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Millathane® 26
Polyether Millable Urethane
for Food Contact (FDA), and Other, Applications

Product Description

Chemical Composition:	Synthetic rubber based on ether/MDI polyurethane
Specific Gravity:	Approximately 1.03
Storage stability:	3 years from date of manufacture (stored under dry and cool conditions)

Part Number	Mooney Viscosity ML(1+4)/100° C	Appearance	Package size/carton
M-0026-45 (Virgin)	45 ± 15	Pale to yellow solid bales	38 pounds (17.2 kg)
M-0026M-40 (Premilled)	40 ± 5	Pale to yellow solid sheets	50 pounds (22.7 kg)

Processing

Millathane 26 is processed by techniques which are common to the rubber industry. Compounds can be mixed on open mills or in internal mixers. The Premilled version, being in sheet form, may be easier to mill mix. Very often a compound can be mixed in one step including the vulcanization chemicals. Molded articles can be produced via compression, transfer or injection molding. Injection molding Millathane 26 provides very short cycle times, excellent flow and demolding and shows negligible mold fouling. Due to the peroxide vulcanization and its chemical base, Millathane 26 can not be cured in direct contact with open steam or hot air, and, hence, for applications like hose, its use is limited to inner liners unless the parts are protected during curing. Calendered sheets can be press-cured or roto-cured.

Properties

Vulcanizates based on Millathane 26 can be produced in hardnesses of approximately 45 to 99 Shore A (to 65 Shore D) and offer excellent strength properties and abrasion resistance. Being a polyether urethane, Millathane 26 gives compounds with excellent resistance to hydrolysis. Millathane 26 vulcanizates show good heat resistance and compression set, and good oil resistance.

Applications

Millathane 26, because of its compliance with the FDA regulation for “Rubber articles intended for repeated use”, (21CFR 177.2600), is used for various rubber parts in contact with wet and dry food. These include hose, gaskets, rollers and belting.

Millathane 26 also finds used in non-food handling applications, including rollers, because of its hydrolysis resistance and good strength properties. The inherent hydrolysis resistance of polyether urethanes like Millathane 26 makes them more forgiving in steam autoclave cure processes than polyester grades.

Millathane 26 Hose

Millathane® 26 Compounding

Reinforcing Fillers

Reinforcing fillers like precipitated silica or carbon black like N330 increase the mechanical strength of Millathane 26 compounds. Fumed silicas such as Wacker HDK N20 or Cabosil M-5 will give somewhat higher reinforcement than precipitated silicas and will give translucent cured compounds (depending on other ingredients). They also give compounds that have lower water absorption than precipitated silicas, and hydrophobic silicas, like Cabosil TS-720 and Wacker HDK H20, are even better in that respect. Clay, talc and calcium carbonate can also be used as fillers to modify properties and processing, but are less reinforcing than silicas and blacks. Silane coupling agents like Silquest RC-1, A171 or A172 will improve the tear strength and set properties of mineral filled/reinforced compound and are recommended to be added at about 2% of the mineral filler content. Note: silane coupling agents are *not* FDA-compliant*.

Plasticizers

TP-95 (DBEEA) can be used for FDA-complaint formulations, up to 30% by weight in the formula. For non-FDA applications, Mediaplast NB-4 and Benzoflex 9-88SG can be used. The antistatic plasticizer Struktol AW-1 can be used to a limited extent, but may tend to bleed at levels over 10 parts.

Process Aids

Small amounts of process aids are normally used to prevent sticking to processing equipment and to improve flow during molding. Generally, about 0.2-0.5 phr of stearic acid is used along with 0.5-2 phr of another process aid such as Struktol WB222 or Vanfre AP-2 Special. A low molecular weight polyethylene like AC617A, added at 1-4 phr, gives good release for calendering and molding. Note: all of the process aids mentioned here are FDA-compliant*.

Stabilizers/Antidegradants

The addition of 0.5-1.0 phr of Irganox 1076 will significantly improve heat aging and is recommended for molding compounds, to eliminate “sticky flash”. Naugard 445, added at 0.5 – 2.0 parts, will provide even better heat resistance than Irganox 1076, although it is not FDA-compliant*.

Curing Agents: Peroxides and Coagents

Typical peroxides used are dicumyl peroxide and DBPH (2,5-dimethyl-2,5-di (t-butylperoxy) hexane), typically used at about 1.6 - 2.4 phr active peroxide (4-6 phr of 40% active). The use of coagents such as SR-350 (TMPTMA), triallyl cyanurate (TAC) and liquid polybutadiene (e.g., Ricon 154) increase the crosslink density and improve compression set. Note that for FDA (21CFR177.2600) compliance, the amount of peroxide plus TAC cannot exceed 1.5% by weight, and SR-350 cannot exceed 3% by weight.*

High Hardness Compounds: Peroxide and Isocyanate Cures

For high hardness compounds (>70 Shore A), high levels of silica or other fillers can be used although they increase viscosity significantly. The liquid methacrylate SR350 will increase hardness and can be used in combination with reinforcing fillers. Liquid polybutadiene (e.g., Ricon 154) and high styrene resin (e.g., Pliolite S6B) can also be used to increase the hardness without increasing the viscosity significantly. High styrene resins are somewhat thermoplastic, and need to be fluxed into the rubber at temperatures of >95ºC.

For applications *not* involving food contact or requiring FDA-compliance, high levels of the liquid methacrylates such as TMTPMA and DEGDMA can be used to increase hardness. Isocyanate cure systems (containing Thanecure® T9SF, HQEE and accelerator (e.g., Bismate) can also be used with

Millathane 26 to achieve high hardness compounds with excellent strength properties, although the cure system components are also not compliant with FDA regulations*.

Typical Millathane® 26 Compound Properties (FDA-Compliant* Recipes)

	4648B	5140MA	5778L	7549I
Millathane 26	100.0	100.0	100.0	100.0
Stearic acid	0.3	0.3	0.3	0.3
N774 Black	10.0	—	—	—
Polyfil HG90	5.0	—	—	—
Hi-Sil 243LD (precipitated silica)	—	25.0	50.0	60.0
Akrofax 11LG	5.0	—	—	—
TP-95 (DBEEA)	10.0	2.0	2.0	—
Struktol WB222	1.0	1.0	1.0	1.0
Carbowax 3350	—	—	—	1.0
Irganox 1076	0.5	0.5	0.5	1.0
AC617A (low melt polyethylene)	1.0	—	—	—
DiCup 40C (dicumyl peroxide 40%)	5.25	4.0	5.0	—
Varox DBPH-50	—	—	—	5.0
SR-350 (TMPTMA)	3.0	—	—	5.5
Ricon 154 (liquid polybutadiene)	—	—	10.0	10.0
MDR at 160ºC (320ºF)				
ML, lb-in (dNm)	0.5 (0.6)	1.5 (1.6)	17.2 (19.4)	17.0 (19.1)
MH, lb-in (dNm)	7.6 (8.6)	12.7 (14.4)	36.0 (40.7)	49.2 (55.6)
ts1, minutes	1.0	0.8	1.7	0.2
t90, minutes	9.0	11.2	9.1	12.2
Press Cure t90/160ºC				
Hardness, Shore A	53	61	75	91
100% Modulus, psi (MPa)	155 (1.1)	160 (1.1)	340 (2.3)	590 (4.1)
200% Modulus, psi (MPa)	240 (1.7)	220 (1.5)	715 (4.9)	1150 (7.9)
300% Modulus, psi (MPa)	405 (2.8)	335 (2.3)	1360 (9.4)	1975 (13.6)
Tensile Strength, psi (MPa)	2240 (15.4)	3400 (23.4)	3440 (23.7)	2600 (17.9)
Elongation, %	635	700	480	370
Tear, Die C, lb/in (kN/m)	133 (23.2)	166 (29.1)	203 (35.5)	206 (36.1)
Tear, Die B, lb/in (kN/m)	—	—	—	323 (56.5)
Bashore Resilience, %	60	53	52	41
DIN Abrasion, mm³ loss (rotating)	75	103	95	174
Compression set, 22 hr/70ºC, %	19	33	23	—
Oven Aging:	**166 hr/70ºC**			**70 hr/100ºC**
Hardness Change, Shore A points	-3	—	—	+3
Tensile Strength, % change	+3	—	—	+14
Elongation, % change	+6	—	—	-38

*Non-FDA Compliant** Millathane® 26 Formulations

	5124BH	4444D	7527A**	8262A**
Millathane 26	100.0	100.0	100.0	100.0
Stearic acid	0.3	0.3	0.3	0.3
N330 Black	10.0	—	—	—
HiSil 243LD (precipitated silica)	—	30.0	—	—
Wacker HDK N20 (fumed silica)	—	15.0	—	—
TP-95 (DBEEA)	2.0	—	—	—
Struktol WB222	1.0	2.0	—	—
Irganox 1076	0.5	0.5	0.5	0.5
SR231 (DEGDMA)	10.0	12.0	—	—
SR350 (TMPTMA)	10.0	12.0	—	—
DiCup 40C (dicumyl peroxide 40%)	4.0	4.0	—	—
BiDMC (Bismate)	—	—	0.3	0.3
Thanecure® T9SF (TDI Dimer)	—	—	25.0	60.0
HQEE (finely ground)	—	—	9.7	30.0

Press Cure t90/160ºC	9'/160ºC	17'/160ºC	20/130ºC	20/130ºC
Hardness, Shore A	67	93	95	99
Hardness, Shore D	—	40	50	65
100% Modulus, psi (MPa)	370 (2.6)	1065 (7.3)	1100 (7.6)	2900 (20.0)
300% Modulus, psi (MPa)	1600 (11.0)	2508 (17.3)	1835 (12.7)	3680 (25.4)
Tensile Strength, psi (MPa)	3100 (21.4)	2883 (19.9)	7500 (51.7)	5010 (34.6)
Elongation, %	440	342	530	445
Tear, Die C, lb/in (kN/m)	200 (35.0)	279 (48.8)	403 (70)	809 (141)
Tear, Die B, lb/in (kN/m)	243 (42.5)	407 (71.2)	539 (94)	1139 (199)

Bashore Resilience, %	52	35	55	65
DIN Abrasion, mm³ loss (rotating)	58	91	36	89
Compression set, 22 hr/70ºC, %	20	29	47	—

Disclaimer

TSE Industries, Inc. product Millathane® 26 uses raw materials that are compliant under the United States Code of Federal Regulations, Title 21 part 177.2600. All articles made from this product must still be constructed with materials listed in the regulation and be tested under the appropriate extraction test as outlined in the same regulation after construction, according to the end use. TSE Industries, Inc. makes no guarantees that the end article complies with any part of the United States Code of Federal Regulations. All testing, registrations, and final approvals must be made by the article's manufacturer. If you require additional information concerning Millathane 26 or its use please contact TSE.

*Comments on FDA compliant materials are accurate to the best of our knowledge at the date of publication. Users should consult the appropriate FDA documents or supplier literature to assure themselves that compounding ingredients are acceptable for use in contact with food products.

**Isocyanate cure systems (those containing Thanecure T9SF, HQEE and an accelerator like BiDMC) have very short shelf lives and mixed compounds stored at room temperature must be used within ~1 day. Contact TSE for guidelines on using this cure system.