 Principle of Test 28

3.10.2 Equipment 28

3.10.3 Preparation of Specimen 28

3.10.4 Procedure 29

3.10.5 Result..... 30

3.11 Solderability 30

3.11.1	General	30
3.11.2	Self-Supported Specimen Method (9-36 AWG).....	30
3.11.3	Fixture-Supported Specimen Method (37-56 AWG)	33
3.50	Thermoplastic Flow	33
3.50.1	Apparatus	34
3.50.2	Procedure for Film Insulated Round Copper Wire.....	34
3.50.3	Procedure for Film Insulated Rectangular and Square Copper Wire	35
3.51	Solubility.....	35
3.51.1	Round Film-Insulated Wire (10 AWG and Finer)	36
3.51.2	Round Wire Larger than 10 AWG, Rectangular and Square Wire.....	36
3.52	Dielectric Breakdown at Rated Temperature.....	37
3.52.1	Twisted Pair Method	37
3.52.2	Shot Box Electrode Method	37
3.53	Toluene/Ethanol Compatibility.....	37
3.53.3	Specimen Preparation	38
3.53.4	Procedure	38
3.53.5	Result.....	38
3.54	Transformer Oil Resistance and Hydrolytic Stability	38
3.54.1	Principle of Test	38
3.54.2	Test Apparatus and Materials	39
3.54.3	Short-Term (24-Hour) Exposure Test—(Screening).....	39
3.54.4	One-Week (168-Hour) Exposure Test	41
3.54.4.8	Procedure	44
3.54.5	Long-Term (Four-Week) Exposure Test.....	45
3.55	Refrigerant (R22) Extraction	45
3.55.1	Preparation of Specimens	46
3.55.2	Environmental Conditioning.....	47
3.55.3	Collecting Residue.....	48
3.55.4	Determinations of Results	48
3.56	Dielectric Breakdown After R22 Conditioning	49
3.56.1	Preparation of Specimens	49
3.56.2	Environmental Conditioning.....	49
3.56.3	Evaluation of Specimens	49
3.56.4	Refrigerant Disposal	50
3.57	Bond.....	50
3.57.1	Principle	50
3.57.2	Determination of Helical Coil Bond Strength	50
3.57.3	Helical Coil Bond Peel Test.....	53
3.57.4	Lap Shear Bond Strength Test.....	56
3.58	Thermal Endurance	57
3.58.1	Test Procedure	57
3.59	Scrape Resistance	58
3.59.1	Apparatus	58
3.59.2	Test Procedure	59

Figures

1-3-1	Tape Layers	4
1-3-2	Full Rounded Edge	4
1-3-3	Rounded Corner	5
1-3-4	Rounded Edge	5
3-3-4-1	Circumferential Cutting Fixture	5
3-3-4-2a	Flat surface cutting	5
3-3-4-2b	Edge surface cutting	5
3-7-1-1	Details of Springback Scale	10
3-7-1-2	Springback Tester after Winding a Coil Under Tension	11
3-7-1-3	Example of Springback Scales	11
3-7-2	Example of Springback Scales	14
3-8-4	Wound Pair Specimen Winder	18
3-8-6	Test Apparatus for Cylinder Method	20
3-8-7	Typical Shot Box for Dielectric Breakdown Test	23
3-9-1-1	Example Conductive Brush Holder	25
3-9-1-2	Electrode with Conductive Brushes in Place	26
3-9-3	Bath for Low-Voltage Continuity Test	28
3-10-2	Electrode and Specimen Arrangement for Dissipation-Factor Test	29
3-11-3	Solderability Test Specimen Fixture	33
3-50-3	Thermoplastic Flow Rectangular Wire Specimen Loading	35
3-50-4	Ball Point Probe	35
3-50-5	Ball Point Probe Positioning	35
3-51-1	Machine for Solubility Scrape	36
3-55-1	Refrigerant Extractable Siphon Cup	47
3-55-2	Condenser Coil	48
3-55-3	Condenser Coil Siphon Cup Assembly	48
3-57-1	Bond Coil Prep Fixture	50
3-57-2-3	Bond Strength Test Fixture	53
3-57-3-2	Bond Coil Prep Fixture	55
3-57-4-1	(Overlap of Wire Specimens - Side View)	56
3-59-1	Machine for Scrape Resistance	58
I-1	Typical Repeated Scrape Test Equipment	20
I-2	Specimen Clamping Support Structure	21
I-3	Needle in Contact with Wire Surface	21

Annexes

A	Reference Magnet Wire Test Conditions and Procedures	A-1
B	Magnet Wire Packaging and Labeling	B-1
C	Cross Reference of NEMA and IEC Magnet Wire Specifications	C-1
D	Formulas for the Determination of Dimensional and Performance Requirements	D-1
E	General Rules for Rectangular Wire Dimensions	E-1
F	Properties of Selected Refrigerants	F-1
G	Recommended Winding Tensions for Round Copper and Aluminum Film-Insulated Magnet Wire	G-1
H	Requirements and Test Procedures for MW 85-C According to IEC 60317-56	H-1
I	Repeated Scrape Resistance	I-1

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Part 1

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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.