

Technical Information for Performance Solutions

Compression Deflection of Millathane® Compounds

Compression deflection is the amount of force required to compress a material a specific percentage of its original thickness. Compression deflection data are useful in comparing stiffness of rubber materials in compression and can be used by engineers and rubber technologists in development of materials for compressive applications. Several Millathane® millable urethane compounds were tested for compression deflection to provide end users and engineers with this information on typical compounds.

For this project, compounds were made of three different Millathane grades, polyether grade Millathane E34 and polyester grades Millathane 76 and Millathane 5004. Two different N330 black/plasticizer levels were used with each polymer, giving a range of compound hardness and tensile stress (“modulus”) values. The Millathane E34 and Millathane 76 compounds were sulfur cured, while the Millathane 5004 compounds were peroxide cured. Formulas for the compounds are shown below and the physical properties are shown on page 2.

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Millathane® Grade, at 100 parts	Millathane E34		Millathane 76		Millathane 5004	
Zinc stearate	0.5	0.5	0.5	0.5		
Stearic acid					0.2	0.2
N330	30	20	30	20	30	20
TP-95	5	15	5	15	5	15
Struktol WB222	1	1	1	1	1	1
MBTS	4	4	4	4		
MBT	2	2	2	2		
Thanecure® ZM	1	1	1	1		
Sulfur	1.5	1.5	1.5	1.5		
DiCup 40C					5	5
Total	145	145	145	145	141.2	141.2

Physical Properties

Millathane® Grade	Millathane E34		Millathane 76		Millathane 5004	
Chart ID	ME34 65A	ME34 55A	ME76 61A	ME76 50A	M5004 63A	M5004 45A
Mooney Viscosity, ML(1+4)/100°C	62	38	37	14	62	33

Press Cure, t90 at 160°C, min. --->	7	9	7	7	11	10
Hardness, Shore A	65	55	61	50	63	45
TSE-100*, psi	425	260	295	185	365	140
MPa	2.9	1.8	2.0	1.3	2.5	1.0
TSE-200, psi	1040	580	655	410	935	285
MPa	7.2	4.0	4.5	2.8	6.4	2.0
TSE-300, psi	1790	1080	1170	795	1730	560
MPa	12.3	7.4	8.1	5.5	11.9	3.9
Tensile Strength, psi	4310	3040	4060	3730	3800	1840
MPa	29.7	21.0	28.0	25.7	26.2	12.7
Elongation, %	530	535	675	690	595	665
Tear, Die C, lb/in	245	168	205	141	216	145
kN/m	42.9	29.4	35.9	24.7	37.8	25.4

*TSExxx=Tensile Stress at xxx% Elongation

Bashore Resilience, %	55	59	18	25	45	46
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The properties show excellent physical properties for all the compounds, although the softer Millathane 5004 compound turned out to be softer and lower tensile strength than expected. Millathane E34 showed the highest resilience and Millathane 76 showed the lowest resilience, as is typical for compounds made from these polymers.

Compression Deflection Results

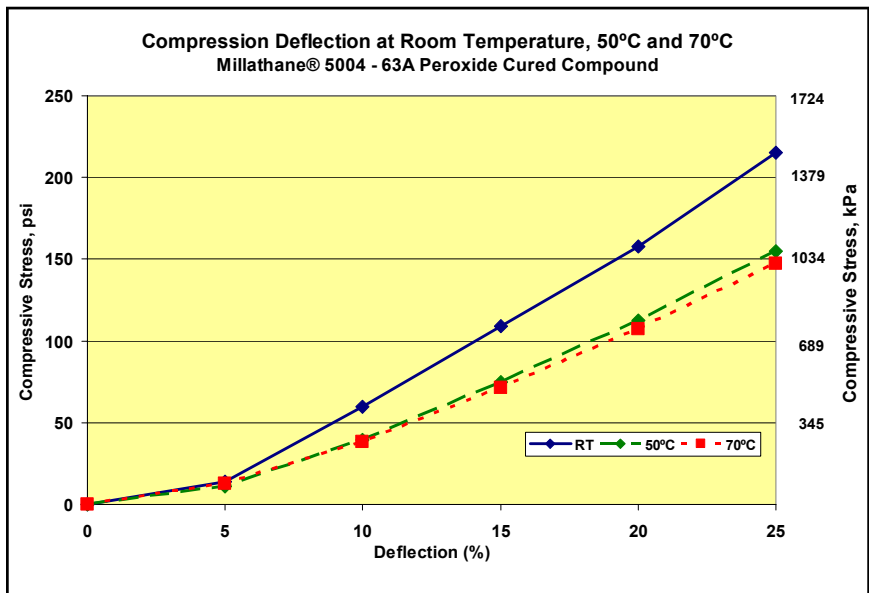
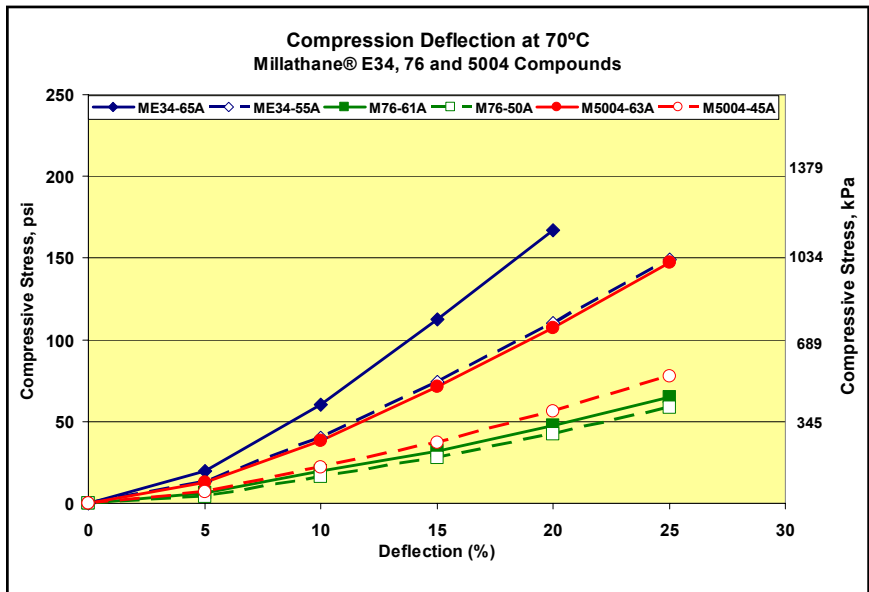
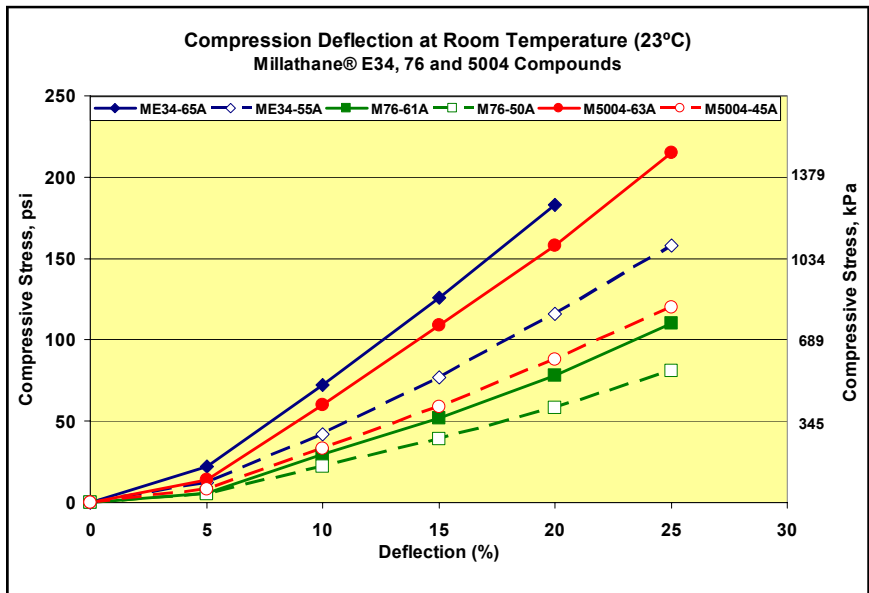
Testing of compression deflection was conducted per ASTM D575 Method A, using a TechPro TensiTECH machine. The compression deflection samples had a shape factor of 0.5 (cylinders 1 inch (25.4 mm) in diameter and 0.5 inch (12.7 mm) high). Compression deflection was tested at room temperature (23°C), 50°C and 70°C.

The data, plotted in the charts below and on the next page, show the softer compounds having lower compression deflection curves than harder compounds. Also, the Millathane 76 compounds show the lowest compression deflection values, while the Millathane E34 and Millathane 5004 compounds had somewhat similar compression deflection, when comparing the compounds at similar hardnesses.

The compression deflection results at **higher temperatures** show the expected trend of less stress required to deflect the samples. This is shown in the plotted 70°C data for all compounds and the 63 Shore A Millathane 5004 compound tested at all three temperatures.

MILLATHANE®

FACTOID: The compression deflection data shown is also a part of our new publication, "Engineering Properties of Millathane®." Visit our web site (www.millathane.com) or call us for a copy.



MILLATHANE®

FACTOID:

Compounds made from a blend of HNBR with Millathane® 26 gave excellent retention of properties after again in a hot, humid environment. This was for a roller.

MILLATHANE®

FACTOID:

"Expancel" microspheres can be used to make sponge/foamed compounds of Millathane millable urethanes.

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: millathaneinfo@tse-industries.com



www.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

**ASK Doctor Millathane®**

Dear Dr. Millathane,

Is post curing of Millathane compounds necessary or beneficial for optimizing physical properties? Our customer is considering replacing castable urethane with a millable urethane.

Nicholas O. Post

Dear N.O. Post,

Post curing of Millathane compounds is not necessary as it is for cast urethanes, which can require post cures of 16 hours or longer. Post curing can be beneficial, however, for optimizing properties for critical applications. A several hour post cure will generally increase the modulus (tensile stress) of the compound somewhat and will generally have a beneficial effect on compression set, especially with sulfur cured compounds.

For example, a silica reinforced, sulfur cured Millathane 76 compound showed the following:

	Original cure	Post cured 3 hr/121°C
Hardness, Shore A	55	56
TSE-100, MPa (psi)	1.3 (185)	1.6 (235)
Tensile Strength, MPa (psi)	28.3 (4100)	27.2 (3940)
Elongation, %	750	650
Tear, Die C, kN/m (lb/in)	49.0 (280)	46.4 (265)
Compression Set, 22 hr/100°C, %	75	45

The benefits to compression set of peroxide cured compounds are generally more subtle.

So, while post curing isn't necessary, there may be cases where post curing is beneficial to optimize set or other properties, especially if you're trying to meet a difficult specification. Post cure temperatures are generally 100° - 125°C for 1 – 4 hours, with lower temperatures generally recommended for polyether grades because their heat resistance is less than that of polyester grades.

Dr. Millathane

If you have any Millathane millable urethane questions you'd like answered, please send an email to millathaneinfo@tse-industries.com.