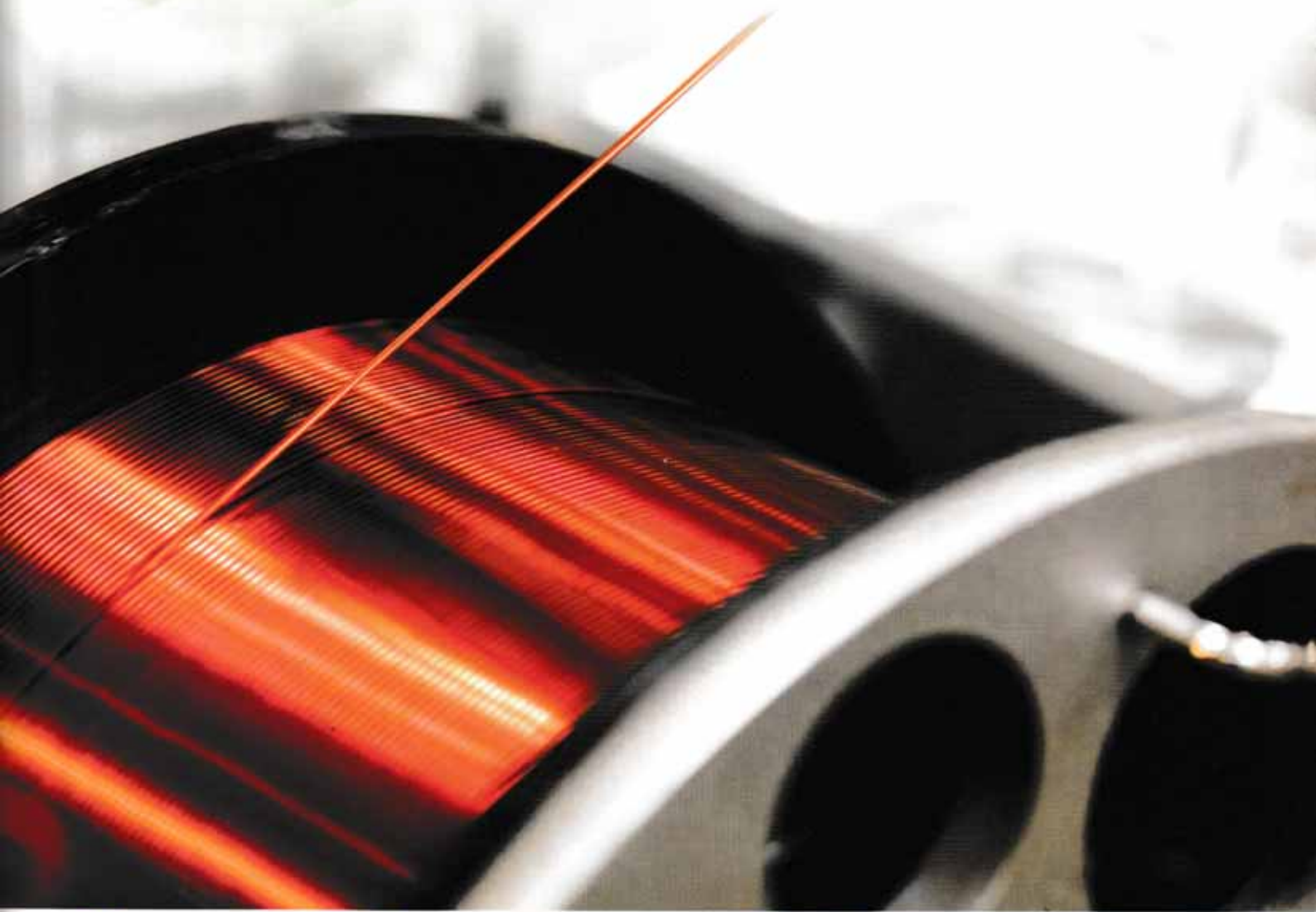




Essex Furukawa

vertically integrated, global
magnet wire leader

World's second largest
manufacturer of enamel
insulation for magnet wire

Increased the output
of copper and aluminum
to ensure and maintain
market stability

As a globally diverse
powerhouse in
magnet wire and
enameling, Essex Furukawa
consistently pushes the boundaries
of innovation, and engineering. We
lead these efforts across the globe
to foster lasting success for the
customers we serve.

Built on more than 120 years of expertise,
our teams form mutually beneficial
relationships with members of the
automotive, commercial, residential,
industrial, and energy markets to provide
the products and services they need to
flourish, and in turn, inspire their customers
to thrive. From the newest electric vehicles,
power transformers, and commercial
generators, we produce the magnet/
winding wire that powers the future.

Global research and
development quickly delivers
innovation for customers



2,062

EMPLOYEES



377kt

PRODUCTION CAPACITY



International distributor of magnet wire, electrical insulation, motors, drives and other critical components and services essential to OEM and motor repair markets with 18 distribution facilities worldwide through our parent company Superior Essex



Facilities



Corporate Headquarters

Atlanta, GA - U.S.A.



Magnet Wire

Fort Wayne, IN - U.S.A.
Franklin, IN - U.S.A.
Franklin, TN - U.S.A.
Simcoe, ON - Canada
Bramsche, Germany
Bad Arolsen, Germany
Zrenjanin, Serbia
Torreon, Coahuila - Mexico
Kameyama, Japan
Suzhou, China
Kuala Lumpur, Malaysia
Penang, Malaysia



MagForceX® Innovation Centers

Fort Wayne, IN - U.S.A.
Hiratsuka, Japan



Rod & Foundry

Columbia City, IN - U.S.A.



Chemical Processing

Fort Wayne, IN - U.S.A.



Distribution

18 Facilities Globally



Magnet Wire Headquarters Japan

Tokyo, Japan



Magnet Wire Sales Japan

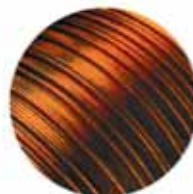
Tokyo, Japan
Nagoya, Japan



High-Voltage Wire (HVWW®)



Shaped/Rectangular Wire



Round Wire



Continuously Transposed Cable (CTC)



Bare Copper Rod



Enamels

NORTH AMERICA

Corporate Headquarters

Superior Essex
5770 Powers Ferry Rd. NW, Suite 300
Atlanta GA, 30327 U.S.A.

+1.770.657.6000
corporatemarketing@spsx.com

Magnet Wire

Essex Furukawa
1601 Wall Street
Fort Wayne, IN 46802 U.S.A.

+1.260.461.4000
info.northamerica@essexfurukawa.com

EUROPE

Magnet Wire

Essex Furukawa Europe
Korbacher Strasse 6
34454 Bad Arolsen, Germany

+49.5691.8940
info.europe@essexfurukawa.com

ASIA PACIFIC

Magnet Wire Headquarters Japan

Essex Furukawa Japan
16-8 Uchikanda 2-chome,
Chiyoda-ku, Tokyo, 101-0047

+81.3.6206.0390
info.japan@essexfurukawa.com

Magnet Wire

Essex Furukawa Malaysia — Penang
Lot 1192, Mukim 14, Permatang Tinggi,
Seberang Perai Tengah,
14000 Bukit Mertajam, Penang, Malaysia

+60.4.588.9609
info.penang@essexfurukawa.com

Essex Furukawa Malaysia — Kuala Lumpur
Lot 2, Persiaran Waja, Bukit Raja Industrial
Estate, 41720 Klang, Selangor, Malaysia

+60.3.3342.7001
info.kualalumpur@essexfurukawa.com

Essex Furukawa China
68 Lushan Road,
Suzhou High-tech Zone
Suzhou, Jiangsu, 215129, China

+86.512.6662.6868
info.china@essexfurukawa.com

PRODUCT DATA SHEET

NEMA MW 80

Class 155 - Copper and Aluminum - Round Conductors - Polyurethane/Polyamide coated magnet wire / winding wire.

APPLICATION

SODERON® FS/155 fast solder magnet wire is designed to be utilized where the particular coil or component design may utilize the unique solder stripping property. SODERON® FS/155 magnet wire with its improved fast solder polyurethane film, over coated with nylon, surpasses standard Class 130 and 155 in its speed of solderability and can be used in a wide array of wire applications. The film lends itself to the precise process control required in manufacturing many electrical/electronic devices.

As with all solderable magnet wire, care must be exercised in the application of SODERON® FS/155 magnet wire since this material does not exhibit overload resistance properties like most non-solderable Classes 105, 130 and 155 resin.

SODERON® FS/155 is recommended but not limited to the following applications:

- Bobbin wound and paper section coils
- Molded and encapsulated coils
- Small motors, armature and fields
- Automotive coils
- Toroidal coils

ENGINEERING HIGHLIGHTS

1. THERMAL CLASSIFICATION

SODERON® FS/155 magnet wire is a UL Listed Class 155 material when measured in accordance with the ASTM D2307 test method.

2. THERMOPLASTIC FLOW

Thermoplastic flow (cut-thru) temperature of SODERON® FS/155 magnet wire is 228°C; well above maximum process conditions found in molded coil work, trickle impregnation processes and standard preheat varnish cycles specified for normal Class 155 systems.

3. SOLDERABILITY

SODERON® FS/155 magnet wire solders faster than any other solderable product without the excessive buildup of enamel residue associated with other solderable type resin coatings.

4. WINDABILITY

Flexibility and adhesion properties of the SODERON® FS/155 magnet wire film, because of its tough nylon topcoat, exceeds most winding applications and requirements.

5. ELECTRICAL

SODERON® FS/155 magnet wire insulation exhibits high dielectric strength.

6. CHEMICAL

The solvent resistant properties of SODERON® FS/155 are suitable for most classes 105, 130 and 155 varnishes, encapsulants, and treating resins.

7. NORMAL AVAILABILITY

- Round Copper Sizes:
 - 10-27 AWG, Single Build
 - 10-27 AWG, Heavy Build
- Round Aluminum Sizes
 - 27 AWG & Heavier

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 cracks @ 175°C
REQUIRED PERFORMANCE: 20%, 3 XD, no cracks†

SOLDERABILITY

TYPICAL PERFORMANCE: 2 seconds @ 390°C
REQUIRED PERFORMANCE: ≤9 seconds @ 390°C†

THERMAL STABILITY

TYPICAL PERFORMANCE: 167°C (Still Under Test)
REQUIRED PERFORMANCE: 155°C minimum†

THERMOPLASTIC FLOW

TYPICAL PERFORMANCE: 228°C
REQUIRED PERFORMANCE: 200°C†

PHYSICAL PROPERTIES

ABRASION RESISTANCE: UNIDIRECTIONAL

TYPICAL PERFORMANCE: 1760 g., avg.
REQUIRED PERFORMANCE: 980 g., minimum ,
1150 g., minimum avg.†

ABRASION RESISTANCE: REPEATED SCRAPE

TYPICAL PERFORMANCE: 250 strokes avg.*

ADHESION AND FLEXIBILITY

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

CONDUCTOR ELONGATION

TYPICAL PERFORMANCE: 39%
REQUIRED PERFORMANCE: 32% minimum†

SPRINGBACK

TYPICAL PERFORMANCE: 46 degrees
REQUIRED PERFORMANCE: 58 degrees, maximum†

ELECTRICAL PROPERTIES

CONTINUITY

TYPICAL PERFORMANCE: ≤ 1 fault/100 feet
REQUIRED PERFORMANCE: ≤ 5 faults/100 feet†

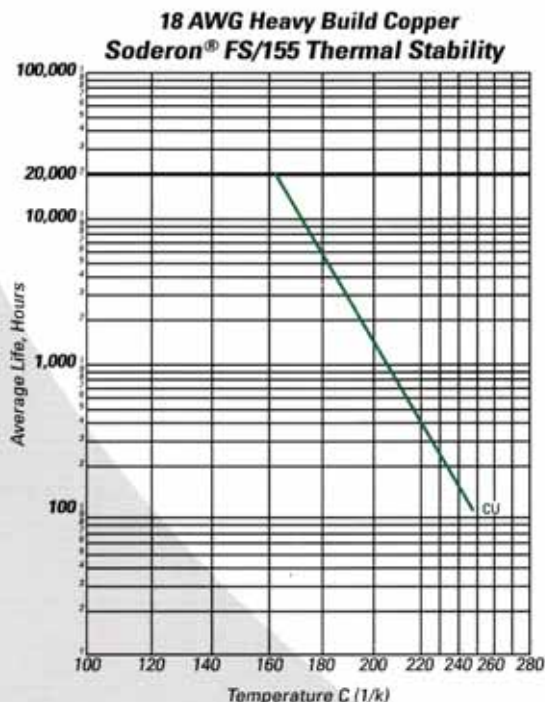
DIELECTRIC BREAKDOWN VOLTAGE

RATED TEMPERATURE

TYPICAL PERFORMANCE: 8740 volts, avg.
REQUIRED PERFORMANCE: 3848 volts, minimum†

ROOM TEMPERATURE

TYPICAL PERFORMANCE: 10,700 volts, avg.
REQUIRED PERFORMANCE: 5130 volts, minimum†



Essex Furukawa
1601 Wall Street
Fort Wayne, IN 46802
260.461.4000
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* Tests not indicated as NEMA are Essex Furukawa 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 80-C.

All Sales are subject to Essex Furukawa Standard Terms and Conditions as posted on essexfurukawa.com. Copies available upon request.



NEMA	MW 35, MW 36, MW 73
Thermal Class	200°C (Copper), 220°C (Aluminum)
Conductor	Copper and Aluminum
Shape	Round, Square and Rectangular
Insulation Material	Polyester/ Polyamide-imide
Size Range	Round Copper; Single Build: 14-33 AWG; Heavy Build: 4-33 AWG, Round Aluminum; Single Build: 14-22 AWG; Heavy Build: 2-22 AWG, Square and Rectangular
Key Applications	Fractional and Integral HP Motors Hermetic Motors DC Motors Power Tools Automotive Alternators and Generators All Dry Type Transformers, Class 105 through 200 Electronics, All Types of Coils, Class 105 Through 200

PRODUCT DESCRIPTION

GP/MR-200® magnet wire is the standard of comparison for magnet wire performance in virtually every severe and heavy duty application. The combination of a modified Polyester basecoat and an improved Polyamide-imide topcoat results in an insulation system with outstanding physical toughness, excellent dielectric properties, and superior chemical resistance to most common solvents and refrigerants.

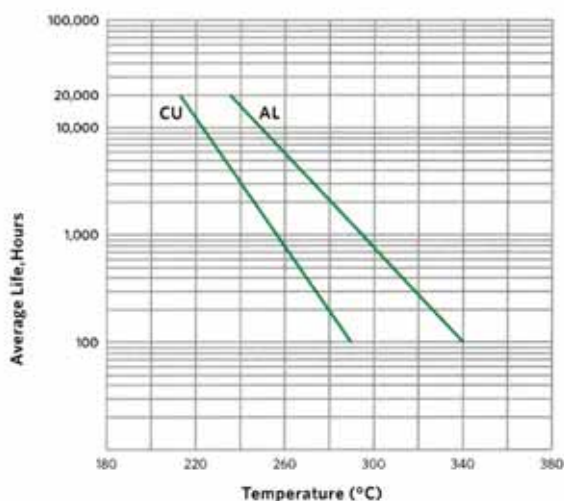
Windability of GP/MR-200® magnet wire, verified by years of experience on virtually every type of winder, has always been excellent. Improvements in the topcoat have resulted in a product that is even more superior with regard to high slot fill and insertability.

FEATURES AND BENEFITS

Thermal Classification	GP/MR-200® magnet wire is classified as Class 200°C on Copper conductor and Class 220°C on Aluminum.
Thermoplastic Flow	GP/MR-200® Copper magnet wire has excellent thermoplastic flow (cut-thru) properties, with typical test values near 390°C.
Windability	The windability of GP/MR-200® magnet wire is excellent, and has been recently improved in the areas of lubricity and scrape resistance. This has been accomplished without sacrificing other key thermal and chemical properties.
Electrical	GP/MR-200® magnet wire insulation exhibits high dielectric strength retention under high moisture conditions. Hydrolysis resistance is excellent.
Chemical	As shown by property data presented elsewhere in this brochure, resistance of GP/MR-200® magnet wire to both traditional refrigerants and replacement refrigerants (for CFC's and HCFC's) is excellent. GP/MR-200® magnet wire has been the standard for hermetic applications virtually since its inception.
Stripping Method	Insulation piercing, mechanical stripping, hot staking and flame welding processes can all be used with copper GP/MR-200® magnet wire. Flame welding processes are not recommended for aluminum GP/MR-200® magnet wire. If the connection is to be soldered, the insulation must be removed prior to soldering.
Normal Availability	- Round Copper Sizes: 14-33 AWG, Single Build; 4-33 AWG, Heavy Build - Round Aluminum Sizes: 14-22 AWG, Single Build; 2-22 AWG, Heavy Build - Square and Rectangular Please consult Magnet Wire Marketing for additional sizes (including metric) and build information

THERMAL ENDURANCE

18 AWG Heavy Build CU/AL



PROPERTIES				
		TEST DETAILS	TYPICAL PERFORMANCE*	REQUIRED PERFORMANCE**
THERMAL				
Heat Shock Resistance		20% Elongation, 220°C x 0.5hr	1xD, no cracks	3xD, no cracks
Thermal Endurance		20,000 hrs, per ASTM D 2307	213°C (CU), 236°C (AL)	≥ 200°C (CU), ≥ 220°C (AL)
Thermoplastic Flow		Crossing method, 5°C/minute rise rate	395°C, 2kg weight (CU only)	≥ 300°C, 2kg weight (CU only)
PHYSICAL				
Abrasion Resistance		Unidirectional Scrape	1550g (CU), 1500g (AL)	≥ 980g & ≥ 1150g avg (CU), ≥ 590g & ≥ 690g avg (AL)
		Repeated Scrape	150 strokes, 700g weight (CU)	-
Adherence and Flexibility		20% Elongation, mandrel wrap (CU), 15% Elongation, mandrel wrap (AL)	1xD, no cracks (CU), 2xD, no cracks (AL)	3xD, no cracks (CU & AL)
Coefficient of Friction		Dynamic Coefficient of Friction per MW 750	Dry Lube: .02 - .06 (CU & AL)	-
Elongation		Elongate to break	38% (CU), 25% (AL)	≥ 32% (CU), ≥ 15% (AL)
Springback		Mandrel wrap	54° (CU)	≤ 58° (CU)
ELECTRICAL				
Continuity		100 ft, graphite fiber brush	≤ 1 fault @ 1500 VDC (CU & AL)	≤ 5 fault @ 1500 VDC (CU), ≤ 10 fault @ 1500 VDC (AL)
Dielectric Breakdown Voltage	Room Temperature	Twisted pairs @ ambient	12,200 volts (CU), 10,000 volts (AL)	≥ 5,700 volts (CU & AL)
	Rated Temperature	Twisted pairs @ 200°C	10,300 volts	≥ 4,275 volts
CHEMICAL				
Solubility		Immersed in 60°C Xylene solvent x 0.5hr, needle scrape	Passes	≥ 575g (CU), ≥ 345g (AL)
		Immersed in 60°C Xylene/Butyl solvent x 0.5hr, needle scrape	Passes	≥ 575g (CU), ≥ 345g (AL)
Other Solvents		Petroleum naphtha, 3% toluene, ethanol, 5% sulfuric acid, 1% potassium hydroxide, butyl acetate, acetone for 24 hours at room temperature.	Passes	≥ 575g (CU), ≥ 345g (AL)
Refrigerant				
Refrigerant Resistance	Extraction	≤ 85% of refrigerant critical pressure x 6 hour, collect residue, measure percent of insulation weight loss	R22	0.15%
			R134a	0.03%
			R123	0.14%
	Dielectric Breakdown after Conditioning	Twisted pairs, exposed to refrigerant at 75-85% of critical pressure x 72 hours	R22	13,000 volts
			R134a	14,300 volts
			R123	14,900 volts

* Performance data is representative of 18 AWG heavy build Copper or Aluminum magnet wire where applicable.

** Requirements for 18 AWG heavy build per NEMA MW 35, MW 36 and MW 73.



NEMA	MW 37-C, MW 38-C, MW 73-C
Thermal Class	220°C
Conductor	Copper
Shape	Round, Square, Rectangular
Insulation Material	Polyester/Polyamide-imide
Size Range	Round Single Build: 14-33 AWG Round Heavy Build: 4-33 AWG Square and Rectangular: Please consult Essex Magnet Wire Marketing for additional sizes (including metric) and build information.
Key Applications	Form Wound Coils Fractional and Integral HP Motors Hermetic Motors DC Motors Automotive Alternators and Generators All Dry Type Transformers Electronics, Power Tools

PRODUCT DESCRIPTION

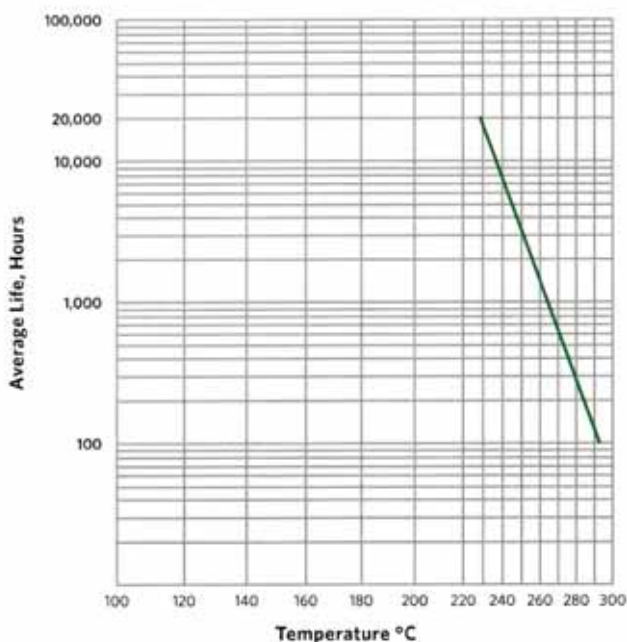
GP/MR-EXTRA® has an improved insulation system that has been engineered to enhance adhesion, scrape abrasion, and chemical resistance with improved thermal properties. GP/MR-EXTRA® is manufactured utilizing THEIC Polyester basecoat in conjunction with a tough, thermally stable Polyamide-imide topcoat polymer. Changes to the THEIC Polyester basecoat and to the Polyamide-imide topcoat provide a product with abrasion resistance and thermal capability.

FEATURES AND BENEFITS

Thermal Classification	GP/MR-EXTRA® magnet wire is classified as Class 220°C on Copper conductor.
Thermoplastic Flow	GP/MR-EXTRA® Copper magnet wire has excellent thermoplastic flow (cut-thru) properties, with typical test values near 390°C.
Windability	The windability of GP/MR-EXTRA® magnet wire is excellent, and has been improved in the areas of lubricity and scrape resistance. This has been accomplished without sacrificing other key thermal and chemical properties.
Electrical	GP/MR-EXTRA® magnet wire insulation exhibits high dielectric strength retention under high moisture conditions. Hydrolysis resistance is excellent.
Chemical	As shown by property data presented elsewhere in this brochure, resistance of GP/MR-EXTRA® magnet wire to both traditional refrigerants and replacement refrigerants (for CFC's and HCFC's) is excellent. GP/MR-EXTRA® magnet wire has been used in hermetic applications virtually since its inception.
Stripping Method	Insulation piercing, mechanical stripping, hot staking and flame welding processes can all be used with GP/MR-EXTRA® magnet wire. If the connection is to be soldered, the insulation must be removed prior to soldering.
Normal Availability	- Round Copper Sizes: 14-33 AWG, Single Build 4-33 AWG, Heavy Build - Square and Rectangular Please consult Magnet Wire Marketing for additional sizes (including metric) and build information

THERMAL ENDURANCE

18 AWG Heavy Build CU





PROPERTIES				
		TEST DETAILS	TYPICAL PERFORMANCE*	REQUIRED PERFORMANCE**
THERMAL				
Heat Shock Resistance		20% Elongation, 3xD	300°C x 0.5hr, no cracks	240°C x 0.5hr, no cracks
Thermal Endurance		20,000 hrs, per ASTM D 2307	228°C	≥ 220°C
Thermoplastic Flow		Crossing method, 5°C/minute rise rate	393°C, 2kg weight	≥ 325°C, 2kg weight
PHYSICAL				
Abrasion Resistance	Unidirectional Scrape		2088g	≥ 980g ≥ 1150g avg
	Repeated Scrape		211 strokes, 700g weight	-
Adherence and Flexibility		20% Elongation, mandrel wrap, 3xD	No cracks	No cracks
Coefficient of Friction		Dynamic Coefficient of Friction per MW 750	Dry Lube: .02 - .06	-
Elongation		Elongate to break	38%	≥ 32%
Springback		Mandrel wrap	54°	≤ 58°
ELECTRICAL				
Continuity		100 ft, graphite fiber brush	≤ 1 fault @ 1500 VDC	≤ 5 fault @ 1500 VDC
Dielectric Breakdown Voltage	Room Temperature	Twisted pairs @ ambient	15,000 volts	≥ 5,700 volts
	Rated Temperature	Twisted pairs @ 220°C	12,000 volts	≥ 4,275 volts
CHEMICAL				
Solubility	Immersed in 60°C Xylene solvent x 0.5hr, needle scrape		Passes	≥ 575g
	Immersed in 60°C Xylene/Butyl solvent x 0.5hr, needle scrape		Passes	≥ 575g
Other Solvents		Petroleum naphtha, 3% toluene, ethanol, 5% sulfuric acid, 1% potassium hydroxide, butyl acetate, acetone for 24 hours at room temperature	Passes	≥ 575g
Refrigerant Resistance	Refrigerant			
	Extraction	≤ 85% of refrigerant critical pressure x 6 hour, collect residue, measure percent of insulation weight loss	R22	0.02%
			R134a	0.04%
	Dielectric Breakdown after Conditioning	Twisted pairs, exposed to refrigerant at 75-85% of critical pressure x 72 hours	R22	9,200 volts
			R134a	14,900 volts
				≥ 5,700 volts

* Performance data is representative of 18 AWG heavy build Copper magnet wire where applicable.

** Requirements for 18 AWG heavy build per NEMA MW 37, MW 38 and MW 73.

UltraShield® Plus

Magnet Wire | Winding Wire

Product Data Sheet

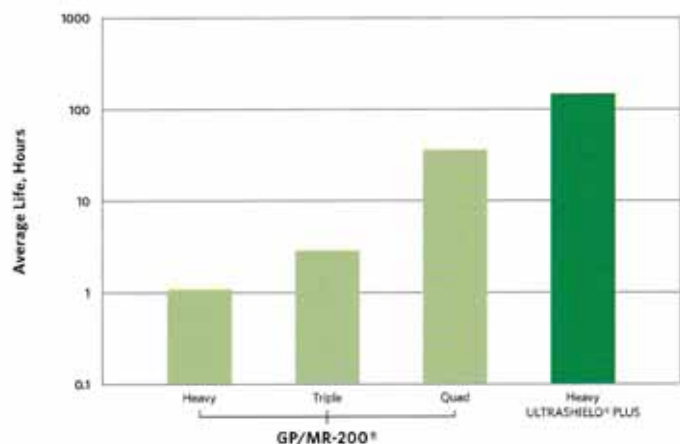


FEATURES AND BENEFITS

Thermal Classification	UltraShield® Plus magnet wire is UL listed at Class 200, and is recommended for NEMA MW 35-C and MW 73-C wire applications.
Thermoplastic Flow	390°C
Solderability	N/A
Windability	UltraShield® Plus magnet wire has been extensively wound in various motor applications and has been highly commended for its superior windability performance.
Electrical	Testing with sinusoidal and with inverter wave shapes shows that UltraShield® Plus magnet wire lasts many times longer than standard NEMA MW 35-C and MW 73-C insulation. 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.
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.
Stripping Method	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.
Normal Availability	- Round Copper Sizes: 9 - 30 AWG, Heavy Build - Please consult Magnet Wire Marketing for additional size (including metric) and build information.

INVERTER LIFE TESTING

150°C, 575V Inverter with 18AWG Twisted Pairs



NEMA	MW 35-C, MW 73-C
Thermal Class	Class 200
Conductor	Copper
Shape	Round
Insulation Material	Polyester/Polyamide-imide
Size Range	9-30 AWG, Heavy Build
Key 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

PRODUCT DESCRIPTION

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, exhibits excellent resistance to partial discharges and abrasion. The combination of the modified Polyester basecoat and Polyamide-imide 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.

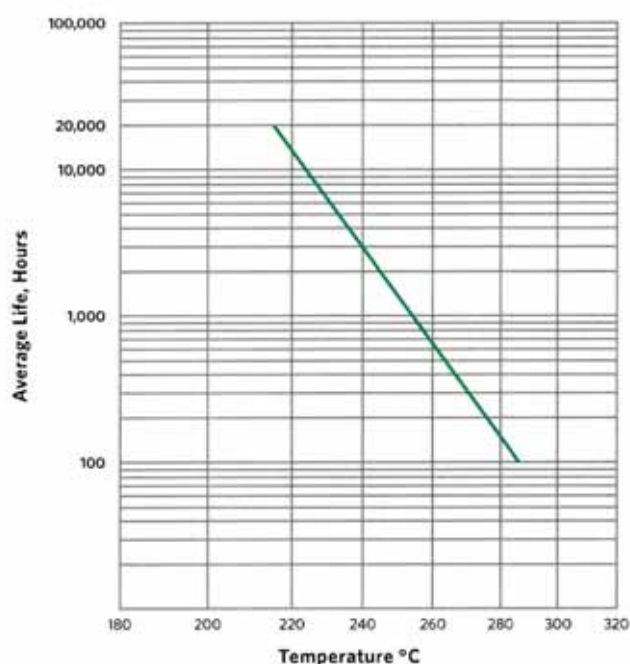


PROPERTIES			
	TEST DETAILS	TYPICAL PERFORMANCE*	REQUIRED PERFORMANCE**
THERMAL			
Heat Shock Resistance	20% Elongation, 3xD mandrel wrap	No topcoat or basecoat cracks	220°C x 0.5hr, no cracks
Thermal Endurance	20,000 hrs, per ASTM D 2307	215°C	≥ 200°C
Thermoplastic Flow	Crossing method, 5°C/minute rise rate	> 380°C, 2kg weight	≥ 300°C, 2kg weight
PHYSICAL			
Abrasion Resistance	Unidirectional Scrape	2,100g	≥ 1,150g avg
	Repeated Scrape	> 300 strokes, 700g weight	-
Adherence and Flexibility	20% Elongation, 3xD mandrel wrap	No topcoat or basecoat cracks	no cracks
Elongation	Elongate to break	38%	≥ 32%
Springback	Mandrel wrap	48°	≤ 58°
ELECTRICAL			
Continuity	100 ft, graphite fiber brush	≤ 1 fault @ 1,500 VDC	≤ 5 fault @ 1,500 VDC
Dielectric Breakdown Voltage	Twisted pairs @ ambient	12,900 volts	≥ 5,700 volts
Dielectric Breakdown Voltage at Rated Temperature	Twisted pairs @ 200°C	10,900 volts	≥ 4,275 volts
CHEMICAL			
Solubility	Immersed in 60°C solvent x 0.5hr, needle scrape	Passes	No exposed bare conductor
Refrigerant Resistance	Weight loss after refrigerant exposure	0.02%	≤ 0.25%
	Dielectric breakdown voltage after refrigerant exposure	11,600 volts	≥ 5,700 volts

* Performance data is representative of 18 AWG heavy build copper magnet wire where applicable. ** Requirements for 18 AWG heavy build per NEMA MW 35-C or MW 73-C.

THERMAL ENDURANCE

18 AWG Heavy Build



Conductor		Minimun thickness of film (mm)	Overall Dia.		Weight (kg/km)	Conductor Resistance 20°C (Ω/km)	
Dia (mm)	Tolerance of Dia. +_(mm)		Standard (mm)	Max. (mm)	Copper	Copper	
						Standard	Max.
3.20	0.030	0.034	3.303	3.338	72.2	2.144	2.184
3.00	0.030	0.034	3.098	3.128	63.4	2.439	2.488
2.90	0.030	0.034	2.998	3.028	59.3	2.610	2.665
2.80	0.030	0.034	2.898	2.928	55.3	2.800	2.860
2.70	0.030	0.034	2.798	2.828	51.4	3.011	3.079
2.60	0.030	0.034	2.698	2.728	47.7	3.247	3.323
2.50	0.030	0.034	2.598	2.628	44.1	3.512	3.598
2.40	0.025	0.033	2.496	2.526	40.7	3.811	3.891
2.30	0.025	0.032	2.393	2.422	37.4	4.150	4.241
2.20	0.025	0.032	2.293	2.322	34.2	4.536	4.640
2.10	0.025	0.031	2.191	2.220	31.2	4.978	5.098
2.00	0.025	0.030	2.089	2.118	28.3	5.488	5.627
1.90	0.025	0.030	1.989	2.018	25.5	6.081	6.244
1.80	0.025	0.029	1.886	1.914	22.9	6.775	6.967
1.70	0.025	0.029	1.786	1.814	20.5	7.596	7.824
1.60	0.025	0.028	1.684	1.712	18.2	8.575	8.849
1.50	0.016	0.028	1.584	1.612	16.0	9.756	9.967
1.40	0.016	0.027	1.481	1.508	13.9	11.20	11.46
1.30	0.016	0.027	1.381	1.408	12.0	12.99	13.31
1.20	0.012	0.026	1.278	1.304	10.2	15.24	15.55
1.10	0.012	0.026	1.178	1.204	8.63	18.14	18.54
1.00	0.012	0.025	1.076	1.102	7.14	21.95	22.84
0.95	0.010	0.024	1.018	1.038	6.44	24.32	24.84
0.90	0.010	0.023	0.966	0.986	5.78	27.10	27.71
0.85	0.010	0.022	0.914	0.934	5.16	30.38	31.11
0.80	0.001	0.021	0.862	0.882	4.57	34.30	35.174
0.75	0.008	0.020	0.810	0.830	4.02	39.03	39.87
0.70	0.008	0.019	0.757	0.776	3.50	44.80	45.84
0.65	0.008	0.018	0.705	0.724	3.02	51.96	53.26
0.60	0.008	0.017	0.653	0.672	2.58	60.98	62.63
0.55	0.006	0.017	0.602	0.620	2.17	72.57	74.72
0.50	0.006	0.017	0.547	0.560	1.80	87.81	90.68
0.45	0.006	0.016	0.495	0.508	1.46	109.2	113.1
0.40	0.005	0.015	0.443	0.456	1.15	138.2	141.6
0.37	0.005	0.014	0.411	0.424	0.99	161.5	165.9
0.35	0.005	0.014	0.390	0.402	0.88	180.5	185.7
0.32	0.005	0.014	0.360	0.372	0.74	215.9	222.7
0.30	0.005	0.014	0.340	0.352	0.65	245.6	257.3
0.29	0.004	0.013	0.328	0.340	0.61	266.3	273.8
0.28	0.004	0.013	0.318	0.330	0.57	285.7	294.0
0.27	0.004	0.013	0.308	0.320	0.53	307.3	316.5
0.26	0.004	0.013	0.298	0.310	0.49	331.4	341.7
0.25	0.004	0.013	0.287	0.298	0.46	358.4	370.1
0.24	0.004	0.013	0.277	0.288	0.42	388.9	402.1
0.23	0.004	0.013	0.267	0.278	0.39	423.4	438.5
0.22	0.004	0.012	0.255	0.266	0.35	462.8	480.1
0.21	0.003	0.012	0.245	0.256	0.32	507.9	522.7
0.20	0.003	0.012	0.235	0.246	0.29	560.0	577.1
0.19	0.003	0.012	0.225	0.236	0.27	620.5	640.5
0.18	0.003	0.012	0.215	0.226	0.24	691.4	714.9
0.17	0.003	0.011	0.203	0.214	0.21	775.1	803.1
0.16	0.003	0.011	0.193	0.204	0.19	875.0	908.7
0.15	0.003	0.010	0.181	0.192	0.17	995.6	1,036
0.14	0.003	0.010	0.171	0.182	0.15	1,143	1,193
0.13	0.003	0.010	0.161	0.172	0.13	1,325	1,388
0.12	0.003	0.010	0.151	0.162	0.110	1,556	1,636
0.11	0.003	0.009	0.139	0.150	0.091	1,851	1,956
0.10	0.003	0.009	0.129	0.140	0.076	2,240	2,380

CLASS TWO, THREE ENAMELLED WIRES

JIS Standard

Conductor		Class Two				Class Three				Conductor Resistance	
Dia (mm)	Tolerance of Dia. +_(mm)	Minimum thickness of film (mm)	Overall Dia.		Weight (kg/km) (mm)	Minimum thickness of film (mm)	Overall Dia.		Weight (kg/km) (mm)	20°C (Ω/km)	
			Standard (mm)	Max. (mm)			Standard (mm)	Max. (mm)		Standard	Max.
1.00	0.013	0.017	1.048	1.062	7.08	-	-	-	-	21.95	22.49
0.95	0.010	0.017	0.996	1.008	6.39	-	-	-	-	24.32	24.84
0.90	0.010	0.016	0.944	0.959	5.74	-	-	-	-	27.10	27.71
0.85	0.010	0.015	0.892	0.904	5.12	-	-	-	-	30.38	31.11
0.80	0.010	0.015	0.841	0.852	4.54	-	-	-	-	34.30	35.17
0.75	0.008	0.014	0.788	0.798	3.99	-	-	-	-	39.03	39.87
0.70	0.008	0.013	0.736	0.746	3.47	-	-	-	-	44.80	45.84
0.65	0.008	0.012	0.684	0.694	3.00	-	-	-	-	51.96	53.26
0.60	0.008	0.012	0.634	0.644	2.56	0.008	0.6240	0.632	2.54	60.38	62.64
0.55	0.006	0.012	0.583	0.592	2.15	0.008	0.5736	0.581	2.14	72.57	74.18
0.50	0.006	0.012	0.5330	0.542	1.78	0.008	0.5236	0.531	1.77	87.81	89.95
0.45	0.006	0.011	0.4810	0.490	1.44	0.007	0.4716	0.479	1.43	109.2	112.1
0.40	0.005	0.011	0.4305	0.439	1.14	0.007	0.4216	0.429	1.13	138.2	141.7
0.37	0.005	0.010	0.3985	0.407	0.98	0.007	0.3906	0.397	0.97	161.5	165.9
0.35	0.005	0.010	0.3785	0.387	0.88	0.007	0.3706	0.377	0.87	180.5	185.7
0.32	0.005	0.010	0.3485	0.357	0.73	0.007	0.3406	0.347	0.73	215.9	222.8
0.30	0.005	0.010	0.3285	0.337	0.65	0.007	0.3206	0.327	0.64	245.6	254.0
0.29	0.004	0.009	0.3160	0.324	0.60	0.006	0.3086	0.315	0.60	266.3	273.9
0.28	0.004	0.009	0.3060	0.314	0.57	0.006	0.2986	0.305	0.56	285.7	294.1
0.27	0.004	0.009	0.2960	0.304	0.52	0.006	0.2886	0.295	0.52	307.3	316.6
0.26	0.004	0.009	0.286	0.294	0.49	0.006	0.2786	0.285	0.48	331.4	341.8
0.25	0.004	0.009	0.276	0.284	0.45	0.006	0.2686	0.275	0.45	358.4	370.2
0.24	0.004	0.009	0.266	0.274	0.42	0.006	0.2586	0.265	0.41	388.9	402.2
0.23	0.004	0.009	0.256	0.264	0.38	0.006	0.2486	0.250	0.38	423.4	438.6
0.22	0.004	0.008	0.244	0.252	0.35	0.005	0.2366	0.243	0.35	462.8	480.1
0.21	0.003	0.008	0.2335	0.241	0.32	0.005	0.2260	0.232	0.31	507.9	522.8
0.20	0.003	0.008	0.2235	0.231	0.29	0.005	0.2160	0.222	0.29	560.0	577.2
0.19	0.003	0.008	0.2135	0.221	0.26	0.005	0.2060	0.212	0.26	620.5	640.6
0.18	0.003	0.008	0.2035	0.211	0.24	0.005	0.1960	0.202	0.23	691.4	715.0
0.17	0.003	0.007	0.1915	0.199	0.21	0.005	0.1856	0.191	0.21	775.1	803.2
0.16	0.003	0.007	0.1815	0.189	0.19	0.005	0.1756	0.181	0.18	875.0	908.8
0.15	0.003	0.006	0.1695	0.177	0.16	0.004	0.1636	0.169	0.16	995.6	1,037
0.14	0.003	0.006	0.1595	0.167	0.14	0.004	0.1536	0.159	0.14	1,143	1,193
0.13	0.003	0.006	0.1495	0.157	0.12	0.004	0.1436	0.149	0.12	1,325	1,389
0.12	0.003	0.006	0.1395	0.147	0.11	0.004	0.1336	0.139	0.10	1,556	1,636
0.11	0.003	0.005	0.1275	0.135	0.089	0.003	0.1220	0.128	0.087	1,851	1,957
0.10	0.003	0.005	0.1175	0.125	0.074	0.003	0.1120	0.118	0.072	2,240	2,381
0.09	0.003	0.005	0.1065	0.113	0.060	0.003	0.1016	0.107	0.059	2,765	2,959
0.08	0.003	0.005	0.0965	0.103	0.048	0.003	0.0916	0.097	0.047	3,500	3,778
0.07	0.003	0.004	0.0845	0.091	0.036	0.003	0.0806	0.085	0.036	4,572	4,990
0.06	0.003	0.004	0.0745	0.081	0.027	0.003	0.0706	0.075	0.027	6,287	6,966
0.05	0.003	0.004	0.0635	0.069	0.020	0.003	0.0600	0.064	0.019	9,050	10,240
0.04	0.002	0.003	0.0510	0.056	0.012	0.002	0.0480	0.052	0.012	14,140	15,670

Conductor		Minimun thickness of film (mm)	Overall Dia.		Weight (kg/km)	Conductor Resistance 20°C (Ω/km)	
Dia (mm)	Tolerance of Dia. +_(mm)		Standard (mm)	Max. (mm)	Copper	Copper	
						Standard	Max.
3.20	0.030	0.049	3.343	3.388	72.4	2.144	2.184
3.00	0.030	0.049	3.138	3.178	63.7	2.439	2.488
2.90	0.030	0.049	3.038	3.078	59.5	2.610	2.665
2.80	0.030	0.049	2.938	2.978	55.5	2.800	2.860
2.70	0.030	0.049	2.838	2.878	51.7	3.011	3.079
2.60	0.030	0.049	2.738	2.778	47.9	3.247	3.323
2.50	0.030	0.049	2.638	2.678	44.3	3.512	3.598
2.40	0.025	0.048	2.538	2.574	40.9	3.811	3.891
2.30	0.025	0.046	2.430	2.468	37.6	4.150	4.241
2.20	0.025	0.046	2.330	2.368	34.4	4.536	4.640
2.10	0.025	0.045	2.228	2.266	31.2	4.978	5.098
2.00	0.025	0.044	2.125	2.162	28.4	5.488	5.627
1.90	0.025	0.044	2.025	2.062	25.7	6.081	6.244
1.80	0.025	0.042	1.920	1.956	23.1	6.775	6.967
1.70	0.025	0.042	1.820	1.856	20.6	7.596	7.824
1.60	0.025	0.041	1.718	1.754	18.3	8.575	8.849
1.50	0.016	0.041	1.618	1.654	16.1	9.756	9.967
1.40	0.016	0.039	1.513	1.548	14.0	11.20	11.46
1.30	0.016	0.039	1.413	1.448	12.1	12.99	13.31
1.20	0.012	0.037	1.308	1.342	10.3	15.24	15.55
1.10	0.012	0.037	1.208	1.242	8.70	18.14	18.54
1.00	0.012	0.036	1.105	1.138	7.20	21.95	22.84
0.95	0.010	0.034	1.045	1.072	6.49	24.32	24.84
0.90	0.010	0.033	0.993	1.020	5.83	27.10	27.71
0.85	0.010	0.032	0.940	0.966	5.21	30.38	31.11
0.80	0.001	0.031	0.888	0.914	4.62	34.30	35.174
0.75	0.008	0.030	0.835	0.860	4.06	39.03	39.87
0.70	0.008	0.028	0.780	0.804	3.54	44.80	45.84
0.65	0.008	0.027	0.728	0.752	3.06	51.96	53.26
0.60	0.008	0.026	0.675	0.698	2.61	60.98	62.63
0.55	0.006	0.025	0.623	0.646	2.20	72.57	74.72
0.50	0.006	0.025	0.568	0.586	1.82	87.81	90.68
0.45	0.006	0.024	0.515	0.532	1.48	109.2	113.1
0.40	0.005	0.023	0.463	0.480	1.17	138.2	141.6
0.37	0.005	0.022	0.430	0.446	1.00	161.5	165.9
0.35	0.005	0.021	0.480	0.424	0.90	180.5	185.7
0.32	0.005	0.021	0.378	0.394	0.76	215.9	222.7
0.30	0.005	0.021	0.358	0.374	0.67	245.6	257.3
0.29	0.004	0.020	0.345	0.360	0.62	266.3	273.8
0.28	0.004	0.020	0.335	0.350	0.58	285.7	294.0
0.27	0.004	0.020	0.325	0.340	0.54	307.3	316.5
0.26	0.004	0.020	0.315	0.330	0.50	331.4	341.7
0.25	0.004	0.020	0.304	0.318	0.47	358.4	370.1
0.24	0.004	0.020	0.294	0.308	0.43	388.9	402.1
0.23	0.004	0.020	0.284	0.298	0.40	423.4	438.5
0.22	0.004	0.019	0.272	0.286	0.36	462.8	480.1
0.21	0.003	0.019	0.262	0.276	0.33	507.9	522.7
0.20	0.003	0.019	0.252	0.266	0.30	560.0	577.1
0.19	0.003	0.019	0.242	0.256	0.27	620.5	640.5
0.18	0.003	0.019	0.232	0.246	0.25	691.4	714.9
0.17	0.003	0.018	0.219	0.232	0.22	775.1	803.1
0.16	0.003	0.018	0.209	0.222	0.20	875.0	908.7
0.15	0.003	0.017	0.197	0.210	0.17	995.6	1,036
0.14	0.003	0.017	0.187	0.200	0.15	1,143	1,193
0.13	0.003	0.017	0.177	0.190	0.13	1,325	1,388
0.12	0.003	0.017	0.167	0.180	0.110	1,556	1,636
0.11	0.003	0.016	0.154	0.166	0.096	1,851	1,956
0.10	0.003	0.016	0.144	0.156	0.081	2,240	2,380

NEMA ENAMELLED WIRE DIMENSIONS

AWG NO.	Conductor			Single		Heavy		Triple	
	Nom. (mm)	Min. (mm)	Max. (mm)	Min. Increase in Dia. (mm)	Max. Overall Dia. (mm)	Min. Increase in Dia. (mm)	Max. Overall Dia. (mm)	Min. Increase in Dia. (mm)	Max. Overall Dia. (mm)
7	3.665	3.630	3.683			0.086	3.787		
8	3.264	3.231	3.282			0.084	3.383		
9	3.206	2.878	2.921			0.081	3.020		
10	2.588	2.563	2.601			0.079	2.695		
11	2.304	2.281	2.316			0.076	2.408		
12	2.052	2.032	2.062			0.074	2.151		
13	1.829	1.811	1.839			0.071	1.923		
14	1.628	1.613	1.636	0.041	1.692	0.081	1.732	0.122	1.778
15	1.450	1.435	1.458	0.038	1.509	0.076	1.547	0.114	1.593
16	1.290	1.278	1.298	0.036	1.349	0.074	1.384	0.109	1.427
17	1.151	1.138	1.156	0.036	1.207	0.071	1.240	0.104	1.280
18	1.024	1.013	1.029	0.033	1.077	0.066	1.110	0.099	1.148
19	0.912	0.902	0.917	0.030	0.963	0.064	1.000	0.094	1.031
20	0.813	0.805	0.818	0.030	0.861	0.058	0.892	0.089	0.925
21	0.724	0.716	0.726	0.028	0.770	0.056	0.798	0.084	0.828
22	0.643	0.635	0.645	0.028	0.686	0.053	0.714	0.081	0.744
23	0.574	0.569	0.577	0.025	0.617	0.051	0.643	0.076	0.671
24	0.511	0.505	0.513	0.025	0.551	0.048	0.577	0.074	0.605
25	0.455	0.450	0.457	0.023	0.493	0.046	0.516	0.069	0.544
26	0.404	0.399	0.406	0.023	0.439	0.043	0.462	0.066	0.490
27	0.361	0.358	0.363	0.020	0.396	0.041	0.417	0.061	0.439
28	0.320	0.318	0.323	0.020	0.356	0.041	0.373	0.058	0.396
29	0.287	0.284	0.290	0.018	0.320	0.038	0.338	0.056	0.361
30	0.254	0.251	0.256	0.018	0.284	0.036	0.302	0.053	0.325
31	0.226	0.224	0.229	0.015	0.254	0.033	0.274		
32	0.203	0.201	0.206	0.015	0.231	0.030	0.249		
33	0.180	0.178	0.183	0.013	0.206	0.028	0.224		
34	0.160	0.157	0.163	0.013	0.183	0.025	0.198		
35	0.142	0.140	0.145	0.010	0.163	0.023	0.178		
36	0.127	0.124	0.130	0.010	0.147	0.020	0.160		
37	0.114	0.112	0.117	0.008	0.132	0.020	0.145		
38	0.102	0.099	0.104	0.008	0.119	0.018	0.130		
39	0.089	0.086	0.091	0.005	0.104	0.015	0.114		
40	0.079	0.076	0.081	0.005	0.094	0.015	0.102		
41	0.071	0.069	0.074	0.005	0.084	0.013	0.091		
42	0.0640	0.061	0.066	0.050	0.0760	0.0100	0.0810		
43	0.0560	0.053	0.058	0.050	0.0660	0.0100	0.0740		
44	0.0510	0.048	0.053	0.025	0.0610	0.0100	0.0690		
45	0.0447			0.025	0.0521	0.0076	0.0584		
46	0.0399			0.025	0.0470	0.0076	0.0533		
47	0.0356			0.025	0.0432	0.0076	0.0483		
48	0.0315			0.025	0.0381	0.0051	0.0432		
49	0.0282			0.025	0.0330	0.0051	0.0381		
50	0.0251			0.025	0.0305	0.0051	0.0356		