

# PRODUCT DATA SHEET

## NEMA MW 35-C or MW 73-C

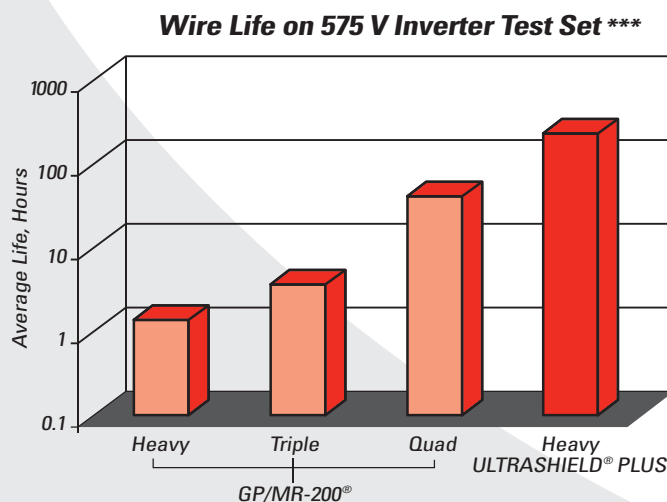
Class 200 Copper - Round Conductors - Polyester/Polyamideimide coated magnet wire / winding wire.

### APPLICATION

ULTRASHIELD® PLUS magnet wire, which is specifically designed for use in motors that may be subjected to higher voltage spikes present in inverter duty applications, has been enhanced for easy identification and differentiation. The enhanced product has exhibited increased resistance to partial discharges and improved abrasion resistance to repeated scrape. The combination of the modified polyester basecoat and polyamideimide topcoat provides an insulation system with outstanding toughness and excellent dielectric properties. ULTRASHIELD® PLUS magnet wire has improved voltage endurance and thermal properties, compared to standard NEMA MW 35-C magnet wire, while retaining superior chemical resistance to common solvents and refrigerants. ULTRASHIELD® PLUS conforms to all of the requirements of NEMA MW 35-C and MW 73-C.

ULTRASHIELD® PLUS is recommended but not limited to the following applications :

- Inverter Duty Drive Motors
- Rotating Machines
- Hermetic Motors
- DC Motors
- Power Tools
- Automotive Alternators and Generators
- Transformers, All Dry Types through Class 200
- Electronics, All Types of Coils through Class 200



### ENGINEERING HIGHLIGHTS

#### 1. THERMAL CLASSIFICATION

ULTRASHIELD® PLUS magnet wire on copper conductor is UL listed at Class 200, and is recommended for NEMA MW 35-C and MW 73-C wire applications with higher burnout requirements.

#### 2. THERMOPLASTIC FLOW

ULTRASHIELD® PLUS magnet wire has excellent thermoplastic flow (cut-thru) properties, with typical test values of 390°C.

#### 3. WINDABILITY

ULTRASHIELD® PLUS magnet wire has been extensively wound in various motor applications and has been highly commended for its superior windability performance.

#### 4. ELECTRICAL

The electrical properties for ULTRASHIELD® PLUS have been measurably improved. Voltage endurance for the enhanced ULTRASHIELD® PLUS magnet wire at 3000V and room temperature increased by 20% and at 1000V and 200C increased by 30%. Testing with sinusoidal and with inverter waveshapes shows that ULTRASHIELD® PLUS magnet wire lasts many times longer than standard NEMA MW 35-C and MW 73-C insulation (see graph at lower left). While no standards for this type of testing have been universally accepted, our testing shows dramatic improvement in insulation life, especially under severe duty applications at higher temperatures.

#### 5. CHEMICAL

ULTRASHIELD® PLUS magnet wire has been tested for resistance to R-22 refrigerant and the results show it to be compatible for hermetic systems.

Successful results are also seen with samples tested for 24 hours at room temperature in a wide variety of other solvents such as petroleum naphtha, toluene, ethanol, 5% sulfuric acid, 1% potassium hydroxide, butyl acetate, and acetone.

#### 6. TERMINATION

Insulation piercing, mechanical stripping, and flame welding processes can all be used successfully with ULTRASHIELD® PLUS magnet wire. If the connection is to be soldered, it is recommended that mechanical stripping be used to remove the insulation prior to soldering.

#### 7. NORMAL AVAILABILITY

- Round Copper Sizes:  
9 - 30 AWG, Heavy Build

Please consult Magnet Wire Marketing for additional size (including metric) and build information.

## PRODUCT DATA SHEET

Performance data is representative of 18 AWG heavy build copper. \*\*

### THERMAL PROPERTIES

#### HEAT SHOCK RESISTANCE

**TYPICAL PERFORMANCE:** No topcoat or basecoat cracks  
**REQUIRED PERFORMANCE:** 20%, 3XD, no cracks†

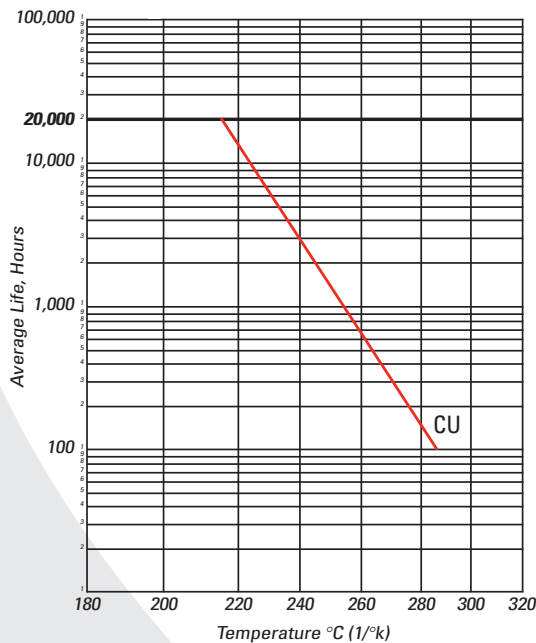
#### THERMAL AGING

**TYPICAL PERFORMANCE:** 215°C  
**REQUIRED PERFORMANCE:** 200°C, minimum†

#### THERMOPLASTIC FLOW

**TYPICAL PERFORMANCE:** 390°C  
**REQUIRED PERFORMANCE:** 300°C, minimum†

#### 18 AWG Heavy Build ULTRASHIELD® PLUS Thermal Aging



### PHYSICAL PROPERTIES

#### ABRASION RESISTANCE: REPEATED SCRAPE

**TYPICAL PERFORMANCE:** 496 strokes, avg.\*

#### ABRASION RESISTANCE: UNIDIRECTIONAL

**TYPICAL PERFORMANCE:** 2100 g., avg.  
**REQUIRED PERFORMANCE:** 980 g., minimum; 1150 g., minimum avg.†



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### PHYSICAL PROPERTIES (cont'd)

#### ADHESION AND FLEXIBILITY

**TYPICAL PERFORMANCE:** No topcoat or basecoat cracks  
**REQUIRED PERFORMANCE:** 20%, 3XD, no cracks†

#### COEFFICIENT OF FRICTION

**TYPICAL PERFORMANCE:** Dry Lube: 0.02 - 0.06\*

#### ELONGATION

**TYPICAL PERFORMANCE:** 38%  
**REQUIRED PERFORMANCE:** 32%, minimum†

#### SPRINGBACK

**TYPICAL PERFORMANCE:** 48 degrees  
**REQUIRED PERFORMANCE:** 58 degrees, maximum†

### ELECTRICAL PROPERTIES

#### CONTINUITY

**TYPICAL PERFORMANCE:** ≤ 1 fault/100 ft.  
**REQUIRED PERFORMANCE:** 5 faults/100 ft., maximum†

#### DIELECTRIC BREAKDOWN VOLTAGE

##### ROOM TEMPERATURE

**TYPICAL PERFORMANCE:** 12,900 volts, avg.  
**REQUIRED PERFORMANCE:** 5,700 volts, minimum†

##### RATED TEMPERATURE

**TYPICAL PERFORMANCE:** 10,982 volts, avg.  
**REQUIRED PERFORMANCE:** 4,275 volts, minimum†

### CHEMICAL PROPERTIES

#### REFRIGERANT RESISTANCE (R-22)

##### EXTRACTION

**TYPICAL PERFORMANCE:** 0.02%  
**REQUIRED PERFORMANCE:** 0.25%, maximum†

##### DIELECTRIC BREAKDOWN VOLTAGE

**TYPICAL PERFORMANCE:** 11,686 volts  
**REQUIRED PERFORMANCE:** 5,700 volts, minimum†

#### SOLUBILITY

**TYPICAL PERFORMANCE:** Passes  
**REQUIRED PERFORMANCE:** 580 g. scrape, minimum†

\* Tests not indicated as NEMA are Essex® Standards.

\*\* The values shown represent typical average results and are not intended to be used as design data or specification limits.

\*\*\* Data obtained from standard 18 AWG twisted pairs tested at 150°C, with a 575 volt drive and motor (phase-to-phase).

† Requirements of NEMA MW 1000; Section MW 35-C or MW 73-C, as applicable.

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# PRODUCT DATA SHEET

## NEMA MW 36-C

Class 200 Copper - Rectangular Conductors - Polyester/Polyamideimide Coated Magnet Wire / Winding Wire.

### APPLICATION

ULTRASHIELD® PLUS rectangular magnet wire is designed specifically for use in motors & generators that may be subjected to higher voltage spikes present in inverter applications. ULTRASHIELD® PLUS rectangular magnet wire provides significant resistance to abrasion while maintaining flexibility. The combination of a modified polyester basecoat and polyamideimide topcoat provides an insulation system with outstanding toughness and excellent dielectric properties. ULTRASHIELD® PLUS conforms to all of the requirements of NEMA MW 36-C.

ULTRASHIELD® PLUS magnet wire is recommended but not limited to the following applications:

- Motors and Generators for Hybrid and Electric Vehicles
- Wind Generators
- Inverter Duty Drive Motors
- Low, Medium & High Voltage Rotating Machines
- Hermetic Motors
- Large Industrial Motors in Corona Applications

### ENGINEERING HIGHLIGHTS

#### 1. THERMAL CLASSIFICATION

ULTRASHIELD® PLUS magnet wire on copper conductor is UL listed at Class 200, and is recommended for NEMA MW 36-C wire applications with higher burnout requirements.

#### 2. THERMOPLASTIC FLOW

ULTRASHIELD® PLUS magnet wire has excellent thermoplastic flow (cut-thru) properties, with typical test values of 405°C.

#### 3. ELECTRICAL

The electrical properties of ULTRASHIELD® PLUS are one of the superior attributes of this product. Overall product quality was key in the development of this product. Due to the design of the insulation system and manufacturing process, AC dielectric breakdown values consistently average 6,000V. Inverter life testing of the rectangular ULTRASHIELD® PLUS insulation system shows a 24X increase in life over the standard MW 36-C insulation system when tested at 200°C on a 575V inverter.▲ While no standards for this type of testing have been universally accepted, our testing shows dramatic improvement in insulation life, especially under severe duty applications at higher temperatures.

#### 4. CHEMICAL

ULTRASHIELD® PLUS magnet wire has been tested for resistance to R-22 refrigerant and the results show it to be compatible for hermetic systems. Successful results are also seen with samples tested for 24 hours at room temperature in a wide variety of other solvents such as petroleum naphtha, toluene, ethanol, 5% sulfuric acid, 1% potassium hydroxide, butyl acetate, and acetone.

#### 5. TERMINATION

Mechanical stripping and flame welding processes can be used for removing the insulation prior to termination.

#### 6. NORMAL AVAILABILITY

- Rectangular Copper Size Ranges:  
0.081-0.257 Thickness (inches)  
0.091-0.300 Width (inches)

Please consult Magnet Wire Marketing for additional sizes (including metric) and product availability.

# PRODUCT DATA SHEET

 Performance data below is representative of 0.102" x 0.204" heavy build copper.†

## THERMAL PROPERTIES

### HEAT SHOCK RESISTANCE

TYPICAL PERFORMANCE: No cracks  
REQUIRED PERFORMANCE: 220°C 30 min, 15%, no cracks†

### THERMOPLASTIC FLOW

TYPICAL PERFORMANCE: 405°C

## PHYSICAL PROPERTIES

### ADHERENCE AND FLEXIBILITY

TYPICAL PERFORMANCE: No topcoat or basecoat cracks  
REQUIRED PERFORMANCE: 30%, no cracks†

## ELECTRICAL PROPERTIES

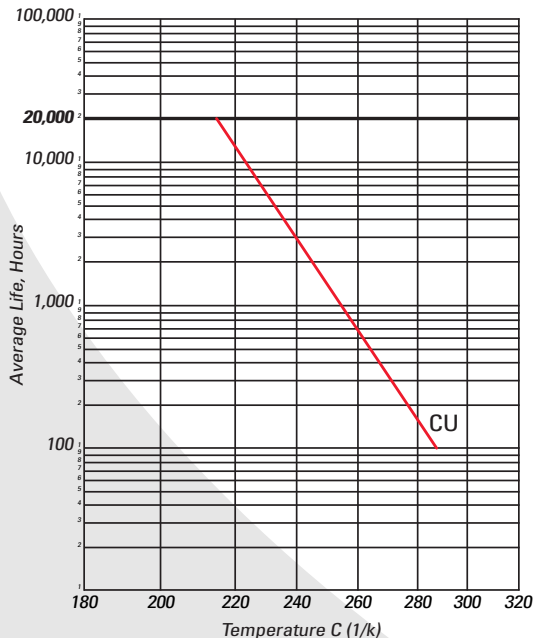
### DIELECTRIC BREAKDOWN VOLTAGE – NEMA

TYPICAL PERFORMANCE: 6,000V  
REQUIRED PERFORMANCE: 10%, Flat & Edge Bend Foil Method: 1500V, minimum, Any 3 of 4 values; 500V, minimum, 4th Value†

### DIELECTRIC BREAKDOWN VOLTAGE – SHOTBOX

TYPICAL PERFORMANCE: 6,000V\*, 10%, Flat & Edge Bend

### 18 AWG Heavy Build ULTRASHIELD® PLUS Thermal Aging



Thermal classifications for rectangular and square magnet wires are based on the thermal endurance results of round wire sizes 10-18 AWG. The preferred round wire size for evaluation is 18 AWG round heavy build insulation.

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 Performance data below is representative of 18 AWG heavy build copper using rectangular enamels.\*

## THERMAL PROPERTIES

### HEAT SHOCK RESISTANCE

TYPICAL PERFORMANCE: No cracks  
REQUIRED PERFORMANCE: 20%, 3XD, no cracks†

### THERMAL AGING

TYPICAL PERFORMANCE: 215°C  
REQUIRED PERFORMANCE: 200°C, minimum‡

### THERMOPLASTIC FLOW

TYPICAL PERFORMANCE: 381°C  
REQUIRED PERFORMANCE: 300°C, minimum‡

## PHYSICAL PROPERTIES

### ABRASION RESISTANCE: REPEATED SCRAPE

TYPICAL PERFORMANCE: 300 strokes, avg.\*

### ABRASION RESISTANCE: UNIDIRECTIONAL

TYPICAL PERFORMANCE: 2,100 g., avg.  
REQUIRED PERFORMANCE: 980 g., minimum; 1,150 g., minimum avg.‡

### ADHESION AND FLEXIBILITY

TYPICAL PERFORMANCE: No cracks  
REQUIRED PERFORMANCE: 20%, 3XD, no cracks†

## ELECTRICAL PROPERTIES

### DIELECTRIC BREAKDOWN VOLTAGE

**ROOM TEMPERATURE**  
TYPICAL PERFORMANCE: 12,900 volts, avg.  
REQUIRED PERFORMANCE: 5,700 volts, minimum‡

**RATED TEMPERATURE**  
TYPICAL PERFORMANCE: 10,982 volts, avg.  
REQUIRED PERFORMANCE: 4,275 volts, minimum‡

## CHEMICAL PROPERTIES

### REFRIGERANT RESISTANCE (R-22)

**EXTRACTION**  
TYPICAL PERFORMANCE: 0.02%  
REQUIRED PERFORMANCE: 0.25%, maximum‡

**DIELECTRIC BREAKDOWN VOLTAGE**  
TYPICAL PERFORMANCE: 11,686 volts  
REQUIRED PERFORMANCE: 5,700 volts, minimum‡

### SOLUBILITY

TYPICAL PERFORMANCE: Passes  
REQUIRED PERFORMANCE: 580 g. scrape, minimum‡

\* Data obtained from standard 18 AWG twisted pairs tested at 200°C, with a 575 volt drive and motor (phase-to-phase).  
\* Data from 18 AWG ULTRASHIELD® PLUS is included in this document to provide material characteristics & properties related to the enamel insulation system for tests that are not typically performed or cannot be performed on rectangular magnet wire.  
\* Tests not indicated as NEMA are Essex® Standards.  
† The values shown represent typical average results and are not intended to be used as design data or specification limits.  
† Requirements of NEMA MW 1000; Section MW 36-C, as applicable.  
‡ Requirements of NEMA MW 1000; Section MW 35-C, as applicable.  
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