# Bondable Products
Magnet Wire / Winding Wire

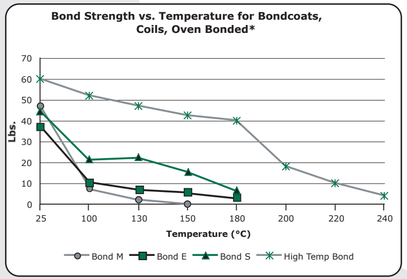
## BONDABLE PRODUCTS AND BONDING GUIDELINES

Bondable magnet wire products are described by the basecoat and topcoat materials. Polybondex® describes a number of possible constructions of bondable wire having a GP/MR-200® or Thermalex 200® base insulation with a thermoplastic bondcoat. For example, Polybondex® T indicates that the basecoat is Thermalex 200®. Polybondex® G indicates that the basecoat is GP/MR-200®. The bondcoat is designated by the letters M (Epoxy), S (Aromatic Polyamide), or E (Polyester).

| Bondable Product | Metal | Basecoat Polymer | Topcoat Polymer | Bondcoat Polymer | Temperature Rating (°C) | Bonding Temperature Guidelines (°C) | NEMA MW 102 |
|---|---|---|---|---|---|---|---|
| Polybondex® G, Bond M | AL / CU | Polyester | Polyamide-imide | Epoxy | 180 | 150-200 | |
| Polybondex® G, Bond S | AL / CU | Polyester | Polyamide-imide | Aromatic Polyamide | 180 | 210-230 | x |
| Polybondex® G, Bond E | AL / CU | Polyester | Polyamide-imide | Polyester | 180 | 180-200 | x |
| Polybondex® T, Bond M | AL / CU | Polyester | N/A | Epoxy | 180 | 150-200 | |
| Polybondex® T, Bond S | AL / CU | Polyester | N/A | Aromatic Polyamide | 180 | 210-230 | |
| Polybondex® T, Bond E | AL / CU | Polyester | N/A | Polyester | 180 | 210-230 | |
| Soderbond® N/155 | CU | Polyurethane | Nylon | Butvar | 155 | 110-150 | |
| Amide-Imide High Temp Bond | CU | Amide-Imide | N/A | Proprietary | N/A | 275-300 | |
| Amide-Imide Bond S | CU | Amide-Imide | - | Aromatic Polyamide | - | 210-230 | |

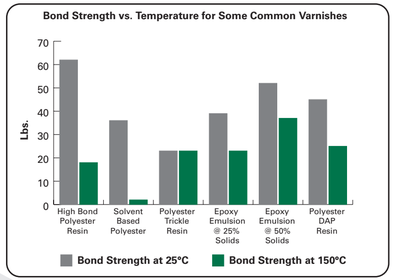
Note: The information provided in this chart is provided for convenience only and is not intended to be a complete product listing. Please consult Magnet Wire Marketing for additional constructions and product information. The bond strength and melt temperatures required will define the proper bondcoat to use.

## BOND STRENGTH COMPARISIONS




* Polybondex® G bond strength was used for the graph.

Note: Helical coil bond strength, NEMA MW 1000-2008.




Note: Helical coil bond strength per ASTM D2519.

## BONDCOAT COMPARISONS

| BONDCOAT TYPE | BONDING METHODS | FEATURES | APPLICATIONS |
|---|---|---|---|
| Bond M | • Solvent - Methylethyl ketone<br>• Heat bonding is recommended | • Use at temperatures not to exceed approximately 130°C | • Armatures<br>• Motor stators<br>• Sensors<br>• Small motors<br>• Transformers<br>• Transponders<br>• Various coil applications |
| Bond S | • Heat activated | • Aromatic polyamide<br>• High bond strength at elevated temperatures | • Appliance motors<br>• Lift magnets<br>• Motor stators<br>• Sensors<br>• Small motors<br>• Solenoids |
| Bond E | • Heat activated | • Requires minimal energy to effectively bond | • Appliance motors<br>• High temperature motors<br>• Sensors<br>• Solenoids<br>• Transformers |
| Soderbond® N/155 | • Denatured or isopropyl alcohol<br>• Heat activated | • High temperature applications where a solderable insulation is desired | • Solenoids<br>• Helical coils<br>• Toroidal coils |
| High Temp Bond | • Heat activated | • Proprietary polymer<br>• High bond strength at elevated temperatures | • Suitable for applications requiring high thermal properties |

## THREE COMMON TYPES OF BONDING

**SOLVENT BONDING**

Some bondcoats can be activated by the application of certain solvents during or after coil winding. The solvent may be applied to the wire via a wick during the winding operation or the finished coils may be dipped in a bath of solvent after winding. In either case, the unit should be heated again to drive off residual solvent and to complete the bonding of the coils.

**HEAT – OVEN BONDING**

After the coils are formed, the unit is heated in an oven which causes the bondcoat to flow and bond the adjacent turns of wire together.

**HEAT – RESISTANCE BONDING**

Resistance heating is similar to oven heating, except that passing current through the formed coils supplies the heat. Time, voltage, and current are all unique to each application.

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## FILM BUILDS ON BONDABLE WIRE

The addition of the bondcoat adds one overall build level to the wire dimension.

#0: Overall single build; half basecoat and half bondcoat - available in AWG 31 and larger. This film may not be a recommended choice for all AWG sizes. Please refer specific questions to Essex Furukawa marketing and engineering personnel.

#1: Overall heavy build; single build film insulation plus single build bondcoat.

#2: Overall triple build; heavy build film insulation plus single build bondcoat.

Note: Since the bondcoat will be softened and displaced during bonding, it should be stressed that the bondcoat will not contribute to the electrical integrity of the film coating on the wire. The basecoat alone will determine the electrical properties of the wire.

In addition, product engineering should be aware of the additional space requirements necessary due to the additional build of the bondcoat. The turns density of the coil will be adversely affected with the addition of a bondcoat.





PRODUCT DATA SHEET

## NEMA MW 102-C*

## APPLICATION

Bondable magnet wire products are an excellent choice for applications requiring the magnet wire to be a compact, self-supporting coil. Bondable wire consists of standard magnet wire insulations overcoated with a thermo-plastic polymer that can be temporarily softened by either heat or solvent, or both. The use of bondable magnet wire allows the coil to be self-supporting so that bobbins or additional varnishing is not necessary. Bondable magnet wire can also assist in reducing the work in progress and shortening the product assembly time; which can help lead to more efficient winding operations.

Depending on the desired application, bondable magnet wire products offer a wide varity of bondcoat polymers and different bond strengths, along with excellent thermal properties and chemical resistance.

Bondable products are typically used, but not limited to the following applications:

- Armatures
- Bobbinless coils
- Clutch coils
- Ignition coils
- Lift magnets
- Motors
- Relays
- Sensors
- Solenoids
- Stators
- Transformers

*Not applicable to all bondcoats.

## ENGINEERING HIGHLIGHTS

**1. THERMAL CLASSIFICATION**

Essex Furukawa offers bondable products that can have a rating above and below an 180°C thermal class rating. Typical heat shock resistance passes 220°C with no cracks.

**2. THERMOPLASTIC FLOW**

Bondable magnet wire products have excellent thermoplastic flow (cut-thru) properties. Typical test values well exceed the 300°C requirement.

**3. WINDABILITY**

The flexiblity and adhesion properties of bondable products are excellent and suitable for most winding applications.

**4. ELECTRICAL**

Bondable products exhibit high dielectric strength.

**5. NORMAL AVAILABILITY**

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

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# Bondable Products

## Magnet Wire / Winding Wire

| | 18 Polybondex® T #2 Bond S | | 18 Polybondex® T #2 Bond E | | 18 Polybondex® T #2 Bond M | | 18 Polybondex® G #2 Bond S | | 18 Polybondex® G #2 Bond E | | 18 Polybondex® G #2 Bond M | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Typical Performance** | **Required Performance** | **Typical Performance** | **Required Performance** | **Typical Performance** | **Required Performance** | **Typical Performance** | **Required Performance†** | **Typical Performance** | **Required Performance†** | **Typical Performance** | **Required Performance** |
| **PHYSICAL PROPERTIES** | | | | | | | | | | | | |
| CONDUCTOR ELONGATION | 38% | 32%, minimum | 38% | 32%, minimum | 38% | 32%, minimum | 38% | 32%, minimum | 38% | 32%, minimum | 38% | 32%, minimum |
| SPRINGBACK | 54° | 62°, maximum | 54° | 62°, maximum | 54° | 62°, maximum | 54° | 62°, maximum | 54° | 62°, maximum | 54° | 62°, maximum |
| FLEXIBILITY | Pass | 20%, 3XD, No exposed bare | Pass | 20%, 3XD, No exposed bare | Pass | 20%, 3XD, No exposed bare | Pass | 20%, 3XD, No exposed bare | Pass | 20%, 3XD, No exposed bare | Pass | 20%, 3XD, No exposed bare |
| ABRASION RESISTANCE: REPEATED SCRAPE | 42 avg. strokes | No Requirement Established | 109 avg. strokes | No Requirement Established | 87 avg. strokes | No Requirement Established | 120 avg. strokes | No Requirement Established | 159 avg. strokes | No Requirement Established | 99 avg. strokes | No Requirement Established |
| ABRASION RESISTANCE: UNILATERAL SCRAPE | 2448<br>2568 | Actual Performance<br>Avg. Performance | 3060<br>3145 | Actual Performance<br>Avg. Performance | 2513<br>2563 | Actual Performance<br>Avg. Performance | 2700<br>2760 | Actual Performance<br>Avg. Performance | 3195<br>3240 | Actual Performance<br>Avg. Performance | 2100<br>2175 | Actual Performance<br>Avg. Performance |
| COEFFICIENT OF FRICTION | .02 - .06 | No Requirement Established | .02 - .06 | No Requirement Established | .02 - .06 | No Requirement Established | .02 - .06 | No Requirement Established | .02 - .06 | No Requirement Established | .02 - .06 | No Requirement Established |
| **CHEMICAL PROPERTIES** | | | | | | | | | | | | |
| SOLUBILITY (Xylene) | Pass | Xylene, No exposed bare | Pass | Xylene, No exposed bare | Pass | Xylene, No exposed bare | Pass | Xylene, No exposed bare | Pass | Xylene, No exposed bare | Pass | Xylene, No exposed bare |
| SOLUBILITY (Xylene/Butyl) | Pass | Xylene/butyl cellosolve, No exposed bare | Pass | Xylene/butyl cellosolve, No exposed bare | Pass | Xylene/butyl cellosolve, No exposed bare | Pass | Xylene/butyl cellosolve, No exposed bare | Pass | Xylene/butyl cellosolve, No exposed bare | Pass | Xylene/butyl cellosolve, No exposed bare |
| **THERMAL PROPERTIES** | | | | | | | | | | | | |
| HEAT SHOCK RESISTANCE | Pass | 20%, 3XD @ 200° No exposed bare | Pass | 20%, 3XD @ 200° No exposed bare | Pass | 20%, 3XD @ 200° No exposed bare | Pass | 20%, 3XD @ 200° No exposed bare | Pass | 20%, 3XD @ 200° No exposed bare | Pass | 20%, 3XD @ 200° No exposed bare |
| THERMOPLASTIC FLOW | > 350°C | Median min. 300°C | > 350°C | Median min. 300°C | > 350°C | Median min. 300°C | > 375°C | Median min. 300°C | > 375°C | Median min. 300°C | > 375°C | Median min. 300°C |
| **ELECTRICAL PROPERTIES** | | | | | | | | | | | | |
| DIELECTRIC BREAKDOWN VOLTAGE ROOM TEMPERATURE | 12,200 volts, avg. | 5,700 volts, minimum | 12,200 volts, avg. | 5,700 volts, minimum | 12,200 volts, avg. | 5,700 volts, minimum | 12,200 volts, avg. | 5,700 volts, minimum | 12,200 volts, avg. | 5,700 volts, minimum | 12,200 volts, avg. | 5,700 volts, minimum |
| DIELECTRIC BREAKDOWN VOLTAGE RATED TEMPERATURE | 10,300 volts, avg. | 4,275 volts, minimum | 10,300 volts, avg. | 4,275 volts, minimum | 10,300 volts, avg. | 4,275 volts, minimum | 10,300 volts, avg. | 4,275 volts, minimum | 10,333 volts, avg. | 4,275 volts, minimum | 10,333 volts, avg. | 4,275 volts, minimum |
| CONTINUITY @ 1,500 VOLTS | ≤ 1 faults/100 ft. | 5 faults/100 ft. | ≤ 1 faults/100 ft. | 5 faults/100 ft. | ≤ 1 faults/100 ft. | 5 faults/100 ft. | ≤ 1 faults/100 ft. | 5 faults/100 ft. | ≤ 1 faults/100 ft. | 5 faults/100 ft. | ≤ 1 faults/100 ft. | 5 faults/100 ft. |
| BOND STRENGTH @ ROOM TEMPERATURE<br>Bond M and E Bonded @ 200°C - 1 hour<br>Bond S Bonded @ 220°C - 1 hour | 34.35 | No specification | 30.38 | No specification | 33.92 | No specification | 45.41 | 30 lbs. - min. | 38.49 | 30 lbs. - min. | 47.00 | No specification |
| BOND STRENGTH @ 100°C | 27.79 | No specification | 11.95 | No specification | 10.38 | No specification | 24.31 | No specification | 10.57 | No specification | 8.78 | No specification |
| BOND STRENGTH @ 130°C | 25.42 | No specification | 9.58 | No specification | 3.30 | No specification | 22.05 | No specification | 8.46 | No specification | 2.18 | No specification |
| BOND STRENGTH @ 150°C | 20.78 | No specification | 7.47 | No specification | No Bond Strength | No specification | 16.51 | No specification | 7.14 | No specification | No Bond Strength | No specification |
| BOND STRENGTH @ 180°C | 6.51 | No specification | 4.29 | No specification | - | - | 7.37 | 3 lbs. - min.† | 4.24 | 3 lbs. - min.† | - | - |

Note: 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 102. Typical performance of base coat.

For customized or engineered bondable constructions, please consult Essex Furukawa Magnet Wire Marketing.