

# Technical Information for Performance Solutions

**Topics:**

- Formulation
- Processing & Physical Properties
- Injection Molding
- Summary

## INJECTION MOLDING OF MILLATHANE® 97

Millathane 97 is a polyether millable urethane that is used to make transparent articles. For transparency, fumed silica must be used as the reinforcing filler and other ingredients must be carefully selected so as to not make the compound cloudy or opaque.

Millathane 97 compounds can be compression, transfer, or injection molded. Details of injection molding a transparent 63 Shore A hardness compound are show below.

### Formulation

Below is a typical Millathane 97 compound for transparent applications. The fumed silica level can be adjusted for the desired hardness. A silane coupling agent, such as the Silquest A-172 used, is added at 2% of the filler loading to give good tear and physical properties. An antioxidant like Irganox 1010 is necessary for good aging and compound stability, and the UV absorber Tinuvin 770DF gives resistance to outdoor weather exposure. SR-231 is a difunctional coagent that, along with the peroxide DiCup R, gives a good state of cure and good tear and abrasion resistance.

	XP-4608-A
<b>Millathane® 97</b>	<b>100.0</b>
<b>Stearic acid</b>	<b>0.3</b>
<b>Wacker HDK N20 (fumed silica)</b>	<b>15.0</b>
<b>Silquest A-172</b>	<b>0.3</b>
<b>Irganox 1010</b>	<b>0.3</b>
<b>Tinuvin 770DF</b>	<b>0.3</b>
<b>SR-231 (DEGDMA)</b>	<b>3.0</b>
<b>DiCup R</b>	<b>0.5</b>
<b>Total</b>	<b>119.7</b>

## Processing and Physical Properties

This compound had excellent physical properties and clarity.

Mooney Viscosity, ML(1+4)/100°C	73
<b>Physical Properties, Press Cure 9'/160° C (320°F)</b>	
Hardness, Shore A	63
100% Modulus, psi	245
MPa	1.7
200% Modulus, psi	400
MPa	2.8
300% Modulus, psi	730
MPa	5.0
Tensile Strength, psi	2680
MPa	18.5
Elongation, %	525
Tear, Die C, lb/in	167
kN/m	29.2
<b>Bashore Resilience, %</b>	60
<b>Compression Set, 22 hr/70°C, %</b>	22
<b>DIN (ASTM D5963) Abrasion loss, mm<sup>3</sup></b>	71

### MILLATHANE®

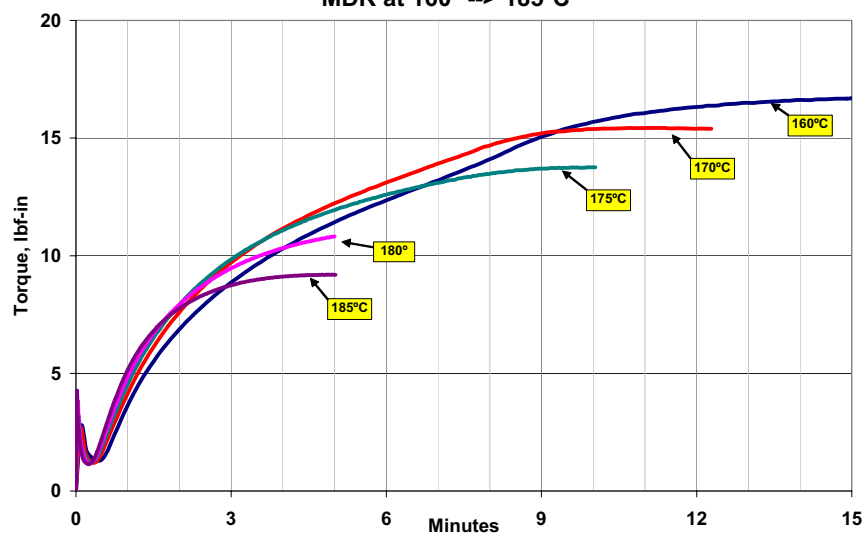
#### FACTOID:

Millathane® 5004  
can be  
compounded to 90  
Shore A having  
only 6%  
compression set!  
Call us for details.

MDR Data at Various Temperatures (using a TechPro MDpt)

Temperature	160°C	170 °C	175 °C	180 °C	185 °C
ML, lb-in (dNm)	1.3 (1.4)	1.2 (1.4)	1.2 (1.4)	1.2 (1.3)	1.1 (1.3)
MH, lb-in (dNm)	16.8 (19.0)	15.4 (17.4)	13.8 (15.5)	10.8 (12.2)	9.2 (10.4)
ts1, min.	0.7	0.6	0.6	0.5	0.5
tc50, min	3.1	2.3	1.8	1.3	1.0
tc90, min	9.3	7.1	5.9	3.4	2.5

Millathane® 97 Compound XP4608A  
MDR at 160° --> 185°C



# Injection Molding

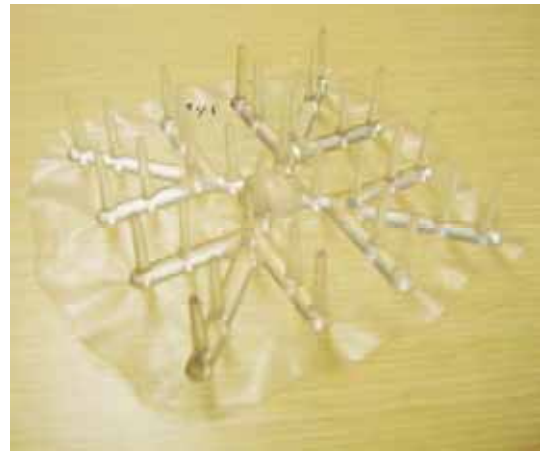
This compound was cured on a REP injection press, Model V37/100, making parts having excellent transparency. Small rollers with OD/ID/Width of 0.68/0.34/0.30 in (18/9/7 mm) were molded with the curing conditions tabulated below.

Extruder temperature	75°C
Injection chamber temperature	80°C
Mold temperature	170 – 185°C
Molding times	1 -5 minutes
Injection pressure	250 bar
Screw speed	80 RPM

Cure conditions evaluated were 5'/170°C, 3'/180°C, 2'/180°C, and 1'/185°C. All conditions gave parts with good look and feel. The runner was well-cured and showed good flow of the compound.



REP injection molding machine



Injection molding runner

**MILLATHANE® FACTOID:**  
 A new Millathane® grade, Millathane 26, complies with FDA regulation 21CFR177.2600 and can be used for food contact applications. It is finding much interest in food handling applications such as belting, grippers, and milking inflations.



Molded rolls



Molded rolls pressed on hubs

**TSE INDUSTRIES**

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**SUMMARY**

This Millathane® 97 compound was easily mixed on a two roll mill. Internal mixing with this compound could be done as well. This Millathane 97 formulation had excellent physical properties and clarity. The peroxide type in the compound could be changed to give lower or higher temperature curing. Parts were easily injection molded over a wide time/temperature range making very nice, transparent rollers.

**GLOSSARY**

Ingredient	Description	Supplier/Tradename owner
Wacker HDK N20	Fumed silica, surface area 200 m <sup>2</sup> /g	Wacker Silicones Corp.
Silquest A-172	Vinyl silane	GE Silicones
Irganox 1010	Antioxidant	Ciba Specialty Chemicals
Tinuvin 770 DF	HALS-Hindered Amine Light Stabilizer	Ciba Specialty Chemicals
SR-231	Diethylene glycol dimethacrylate	Sartomer Corporation
DiCup R	Dicumyl peroxide	Geo Specialty Chemicals