Peroxide Levels in Millathane® 66

Millathane® 66 is a polyester millable urethane that has excellent abrasion resistance, heat resistance and oil resistance. Millathane 66 is widely used for seals and rollers that require these excellent properties and is easily processed on standard rubber equipment. Millathane 66 is a polyurethane rubber that is peroxide-curable only, and the question ofttimes comes up regarding the optimum level of peroxide to use to optimize a certain property. A study was done in a silica reinforced Millathane 66 compound, comparing the properties of compounds with levels of DBPH-50 from 4 to 8 phr. Testing was done on the compounds per ASTM D2000, and the compounds generally met the requirements of M2BG728.

FORMULATION	
Millathane® 66	100.0
Stearic Acid	0.2
Ultrasil VN3	25.0
Silquest A-172	0.5
TP-95	2.0
Millstab™ P	2.0
Struktol WB222	1.0
SR350	2.0
Varox DBPH-50	4 to 8

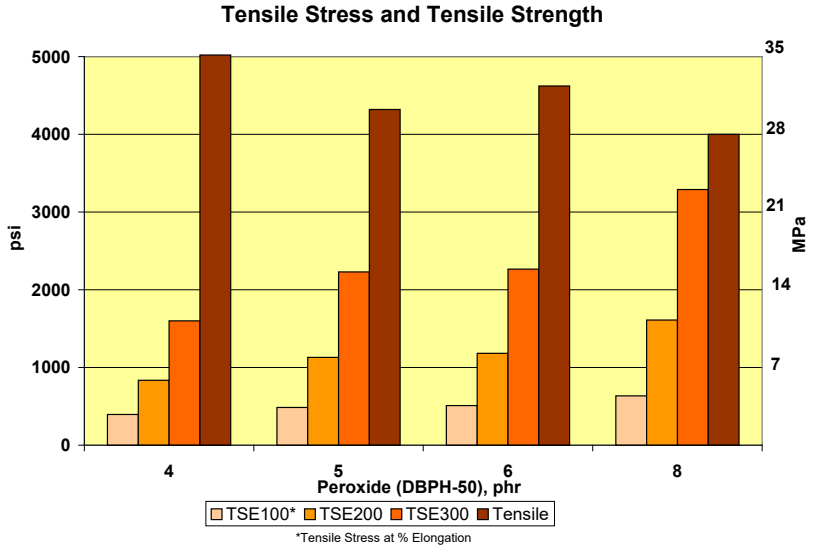
RHEOMETRICS

Curemeter data (MDR using a Tech-Pro MDPt), showed the MH values increasing and cure times (tc50 and tc90) decreasing as the peroxide level increases.

Varox DBPH-50	4	5	6	8
MDR at 170ºC				
MH, lb-in (dNm)	31.3 (35.4)	35.0 (39.5)	37.4 (42.2)	41.7 (47.1)
t50, minutes	2.3	2.1	1.9	1.7
t90, minutes	6.6	6.4	6.1	5.5

TENSILE PROPERTIES

The tensile stress (aka modulus) of the compounds increased as the peroxide level increased, while the tensile strength decreased slightly.



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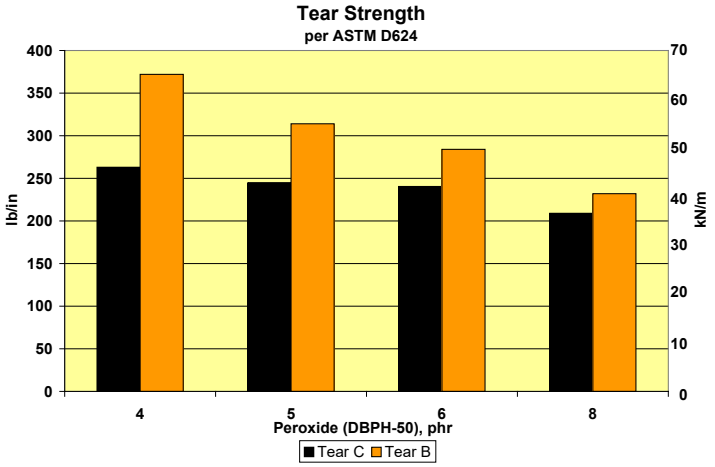
Peroxide Levels in Millathane® 66 (cont.)

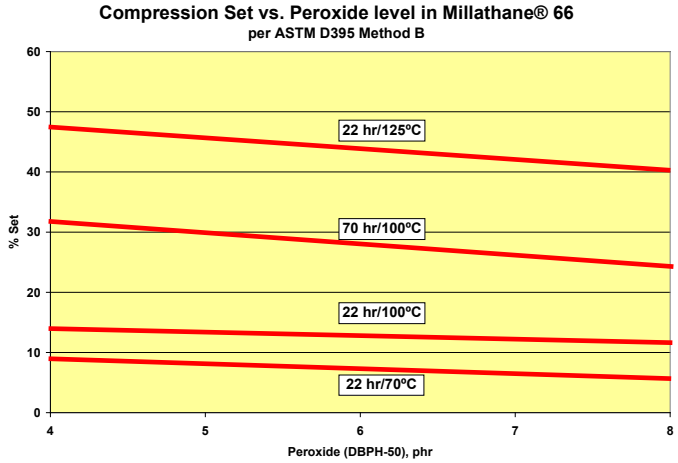
TEAR STRENGTH

Tear strength decreased somewhat as the peroxide level increased, slightly for Tear Die C and more significantly for Tear Die B.



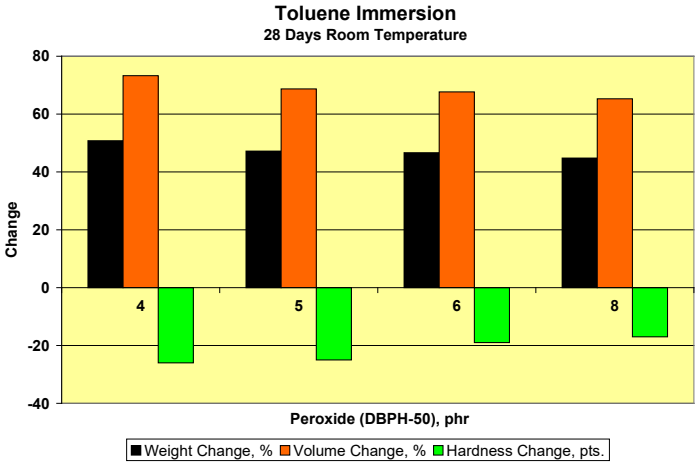
COMPRESSION SET

Compression set decreases (improves) as the peroxide level increases, as expected. The effect of peroxide level is more prominent with longer test times and higher temperatures.



HEAT, OIL AND TOLUENE RESISTANCE

All the compounds had excellent heat and oil resistance as seen by the data in the table on the following page. Property and volume changes were minimal after 70 hours at 100ºC in either IRM 901 or IRM 903 oil, or oven aging. Compounds were also tested for resistance to toluene for 28 days at room temperature (~23ºC). The data, in the chart to the right, show less hardness, volume and weight changes as the peroxide level increases.



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Peroxide Levels in Millathane® 66 (cont.)

ABRASION RESISTANCE

All compounds had excellent abrasion resistance, giving between 69 and 88 mm^3 loss in the DIN abrasion test (ASTM D5963), with no significant correlation of abrasion resistance with peroxide level.

COMPOUND PROPERTIES PER ASTM D2000 3BG728 A14 B14 EO14 E034

The properties of the compounds in this study are shown below, comparing them to those of ASTM D2000. The compounds with 4-6 parts of DBPH-50 meet all the requirements of ASTM D2000 3BG728A14B14EO14EO34 and 4BG728A14B14EO14EO34, with the compound with highest peroxide level (8 phr of DBPH-50) being slightly deficient in tensile and elongation for the 28 MPa tensile requirement, although it would easily meet the 17 MPa requirement. Since the 5 and 6-part DBPH-50 compounds are both 75 Shore A, they'd meet the requirements of either 70 ± 5 or 80 ± 5 Shore A hardness, and could be easily be hardened or softened slightly to center the hardness on 70 or 80 Shore A, if necessary. These compounds would also be expected to pass the requirements of the ASTM D2000 suffixes C12 (ozone resistance) and F17/F19 (low temperature brittleness).

Millathane® 66	**100**			
Stearic acid	0.2			
Ultrasil VN3	25			
Silquest A-172	0.5			
TP-95	2			
Stabaxol P	2			
Struktol WB222	1			
SR-350	2			
Varox DBPH-50	**4**	**5**	**6**	**8**
Total	**136.7**	**137.7**	**138.7**	**140.7**

Original Properties					**ASTM D2000 Requirements**		
					BG Basic	**Grade 3**	**Grade 4**
Hardness, Shore A	73	75	75	75	70 ± 5		
Tensile Strength, MPa	34.6	29.8	31.9	27.6*	28		
Elongation, %	535	425	435	335*	400		

**Doesn't meet BG728 but would meet BG717*

Oven Aged 70 hr/100ºC					**BG Basic**		**A14**
Hardness change, points	2	2	3	4	±15		±5
Tensile change, %	-6	4	2	-10	±30		±15
Elongation change, %	-6	-1	-6	-9	-50 max		-15 max

Compression Set					**BG Basic**	**B14**	**B14**
22 hr/100ºC, % set	16	12	12	13	+50 max	+50 max	+50 max

IRM 903 Oil Aging 70 hr/100ºC						**EO34**	**EO34**
Hardness change, points	1	-1	-1	0		-10 to +5	-10 to +5
Tensile change, %	-13	-11	-18	-14		-35 max	-35 max
Elongation change, %	1	1	-7	6		-40 max	-40 max
Volume Change, %	0.1	-0.1	0	-0.3	+40 max	+16 to +35	0 to +6

IRM 901 Oil Aging 70 hr/100ºC					**EO14**	**EO14**
Hardness change, points	-4	-5	-4	-1	-7 to +5	-7 to +5
Tensile change, %	-5	2	-4	-9	-20 max	-20 max
Elongation change, %	-3	4	-4	-1	-40 max	-40 max
Volume Change, %	-3.2	-3.5	-3.5	-3.7	-5 to +10	-5 to +5

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