



Guidelines for Using Millathane® Millable Polyurethanes in Low Hardness Rollers

Millathane millable polyurethanes can be used for manufacture of low hardness (30-50 Shore A) rollers, but the process is very sensitive to formulation, compound viscosity, roll building procedure, and vulcanization process. The following are suggestions in each of these areas to facilitate production of these rolls.

Compounding

Use plasticizers (and other ingredients) with low moisture and acidity.

Generally, soft compounds contain relatively high levels of plasticizers, so it's important to use good quality plasticizers. DLCs (Dry Liquid Concentrates), typically with about 70% plasticizer and 30% inert filler, are often used to make plasticizer addition easier. Some plasticizers can pick up moisture with extended storage and they may become more acidic, both of which can cause problems with millable polyurethanes from curing and air entrapment standpoints. Fillers and other ingredients can also pick up moisture upon storage; drying for several hours at about 105°C should reduce the moisture significantly.



Use factice (vulcanized vegetable oil) along with plasticizers to soften.

Sulfur-free factices, like Akrofax 758/Adafax 758, generally work best with millable polyurethanes, especially in peroxide cured compounds. Sulfur-containing grades, like Akrofax 11LG or Akrofax BR, can be used in sulfur cures, at levels up to about 20 phr. White VVOs will inhibit the cure of millable polyurethanes and are not recommended.

Compounding/Compound Viscosity

Use Millathane grades with high viscosity.

Many Millathane types come in several viscosity ranges (e.g., Millathane 76 comes in 25 to 65 Mooney viscosity (ML 1+4/100°C) grades), so choosing a higher viscosity grade (55 or 65 viscosity) will give the mixed compound a higher viscosity, which will help reduce sagging during cure and air entrapment. A higher viscosity polymer (e.g., Millathane CM) could be blended with a lower viscosity polymer to increase viscosity and improve green strength.

Roller Manufacturing

Air-Free Compounds

As polyurethanes are relatively resistant to gas permeability, uncured compounds applied to the roller should be as air-free as possible. If rolls are built using calendered rubber, plying up thin sheets to make thicker sheets will minimize air entrapment in the calendered sheets.



Adhesives

There are several adhesive systems that work well with Millathane millable polyurethane compounds. These include:

- TyPly BN (alone or with Chemlok 205 primer) [Lord Corporation]
- Chemlok 218, Chemlok 213, Chemlok 219 or Chemlok 8116
- Thixon 715-1/Thixon 720 [Dow Chemical]
- Cilbond 49SF/Cilcure B [Chemical Innovations]

End Plates (Caps)

For soft compounds, of low viscosity, end caps or plates are often used on the roll to keep the rubber from “squirting out” or sagging during curing. These end caps, like large washers fitted at the ends of the roller faces, are fixed at each end of the roller to provide support for the uncured compound during cure.

Wrapping

For steam autoclave cured rolls, they must be wrapped with a moisture barrier such as Mylar or other plastic film or aluminum foil, to prevent steam degradation of the Millathane compound during cure. A wrap of tissue paper can be applied first, over the rubber, to facilitate removal of the moisture barrier after cure. Two or three thicknesses of the moisture barrier are recommended and the film should be secured tightly around the end caps or journals to prevent leakage. On top of this film, a cross-wrap of dry nylon fabric or cotton tape should be applied over the end caps.

Vulcanization

Step cures are frequently used with millable polyurethanes, especially softer rollers, to give any trapped air time to dissipate before vulcanization starts. A typical cure cycle is: a rise in temperature from ambient to ~100°C, a “soak” at ~100°C for 0.5-2 hours, then a rise to curing temperature 140°-145°C, then 1-4 hours at curing temperature, depending on the size of the roller. Rollers should be cooled completely before unwrapping. If using a hot air vulcanizer, where air pressure can be adjusted separately from the temperature, a pressure of 50-60 psi (340-415 kPa) should be applied throughout the curing cycle.

Grinding

For the best grinding of soft millable polyurethane rollers, the following are recommended:

1. Use a Tungsten Carbide grinding wheel
2. Run at maximum rated speed
3. Use a very slow feed rate in the grinding machine, and
4. Use lots of water for coolant.

33 Shore A Roller Compound	
Millathane 76*	70.0
Millathane CM	30.0
Zinc Stearate	0.5
N550 Black	1.0
HiSil 243LD	5.0
DBEEA (TP-95)	35.0
Cumar P10	5.0
Akrofax BR	15.0
Akrofax 11LG	5.0
AC617A Polyethylene	2.0
Millstab™ P*	1.0
MBTS	4.0
MBT	2.0
Thanecure® ZM	1.5
Sulfur-80% dispersion	2.5
Physical Properties (Press Cure 10'/155°C)	
Hardness, Shore A	33
300% Tensile Stress, psi (MPa)	205 (1.4)
Tensile Strength, psi (MPa)	2410 (16.6)
Elongation, %	710
Tear Die C, lb/in (kN/m)	100 (17.5)
Bashore Resilience, %	38
Compression Set, 22 hr/70°C, %	61
*65 Mooney Viscosity Millathane 76 was used; Millathane 76 Premilled, containing 1.5 phr Millstab P can be used in place of the Millathane 76 and Millstab P.	