

Technical Information for Performance Solutions

Choosing the Right MILLATHANE® Polyester Urethane

Topics:

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TSE Industries currently provides five grades of polyester millable polyurethanes, each being developed for different end use applications. This study compares these five polyester millable urethanes to better assist the compounder in choosing the best millable urethane having the required properties for the application.

Grades Evaluated

Millathane 76 – General purpose, sulfur and peroxide curable

Millathane 5004 – Excellent heat and oil resistance; peroxide curable only

Millathane 66 – Excellent processing, heat and oil resistance; peroxide curable only

Millathane HT – Excellent hydrolytic stability and low temperature flexibility; sulfur and peroxide curable

Millathane 28 – Excellent resistance to gas permeability combined with low temperature flexibility; peroxide curable only

Typical Applications

Millathane 76 is used in automotive vibration damping applications such as door and trunk stoppers because of its low resilience and consistent modulus upon aging.

Millathane 5004 has excellent tear strength which enables de-molding of parts having complex design with low scrap.

Millathane 66 and **Millathane HT** are used in business machine applications where low temperature properties, combined with excellent abrasion resistance, are required for small rollers and drive belts.

Millathane 28 offers excellent permeability resistance combined with low temperature properties for automotive and industrial pneumatic seals and gaskets.

Formulation

The same general formulation was used for all compounds, with the only variable being the peroxide (DiCup 40C) level, as each polymer requires different peroxide levels to achieve optimum properties. Two peroxide levels were evaluated for each polymer. The compounds with the peroxide level that gave similar stress at 100% elongation (100% modulus) are shown to compare the polymers on an equal basis. Data comparing the two peroxide levels is shown on page 3.

Millathane® Urethane	100.0
Stearic acid	0.2
N330 Black	25.0
DBEEA (TP-95)	2.0
Struktol WB-222	1.0
Stabaxol P	2.0
DiCup 40C	Variable

Physical Properties

As the table below shows, Millathane 66 and Millathane 28 gave the highest tensile strength, while Millathane 5004 gave the highest tear strength.

Millathane grade	76	5004	66	HT	28
DiCup 40 level	2	4	6	1	6
Hardness, Shore A	65	70	67	69	65
TSE-100*, psi	310	390	300	270	300
MPa	2.1	2.7	2.1	1.9	2.1
TSE-300*, psi	1840	1770	1300	1430	1600
MPa	12.7	12.2	9.0	9.9	11.0
Tensile Strength, psi	3840	3910	4560	3260	4800
MPa	26.5	27.0	31.4	22.5	33.1
Elongation, %	465	565	625	485	570
Tear, Die C, lb/in	199	304	258	172	250
kN/m	34.8	53.2	45.2	30.1	43.8

*TSExxx=Tensile Stress at xxx% Elongation

Heat Aging

Heat aging at both 100°C and 125°C showed very good results for all the compounds, with Millathane HT having somewhat higher change of elongation after aging than the other Millathane grades.

Millathane grade	76	5004	66	HT	28
DiCup 40 level	2	4	6	1	6
Oven Aging 70 hr/100° C					
Hardness change, pts.	2	5	3	6	5
Tensile strength change, %	10	11	7	3	-11
Elongation change, %	1	-2	1	-16	4
Oven Aging 70 hr/125° C					
Hardness change, pts.	4	3	5	3	1
Tensile strength change, %	-7	12	5	5	-1
Elongation change, %	-15	-12	-10	-38	-4

Fluid Aging

The *IRM 903 oil* aging showed good results for all the compounds, with Millathane 5004, 66, and 28 giving slightly better overall retention of properties. The *boiling water* immersion test showed the best retention of properties with Millathane HT, 66, and 5004. Note that all compounds had two parts of the hydrolysis stabilizer Stabaxol P added to the formulations. The *toluene* immersion test showed the best resistance to swelling by Millathane 28, while Millathane 28, 76, and 5004 had the lowest hardness changes.

Millathane grade	76	5004	66	HT	28
DiCup 40 level	2	4	6	1	6
IRM 903 Oil aging, 70 hr/100° C					
Hardness change, pts.	-7	-5	-7	-6	-8
Tensile strength change, %	-23	4	-9	-5	-1
Elongation change, %	-13	-5	-6	-30	-3
Water aging 70 hr/100° C					
Hardness change, pts.	-15	-8	-9	-4	-8
Tensile strength change, %	-42	-19	-26	-17	-44
Elongation change, %	39	19	1	-25	9
Volume change, %	7	2	3	2	4
Toluene aging, 7 days/23°C					
Hardness change, pts.	-13	-13	-20	-20	-15
Volume change, %	58	61	61	60	48

TIPS

Other Tests

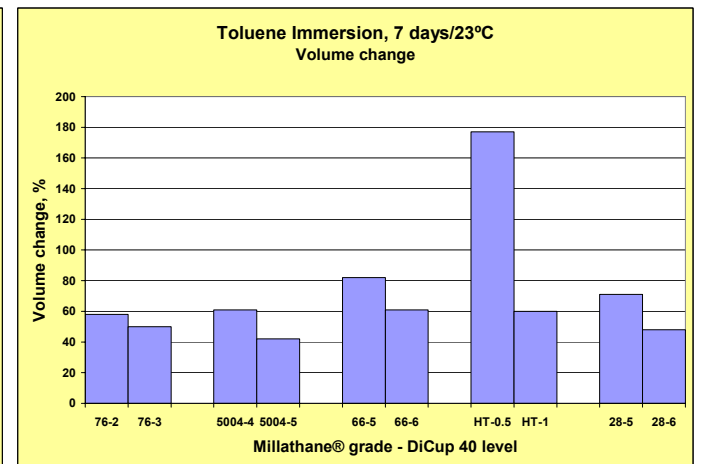
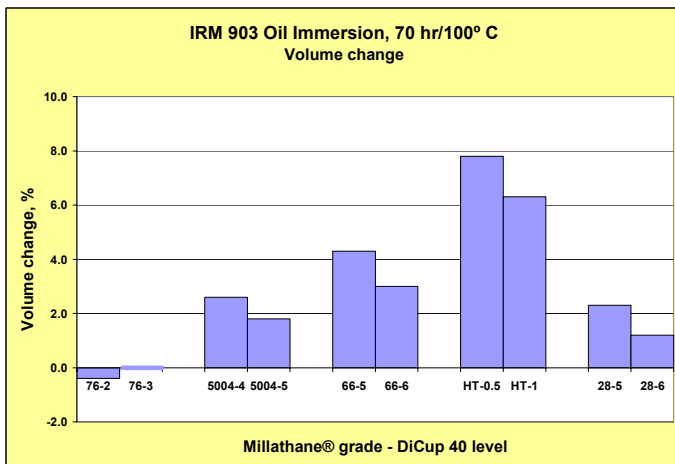
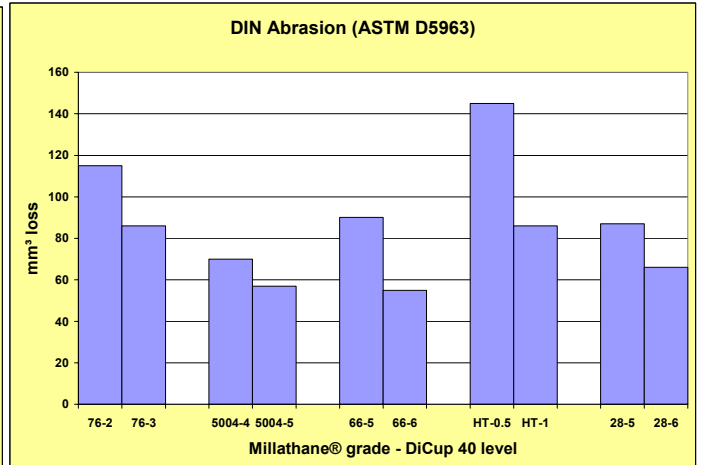
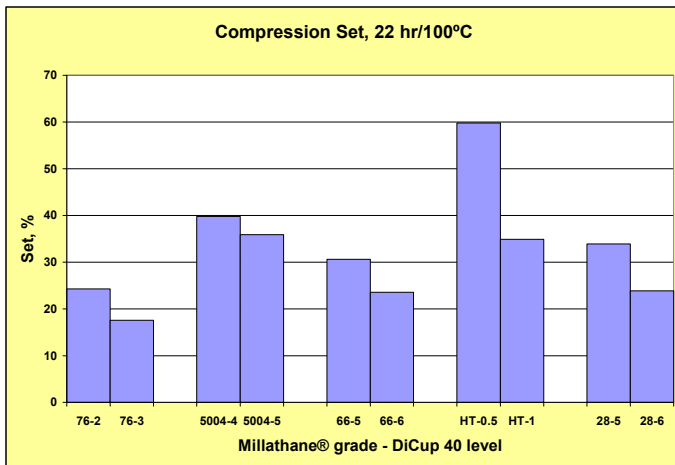
Compounds based upon Millathane 76 and HT gave lower resilience (rebound) than the other polyester urethanes. Millathane 5004, 28 and 66 had the best abrasion resistance, while Millathane HT, 66, and 5004 had the lowest brittle point. Compression set resistance was best for Millathane 28, 76, and 66.

Millathane grade	76	5004	66	HT	28
DiCup 40 level	2	4	6	1	6
Bashore Resilience, %	25	43	50	23	44
DIN Abrasion, mm ³	115	70	55	86	66
Low Temperature Brittle Point, °C	-35	-55	-57	-59	-45

Compression Set, %					
22 hr/70°C	7	13	11	10	7
22 hr/100°C	24	40	24	35	24
22 hr/125°C	39	67	39	52	33

Effect of Peroxide Level

Generally, higher peroxide levels give higher stress at elongation (modulus) values, better abrasion resistance, lower compression set, and better fluid resistance. The charts below illustrate the effect of peroxide level on several of these properties.



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SUMMARY

The five polyester millable urethanes tested in this report have somewhat different chemical compositions which give them different properties in vulcanized compounds. It is important to choose the best polymer for the properties required in the finished part. Some polyester urethanes are better for oil resistance or abrasion resistance, for example, than others, and the state of cure (here studied by two levels of peroxide) can affect most of these properties as well. Hopefully, this study will be useful in choosing the best Millathane millable urethane for the job.

Note: Additional test results are available in the full report XP-4642. Contact us to obtain a copy.