

Technical Information for Performance Solutions

MILLATHANE® POLYURETHANE RUBBER - Premilled versus Virgin

Millathane polyurethane rubbers have excellent abrasion resistance as well as oil and fuel resistance along with low temperature flexibility. These properties make Millathane polymers well suited for many applications in automotive, business machines, agriculture and industrial applications.

Premilled Millathane

Many of Millathane polyurethane rubbers are available in two forms: Virgin which would be a 38 (17.2 kg) or 45 (20.4 kg) pound bale and Premilled sheets available in 50 lbs per carton. There are several advantages for Millathane customers to use Premilled sheets.

- Ease of mixing on two roll mills
- Range of Mooney viscosity is ± 5 points for most products
- Premilled polyesters contain hydrolytic stabilizer
- Premilled package is 50 lbs (22.7 kg) net weight

For customers mixing on two roll mills Premilled Millathane facilitates mixing compared to solid bales which have no previous rubber breakdown. Starting out with a narrow defined Mooney viscosity range ensures a consistent mixed compound viscosity. Table 1: Millathane Premilled products lists the various grades and their respective Mooney viscosity range.

Table 1: Millathane® Premilled Products

Product	Part Number	Mooney Viscosity ML 1+4@100°C	Note
Millathane 76	M-0076M-30	25 to 35	Stabilized polyester
	M-0076M-40	35 to 45	Stabilized polyester
	M-0076M-50	45 to 55	Stabilized polyester
Millathane E34	M-0034M-40	35 to 45	Polyether
	M-0034M-45	40 to 50	Polyether
	M-0034M-50	45 to 55	Polyether
Millathane 66	M-0066M-45	38 to 52	Stabilized polyester
	M-0066M-50	43 to 57	Stabilized polyester
Millathane HT	M-00HTM-45	37 to 53	Made to order, Stabilized
Millathane 26	M-0026M-40	35 to 45	FDA Polyether
Millathane 28	M-0028M-50	45 to 58 ML5+4	Stabilized polyester
Millathane CM	M-00CM-30	30 – 35 MS1+10	Polyether
	M-00CM-40	35 – 45 MS1+10	Polyether
	M-00CM-45	40 – 50 MS1+10	Polyether
	M-00CM-55	50 – 60 MS1+10	Polyether
Millathane 97	M-0097M-60	50 to 70	Polyether

Topics:

- Premilled Millathane
- Physical Properties Comparison
- Premilled Millathane Stability
- Abrasion Resistance
- Pictures

MILLATHANE®

FACTOID:

Did you know that punch stops for the Florida voting machines were made from Millathane 76?

Physical Properties Comparison

Test formulations for comparing Virgin and Premilled Millathane have 20 phr N-330 black, process aids and curatives. The scope of this testing was to compare Premilled Millathane against Virgin Millathane in both sulfur and peroxide cure recipes for differences in stress-strain properties and abrasion resistance. Table 2 lists the formulation ingredients used to develop physical property test data in Table 3.

Table 2: Test Formulations Millathane Virgin versus Premilled

SULFUR FORMULATION	phr	PEROXIDE FORMULATION	phr
Millathane Virgin	100.0	Millathane Virgin	100.0
Millathane Premilled*	101.5	Millathane Premilled*	101.5
Zinc Stearate	0.5	Stearic Acid	0.5
Process Aid - wax	1.0	Triallylcyanoate	0.5
N-330 Black	20.0	N-330 black	20.0
DBEEA plasticizer	5.0	Process Aid - wax	1.0
MBTS	4.0	DBEEA plasticizer	5.0
MBT	2.0	40% dicumylperoxide	2.5
Thanecure® ZM	1.0		
Sulfur	1.5		
TOTAL	135.0	TOTAL	129.5

* polyesters will contain 1.5 phr polycarbodiimide ref XP-2087

Millathane® 76 is a sulfur or peroxide curable polyester polyurethane rubber. A carbodiimide hydrolytic stabilizer is added to the Premilled version. From the rheometer (ODR) data, we find a delay in cure caused by the addition of stabilizer to Millathane 76 Premilled. Stress strain results of Premilled versus Virgin are clearly within experimental error for tensile, elongation and hardness. Tear strength are comparable as well as abrasion resistance and compression set. See Table 3 for test results.

Table 3: Physical Properties Millathane® 76 Virgin & Premilled

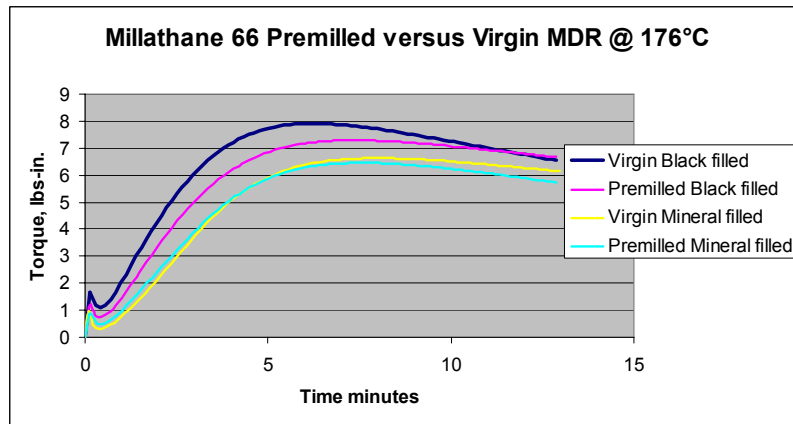
TEST DATA	Millathane 76 Sulfur		Millathane 76 Peroxide	
	Virgin	Premilled	Virgin	Premilled
ODR°C	155	155	160	160
Ts2	1.7	2.6	2.9	3.3
T90	7.1	9.6	17.6	18.6
Cure ,min.@ °C	7'@155	10'@155	18'@160	19'@160
Hardness, Shore A	65	63	55	54
TSE-100*, psi	550	531	226	243
MPa	3.8	3.7	1.6	1.7
TSE-200, psi	1248	1218	720	797
MPa	8.6	8.4	5.0	5.5
TSE-300, psi	2134	2068	1508	1599
MPa	14.7	14.3	10.4	11.0
Tensile Strength, psi	4708	4291	2525	2383
MPa	32.5	29.6	17.4	16.4
Elongation, %	524	510	425	397
Tear, Die C, lb/in	264	243	104	108
kN/m	46.2	42.5	18.5	18.9
*TSE-xxx = tensile stress at xxx% elongation				
Bashore resilience, %	20	18	24	23
DIN abrasion, mm ³ loss	83	71	55	56
Compression Set, %				
22 hr/70°C	42	49		
22 hr/100°C			72	70
Ref:XP-2087				

Premilled Millathane® Stability

Premilled Millathane polyester grades contain carbodiimide hydrolytic stabilizer which improves shelf life, resists hydrolysis in cured parts and there is some indication of improved reversion resistance.

In the study done with Millathane 66, a polyester polyurethane rubber, we compared Virgin against Premilled in both a black filled and mineral filled compounds. In both cases, there is a slight improvement in reversion resistance as indicated in Figure 1 which compares the cure curves using a moving die rheometer.

Figure 1: Reversion Resistance Premilled Millathane 66



Abrasion Resistance

Abrasion resistance testing showed comparable DIN Abrasion in clay-filled compounds for Virgin vs. Premilled Millathane 66, but in black-filled compounds the Premilled Millathane 66 gave improved abrasion resistance over typical and extended cure times. This may be due to the stabilizing effect of the carbodiimide included in Premilled Millathane 66. Millathane 66 mineral filled as can be seen in Figure 2: Improved Abrasion Resistance of Premilled Millathane 66.

Figure 2: Improved Abrasion Resistance Premilled Millathane® 66

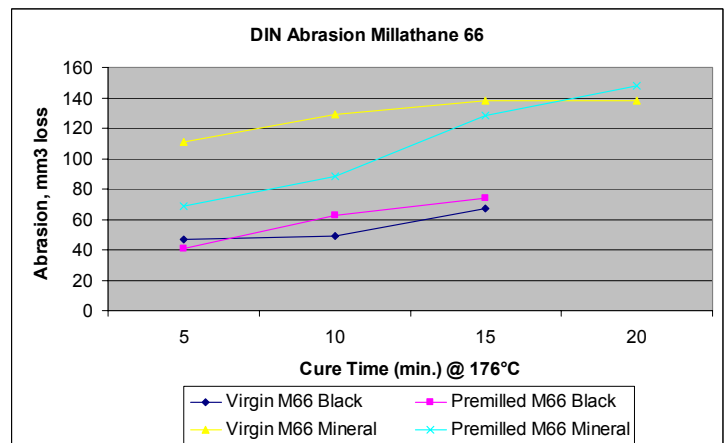


Table 4: Test Recipe Millathane® 66 Virgin and Premilled

Ingredients	A	B	C	D
Millathane 66 virgin	100		100	
Millathane 66 premilled		101.5		101.5
Stearic Acid	0.3	0.3	0.3	0.3
N-330 black	30	30		
Process aid	0.5	0.5	0.5	0.5
Hard Clay			40	40
Co-Agent	3	3	3	3
40% Dicumylperoxide	5	5	5	5
Total	138.8	140.3	148.8	150.3
Ref: XP4427				

TSE INDUSTRIES

4370 112th Terrace North
Clearwater, FL , USA 33762-4902

Toll Free: 800-237-7634
Phone: 727-573-7676
Fax: 727-572-0487
E-mail: millgumsinfo@tse-industries.com



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We are here to serve you:

Tom Jablonowski, <i>Technical Service Manager</i>	tom.jablonowski@tse-industries.com
Jim Ahnemiller, <i>Technical Director</i>	jim.ahnemiller@tse-industries.com
Nina Manee, <i>Sales & Marketing Representative</i>	nina.manee@tse-industries.com
Jerry McCall, <i>Director of Sales & Marketing</i>	jerry.mccall@tse-industries.com

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FIGURE 1: PREMILLED MILLATHANE E34



FIGURE 2: PREMILLED MILLATHANE 76 MILLED SHEETS



FIGURE 3: PACKAGING MILLATHANE 76 PREMILLED SHEETS



FIGURE 4: STANDARD SKID VIRGIN MILLATHANE 76