

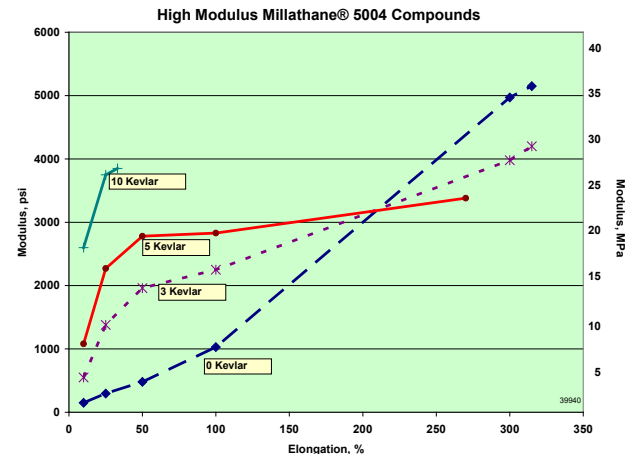


High Modulus Millathane® 5004 Compounds

Several levels (3-5-10 parts) of Kevlar (DuPont's tradename for their polyaramid fiber) pulp were added to a Millathane® 5004 millable urethane compound and the physical properties measured at room temperature and at elevated temperatures. The Kevlar was added as a masterbatch with 50% Kevlar and 50% NBR (nitrile rubber) that was obtained from Rhein Chemie. The results show a dramatic increase in modulus, even with as little as 3 parts of Kevlar. Tensile strength is reduced somewhat, probably at least partly due to the effect of the lower strength NBR rubber in the compound.

Other data, in the table below, show that as the Kevlar level increases, the Mooney Viscosity and hardness also increase, while cure characteristics are negligibly affected. The cured elongation drops slightly up to 5 parts of Kevlar, then significantly with 10 parts. These compounds were also compared to compounds with increased N330 black (+7 and +13 parts), and but these compounds only showed marginally higher modulus, especially at low elongations.

Testing of compounds at elevated temperatures (125°C and 150°C) showed a greater change in modulus from room temperature with the Kevlar-containing compounds, but they were still higher modulus than the non-Kevlar compounds.



Millathane® 5004	100	97	95	90
Kevlar/NBR Masterbatch 50/50		6	10	20
(Parts of Kevlar)	(0)	(3)	(5)	(10)
Stearic Acid	0.3	0.3	0.3	0.3
N330 Black	27	27	27	27
Process Aid	0.5	0.5	0.5	0.5
DiCup 40C	6.0	6.0	6.0	6.0
Mooney Viscosity				
ML4/100°C	73	76	80	89
MDR, 30'/160°C				
ML, lb-in	1.3	1.3	1.4	2.0
dN-m	1.5	1.4	1.6	2.3
MH, lb-in	66.6	56.4	49.4	38.6
dN-m	75.3	63.7	55.8	43.6
ts1, min.	0.7	0.7	0.7	0.8
t50, min.	4.8	5.1	5.2	5.6
t90, min.	12.2	12.4	12.0	12.5
Press Cure 20/160°C				
Hardness, Shore A	78	83	83	86
10% Modulus, psi	150	550	1080	2600
MPa	1.0	3.8	7.4	17.9
25% Modulus, psi	295	1380	2270	3750
MPa	2.0	9.5	15.7	25.9
50% Modulus, psi	480	1960	2780	--
MPa	3.3	13.5	19.2	--
Tensile Strength, psi	5150	4200	3380	3850
MPa	35.5	29.0	23.3	26.6
Elongation, %	315	315	270	33



High Modulus Millathane® 5004 Compounds (cont.)

Aramid-reinforced compounds such as those in the table above find use in applications like belting, seals, and diaphragms.

BONDING OF MILLATHANE® MILLABLE URETHANE COMPOUNDS

Millable urethanes can be readily bonded to a variety of substrates with the proper adhesives and procedures.

BONDING TO METAL

Black-filled, sulfur-cure Millathane E34 and Millathane 76 compounds were molded to grit-blasted steel. The data below indicated that Chemlok 219, Chemlok 218, Chemlok 213, and Chemlok 8600 (aqueous) gave the best adhesion with Millathane® E34 while Chemlok 213 and Chemlok 8007/8560S (aqueous) gave the best results with Millathane® 76.

Lord Adhesive Grades (*=aqueous)	Millathane® 76		Millathane® E34	
	Adhesion, lb/in	Failure mode**	Adhesion, lb/in	Failure mode
TyPly BN	77	50C/50A	136	80C/20A
Chemlok 205/TyPly BN	73	50C/50A	160	60C/40A
Chemlok 219	66	30C/70A	159	100C
Chemlok 218	45	100A	120	100C
Chemlok 213	79	80C/20A	159	100C
Chemlok 8600*	----	----	65	50C/50A
Chemlok 8007*/8560S*	83	30C/70A	----	----

**A – Adhesive failure (Rubber to cement and/or cement to metal)

C – Cohesive failure

- For bonding to aluminum, Chemlok 218, Chemlok 213, or Chemlok 219 are suggested.
- Other adhesives recommended for millable urethanes are Megum 15637 (Rohm & Haas) and Chemlok 250.
- For injection molding applications, one must use adhesives that aren't easily wiped by the rubber. Chemlok 250 is recommended for injection molded sulfur cure urethanes and Chemlok 219 for peroxide cures; TyPly BN is not recommended for injection molding.

BONDING TO FABRIC

Millathane millable urethane compounds generally bond well to RFL-treated fabrics including nylon and polyester, but adhesion to untreated fabrics is usually not adequate. Applying a coat of an adhesive such as Chemlok 219 or TyPly BN to the bare fabric should improve adhesion.