

# Bondable Magnet Wire/ Winding Wire

by **Ronald J. Beeckman**

## **Bondable Magnet Wires**

Bondable magnet wires are used in a variety of applications such as transformers, lift magnets, solenoids, bobbinless coils, clutch coils, television yoke coils, voice coils, motor stator and armature windings.

Use of bondable wire allows coils to be self-supporting, so that bobbins or additional varnishing is not necessary. Bondable wire consists of standard magnet wire insulations overcoated with a thermoplastic polymer that can be temporarily softened by either heat or solvent, or both.

## **Three Common Methods of Bonding**

### 1. 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.

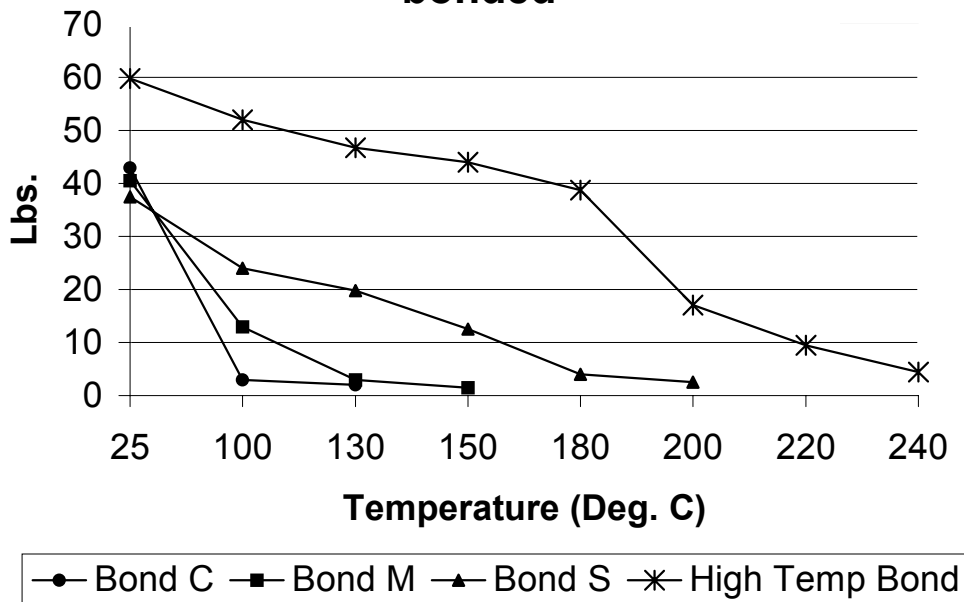
### 2. Heat - Oven Bonding

After the coils are formed, the unit is heated in an oven, causing the bondcoat to flow, bonding the adjacent turns of wire together.

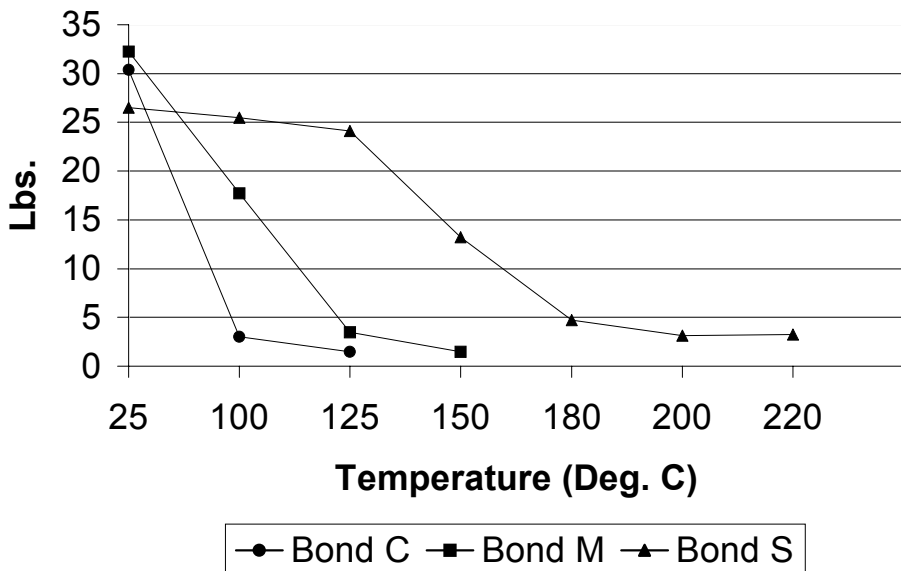
### 3. Heat - Resistance Bonding

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

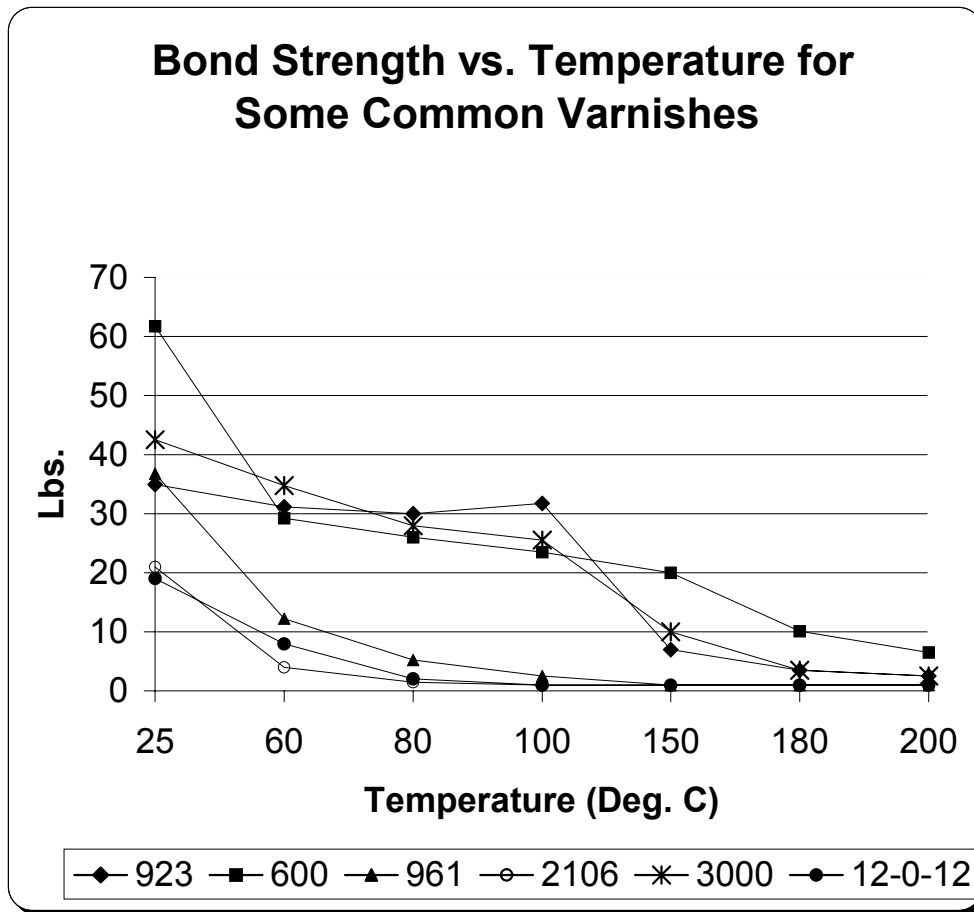
### Bond Strength vs. Temperature for Essex Bondcoats, coils resistance bonded



### Bond Strength vs. Temperature for Essex Bondcoats, coils oven bonded



## Bond Strength vs. Temperature for Some Common Varnishes



### Film Builds for Bondable Wire

- #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<sup>®</sup> marketing and engineering personnel.
- #1: Overall heavy build; single build basecoat plus single build bondcoat.
- #2: Overall triple build; heavy build basecoat 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.

## Essex® Bondable Magnet Wire Insulations

Essex bondable wires are described by the basecoat and topcoat materials. For example, Polybondex® T indicates that the basecoat is Thermalex 200®. Polybondex® G indicates that the basecoat is GP/MR - 200®. The bondcoat type is described by the letter M or S for epoxy or polyamide, respectively.

Essex Bondable Magnet Wire Insulations:

Product	Basecoat Polymer	Topcoat Polymer	Bondcoat Polymer	Thermal Rating °C (UL)	
Amide-Imide High Temp Bond	Amide-Imide	Amide-Imide	Proprietary	N/A	N/A
Polybondex (PBX-G) Bond - M	Polyester	Amideimide	Epoxy	180	(180°)
Polybondex (PBX-G) Bond - S	Polyester	Amideimide	Aromatic Polyamide	180	(180°)
Polybondex (PBX-T) Bond - M	Polyester	N/A	Epoxy	180	(180°)
Polybondex (PBX-T) Bond - S	Polyester	N/A	Aromatic Polyamide	180	(180°)
Soderbond® (SBDX)	Polyurethane	Nylon	Butvar	105	N/A
Soderbond® N/130 (SBDX/130)	Polyurethane	Nylon	Butvar	130	(130°)

High Temp Bond is a proprietary polymer that has the highest bond strength at elevated temperatures than other bondcoats. It is not attacked by conventional solvents, but is activated by heat.

Bond M is an epoxy bond designed for use at temperatures not to exceed approximately 130°C. Bond strengths up to 130°C are higher than with butvar. Solvents such as methylethyl ketone can activate Bond M, but heat bonding is recommended.

Bond S is an aromatic polyamide that has higher bond strength at elevated temperatures than other bondcoats. It is not attacked by conventional solvents, but is activated by heat.

Soderbond N (Soderon® Bond C) has a Soderon base with a butvar bondcoat. It is primarily intended for low temperature applications where a solderable insulation is desired. The butvar bondcoat may be activated with denatured or isopropyl alcohol or by heating.

Soderbond N/130 (Soderon® Bond C) has a Soderon base with a butvar bondcoat. It is primarily intended for higher temperature applications where a solderable insulation is desired. The butvar bondcoat may be activated with denatured or isopropyl alcohol or by heating.

## Bondable Magnet Wire and Bonding Guidelines

<b>SUPERIOR ESSEX Tradename</b>	<b>Basecoat Polymer</b>	<b>Topcoat Polymer</b>	<b>Bondcoat Polymer</b>	<b>Temperature Rating (°C)</b>	<b>Bonding Temperature Guidelines (°C)</b>
Amide-Imide High Temp Bond	Amide-Imide	Amide- Imide	Proprietary	N/A	275-300
Polybondex G, Bond M	Polyester	Polyamide -imide	Epoxy	180	150-200
Polybondex G, Bond S	Polyester	Polyamide -imide	Aromatic Polyamide	180	220-230
Polybondex T, Bond M	Polyester	N/A	Epoxy	180	150-200
Polybondex T, Bond S	Polyester	N/A	Aromatic Polyamide	180	220-230
Soderbond N/ 130	Polyurethane	Nylon	Butvar	130	110-130
Soderbond N	Polyurethane	Nylon	Butvar	105	110-130

**TABLE 3**  
**ESSEX STANDARD DIMENSIONS FOR BONDABLE WIRE**  
**TYPE 1**

AWG	Bare Wire			Minimum	Maximum	Min Bond	Maximum Overall OD
	Minimum	Nominal	Maximum	Build w/o Bond	OD w/o Bond		
14	0.0635	0.0641	0.0647	0.0016	0.0666	0.0009	0.0682
14-1/2	0.0599	0.0605	0.0611	0.0016	0.0630	0.0009	0.0646
15	0.0565	0.0571	0.0576	0.0015	0.0594	0.0009	0.0609
15-1/2	0.0534	0.0539	0.0544	0.0015	0.0561	0.0009	0.0577
16	0.0503	0.0508	0.0513	0.0014	0.0531	0.0009	0.0545
16-1/2	0.0475	0.0480	0.0485	0.0014	0.0503	0.0009	0.0517
17	0.0448	0.0453	0.0457	0.0014	0.0475	0.0009	0.0488
17-1/2	0.0423	0.0427	0.0431	0.0014	0.0448	0.0009	0.0462
18	0.0399	0.0403	0.0407	0.0013	0.0424	0.0008	0.0437
18-1/2	0.0377	0.0380	0.0384	0.0013	0.0401	0.0008	0.0414
19	0.0355	0.0359	0.0362	0.0012	0.0379	0.0008	0.0391
19-1/2	0.0336	0.0339	0.0342	0.0012	0.0358	0.0008	0.0371
20	0.0317	0.0320	0.0323	0.0012	0.0339	0.0007	0.0351
20-1/2	0.0299	0.0302	0.0305	0.0012	0.0321	0.0007	0.0333
21	0.0282	0.0285	0.0287	0.0011	0.0303	0.0007	0.0314
21-1/2	0.0266	0.0269	0.0271	0.0011	0.0287	0.0007	0.0298
22	0.0250	0.0253	0.0256	0.0011	0.0270	0.0007	0.0281
22-1/2	0.0237	0.0239	0.0241	0.0011	0.0255	0.0007	0.0267
23	0.0224	0.0226	0.0228	0.0010	0.0243	0.0006	0.0253
23-1/2	0.0211	0.0213	0.0215	0.0010	0.0230	0.0006	0.0240
24	0.0199	0.0201	0.0203	0.0010	0.0217	0.0006	0.0227
24-1/2	0.0188	0.0190	0.0192	0.0010	0.0206	0.0006	0.0216
25	0.0177	0.0179	0.0181	0.0009	0.0194	0.0006	0.0203
25-1/2	0.0167	0.0169	0.0171	0.0009	0.0184	0.0006	0.0193
26	0.0157	0.0159	0.0161	0.0009	0.0173	0.0005	0.0182
26-1/2	0.0149	0.0150	0.0151	0.0009	0.0164	0.0005	0.0173
27	0.0141	0.0142	0.0143	0.0008	0.0156	0.0005	0.0164
27-1/2	0.0133	0.0134	0.0135	0.0008	0.0148	0.0005	0.0156
28	0.0125	0.0126	0.0127	0.0008	0.0140	0.0005	0.0147
28-1/2	0.0118	0.0119	0.0120	0.0008	0.0132	0.0005	0.0140
29	0.0112	0.0113	0.0114	0.0007	0.0126	0.0004	0.0133
29-1/2	0.0105	0.0106	0.0107	0.0007	0.0119	0.0004	0.0126
30	0.0099	0.0100	0.0101	0.0007	0.0112	0.0004	0.0119
30-1/2	0.0094	0.0095	0.0096	0.0007	0.0107	0.0004	0.0114
31	0.0088	0.0089	0.0090	0.0006	0.0100	0.0004	0.0108
31-1/2	0.0083	0.0084	0.0085	0.0006	0.0096	0.0004	0.0103
32	0.0079	0.0080	0.0081	0.0006	0.0091	0.0004	0.0098

**TABLE 3 (cont'd)**  
**ESSEX STANDARD DIMENSIONS FOR BONDABLE WIRE**  
**TYPE 2**

<b>AWG</b>	<b>Minimum</b>	<b>Bare Wire Nominal</b>	<b>Maximum</b>	<b>Minimum Build w/o Bond</b>	<b>Maximum OD w/o Bond</b>	<b>Min Bond</b>	<b>Maximum Overall OD</b>
14	0.0635	0.0641	0.0647	0.0032	0.0682	0.0009	0.0700
14-1/2	0.0599	0.0605	0.0611	0.0032	0.0646	0.0009	0.0664
15	0.0565	0.0571	0.0576	0.0030	0.0609	0.0009	0.0627
15-1/2	0.0534	0.0539	0.0544	0.0030	0.0576	0.0009	0.0595
16	0.0503	0.0508	0.0513	0.0029	0.0545	0.0009	0.0562
16-1/2	0.0475	0.0480	0.0485	0.0029	0.0517	0.0009	0.0534
17	0.0448	0.0453	0.0457	0.0028	0.0488	0.0009	0.0504
17-1/2	0.0423	0.0427	0.0431	0.0028	0.0461	0.0009	0.0478
18	0.0399	0.0403	0.0407	0.0026	0.0437	0.0008	0.0452
18-1/2	0.0377	0.0380	0.0384	0.0026	0.0414	0.0008	0.0429
19	0.0355	0.0359	0.0362	0.0025	0.0391	0.0008	0.0406
19-1/2	0.0336	0.0339	0.0342	0.0025	0.0370	0.0008	0.0386
20	0.0317	0.0320	0.0323	0.0023	0.0351	0.0007	0.0364
20-1/2	0.0299	0.0302	0.0308	0.0023	0.0333	0.0007	0.0346
21	0.0282	0.0285	0.0288	0.0022	0.0314	0.0007	0.0326
21-1/2	0.0266	0.0269	0.0272	0.0022	0.0298	0.0007	0.0310
22	0.0250	0.0253	0.0256	0.0021	0.0281	0.0007	0.0293
22-1/2	0.0237	0.0239	0.0241	0.0021	0.0266	0.0007	0.0279
23	0.0224	0.0226	0.0228	0.0020	0.0253	0.0006	0.0264
23-1/2	0.0211	0.0213	0.0215	0.0020	0.0240	0.0006	0.0251
24	0.0199	0.0201	0.0203	0.0019	0.0227	0.0006	0.0238
24-1/2	0.0188	0.0190	0.0192	0.0019	0.0216	0.0006	0.0227
25	0.0177	0.0179	0.0181	0.0018	0.0203	0.0006	0.0214
25-1/2	0.0167	0.0169	0.0171	0.0018	0.0193	0.0006	0.0204
26	0.0157	0.0159	0.0161	0.0017	0.0182	0.0005	0.0193
26-1/2	0.0149	0.0150	0.0151	0.0017	0.0173	0.0005	0.0184
27	0.0141	0.0142	0.0143	0.0016	0.0164	0.0005	0.0173
27-1/2	0.0133	0.0134	0.0135	0.0016	0.0156	0.0005	0.0165
28	0.0125	0.0126	0.0127	0.0016	0.0147	0.0005	0.0156
28-1/2	0.0118	0.0119	0.0120	0.0016	0.0140	0.0005	0.0149
29	0.0112	0.0113	0.0114	0.0015	0.0133	0.0004	0.0142
29-1/2	0.0105	0.0106	0.0107	0.0015	0.0126	0.0004	0.0135
30	0.0099	0.0100	0.0101	0.0014	0.0119	0.0004	0.0128
30-1/2	0.0094	0.0095	0.0096	0.0014	0.0114	0.0004	0.0123
31	0.0088	0.0089	0.0090	0.0013	0.0108	0.0004	0.0115
31-1/2	0.0083	0.0084	0.0085	0.0013	0.0103	0.0004	0.0110
32	0.0079	0.0080	0.0081	0.0012	0.0098	0.0004	0.0105