

# Magnet Wire Insulation Guide

Thermal Class	Insulation Type	NEMA Standard (MW100)	Federal Specification (JW1177)	Insulation Characteristics
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## 105C

Plain Enamel	NONE	NONE	Plain Enamel, known as oleoresinous enamel, was one of the first film insulations developed more than 75 years ago and is still in use today in a variety of electronic components. Plain Enamel wires are manufactured to single-build dimensional standards. Available in 40-44 AWG.
Formvar	MW 15 (RD), MW 18 (SQ/RECT)	JW1177/4 (RD), JW1177/16 (SQ/RECT)	Formvar Enamel is made from vinyl acetal resins produced as a smooth uniform film. Formvar has excellent mechanical properties such as abrasion resistance and flexibility.
Polyurethane Bondable	MW 3	JW1177/44	Bondable magnet wire is insulated copper wire with a superimposed film of thermoplastic bonding material. The bonding material is activated by heat or a solvent making it possible to wind coils in tight and unusual shapes since the wire may be bonded turn-to-turn as it is being wound.
Formvar Bondable	MW 19	JW1177/6	
Polyurethane Nylon Bondable	MW 29	JW1177/30	

## 155C

Polyurethane-155	MW 79	JW1177/41	Polyurethane-155 is a 155°C thermal class solder strippable insulation produced primarily 30 AWG and finer with quick soldering characteristics at 390C.
Polyurethane Nylon-155	MW 80	JW1177/42	Polyurethane Nylon-155 is similar to the 155°C Polyurethane with an additional Nylon overcoat to improve the abrasion resistance and heat shock characteristics for coil and motor windings.

## 180C

Polyurethane-180	MW 82	NONE	Polyurethane-180 combines the thermal properties of a class 180°C insulation, while offering low temperature solderability at 390 C.
Polyurethane Nylon-180	MW 83	NONE	Polyurethane Nylon-180 offers excellent abrasion resistance for ferrite core coils and transformers, while exhibiting high temperature thermal stress and low temperature solderability at 430C.
Polyester-imide	MW 30	JW1177/12	Polyester-imide magnet wire is insulated with a Class H modified polyester resin. It has excellent thermal endurance, solvent resistance and exhibits a low coefficient of friction to improve windability.
Polyester Nylon	MW 76	JW1177/38	Polyester Nylon is a film insulation with a modified polyester basecoat and a nylon topcoat. Typical of a dual coat construction, advantage is taken of the high thermal properties of the polyester and the mechanical properties of the nylon.
Solderable Polyester	MW 77	JW1177/39	Solderable Polyester magnet wire is an ester-imide insulated wire which solders at 470°C.
Solderable Polyester Nylon	MW 78	JW1177/40	Solderable Polyester-Nylon magnet wire is a two-part insulation system in which ester-imide basecoat is overcoated with nylon. This wire solders at 455C.
Polyester-imide Bondable	NONE	NONE	Self-bonding polyester actually describes a number of possible constructions of polyester base insulation with a thermoplastic bond coat. The bond coat is heat or solvent activated.
Polyester-amide-imide Bondable	NONE	NONE	
Solderable Polyester Bondable	NONE	NONE	

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200C	Glass Fibers	MW 44 (RD), MW 43 (SQ/RECT)	JW1177/21 (RD)	Both glass and Dacron glass are a served filament on the magnet wire conductor. They are available as unvarnished or varnished with organic or silicone varnishes. The fibers may be served over bare conductor or over film constructions. The glass is a continuous filament glass yarn and the Dacron glass is a combination of glass and polyester fibers. Glass offers high resistance to overload burnout and Dacron offers excellent abrasion resistance and flexibility.
	Dacron Glass (DDG)	MW 45 (RD), MW 46 (SQ/RECT)	JW1177/20 (RD), JW1177/25 (SQ/RECT)	
	Polyester-200	MW 74	JW1177/43	Polyester-200 is a modified theic-polyesterimide one-part system. It has high temperature thermal properties and good chemical resistance.
	Polyester-Amide-Imide	MW 35 (RD), MW 36 (SQ/RECT)	JW1177/14 (RD), JW1177/13 (SQ/RECT)	Polyester-amide-imide magnet wire is a two-part insulation consisting of a modified polyester basecoat with a superimposed amide-imide outer coating. The wire exhibits exceptional windability, heat shock resistance and ability to withstand overloads. Excellent chemical resistance to most solvents and insulating varnishes.
	Polytetrafluoroethylene (Teflon)	NONE	NONE	Teflon has high heat resistance and excellent resistance to most solvents, acids and corrosive chemicals and a high dielectric constant.
240C	Polyimide-ML	MW 16 (RD), MW 20 (SQ/RECT)	JW1177/15(RD),JW1177/18(SQ/RECT)	ML is a film insulation made of polyimide resins. It is a Class 240 C thermal rated insulation with exceptional resistance to chemical solvents and burnout. The wire ability to withstand excessive overloads extends the use of the magnet wire in extreme conditions. MS is unaffected by prolonged exposure to varnish solvents.

# Wire Insulation Guide

Magnet wire is a copper (Cu) or aluminum (Al) wire coated with a thin layer of insulation. Insulated magnet wire is the standard conductor used in most electromagnet coil applications.

Depending on the application, various insulation materials affect the conductor properties differently. The primary purpose of the insulation is to provide the electrical barrier between conductor turns on a coil, as well as with heat and moisture resistance for strength and thermal resistance.

This Magnet Wire Insulation Guide discusses the general conductor properties and gives a breakdown of the insulation types and characteristics.

# General Conductor Properties

- Conductance Properties:** Conductance defines the amount of current that can pass through a given copper wire. The opposite of conductance is resistance. The higher the resistance, the lower the amount of current.
- Inductance Properties:** Inductance of a coil influences current. The more inductance, the more resistance there is to the current passing through causing less voltage and power.
- Area, Weight, and Resistance:** More resistance occurs as the wire length increases. Conversely, the larger the cross-section area, the less resistance for the electrons to flow through the distance.
- Physical Properties:** Physical properties of conductors include density, thermal capacity, thermal conductivity, thermal coefficient of expansion, melting point, and tensile characteristics of strength.
- Electrical Properties:** Electrical conductor properties include IACS volume conductivity, volume resistivity, weight resistivity, thermal coefficient of resistance, and change in unit resistance at 20°C.
- Resistance Correction Factors:** Ambient temperature and thermal insulation can have a detrimental effect on the electric current. In these situations, it's necessary to multiply the allowable ampacity by the temperature correction factors.
- AWG System:** AWG is the standard for sizing single-strand, round, solid wires in North America. The wire size from largest diameter to smallest are 0000 AWG to 40 AWG.
- Winding Tensions:** Winding tension recommendations are available from the [Essex Handbook](#). The winding tension chart gives the maximum and minimum recommended winding tensions for copper and aluminum.

# Wire Insulation & Properties

Wire cable insulation properties increase safety levels and wire performance. The most important insulation properties for electrical cables are:

- Superior insulation resistance to prevent current leakage.
- High dielectric strength of the insulation material to withstand voltage before breakdown happens.
- Effective mechanical strength to withstand handling the conductor.
- Non-flammable
- Non-hygroscopic properties to buffer exterior air and soil moisture that can permeate insulation materials. This can cause cable degradation and breakdown.
- Resistant to environmental hazards like acids and alkalis to prevent corrosion and chemical reactions.

## Magnet & Wire Insulation Guide

Magnet wire or winding wire is essential for conducting electricity. There are specifications for different types of coatings or coverings for effective insulation performance.

The following sheet provides information on Thermal Class, Insulation Type, NEMA Standard(MW1000), Federal Specifications, and Insulation Characteristics.

Magnet & Wire Insulation Guide

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At Custom Coils, Inc., we can help you with all your custom coil projects. Our team of expert engineers and designers are leaders in creating magnetic coil components. Please check our technical resources when planning your project.

Download our [Magnet & Wire Insulation Guide PDF](#) for detailed information. Also, consult the [Essex Handbook](#) for Conductor Properties information.

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