



Producers of Specialty Chemicals

Struktol Company of America

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DYNAMAR **REPLACEMENT**

STRUKTOL[®] WS 280 and OTHERS

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STUDY 1: EPDM – PEROXIDE CURE

<u>FORMULAE</u>	<u>BLANK</u>	<u>WB 16</u>	<u>FLUORO ADDITIVE</u>
Vistalon 2504	100.00		
N 774	55.00		
ZnO	5.00		
STRUKTOL® T.M.Q.	1.00		
STRUKTOL® WB 16 Powder	---	2.00	---
FLUORO ADDITIVE		---	1.00

SECOND PHASE

Di Cup 40 C	10.00		
TOTALS	171.00	173.00	172.00

MIXING

First Stage: Lab BR mixer. 161 RPM.
O - Load polymer and process aid.

15 sec - Load remainder
280°F - Sweep
310°F - Dump

Final Stage: Lab BR mixer. 138 RPM.
O – Load all
210°F - Dump

HANDLING

All dry, bag on mill rolls.

MOONEY VISCOSITY

ML 1+4 @ 212°F	63.5	60.0	62.0
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ODR @ 340°F, 3° ARC

Minimum Torque, in/lbs:	10.0	9.0	9.0
T ₂ , minutes:	1.2	1.2	1.2
T ₉₀ , minutes:	9.4	9.6	8.9
Maximum Torque, in/lbs:	144.0	130.0	140.0

SPIRAL MOLD FLOW

BLANK

WB 16

FLURO
ADDITIVE

3571 psi @ 340°F
Ave. grams flow:

2.3

2.8

2.4

PROPERTIES

Specimens cured 12'/340°F

ORIGINALS

Hardness, Shore A, 1/4" disc

70

70

70

Tensile Strength, psi

2345

2300

2570

Elongation, %

210

220

220

Modulus @ 100% E, psi

705

595

675

STUDY 2: NATURAL RUBBER

<u>FORMULAE</u>	<u>BLANK</u>	<u>A 60</u>	<u>WB 16</u>	<u>FLUORO ADDITIVE</u>	<u>A 60/ WB 16</u>	<u>A 60 FLUORO ADDITIVE</u>
SMR CV	100.00					
N 650	100.00					
Sundex 790	8.00					
Reogen	2.00					
Agerite White	1.50					
STRUKTOL®	1.00					
T.M.Q.						
ZnO	5.00					
Stearic Acid	2.00					
STRUKTOL® A 60	---	3.00	---		2.00	2.00
STRUKTOL®		---	3.00		1.00	
WB 16 Flakes						
Fluoro Additive				1.50		1.00

SECOND PASS

Sulfur	1.00					
BBTS	1.25					
TMTD	0.25					
TOTALS	222.00	225.00	225.00	223.50	225.00	225.00

MIXING

First Stage: Lab BR Mixer.

O – Load polymer + PA @ 230 RPM

- 15 sec - Add ½ Black
- 1.5 min. - RPM to 184. Load remainder
- 280°F - Sweep
- 300°F - Dump

Final Stage: 230 RPM. Add ½ MB.

- At one minute, dump, band on mill.
- Add cures to second half in BR @ 230 RPM.
- At one minute, dump, blend with 1st half on mill.

<u>MOONEY SCORCH</u>	<u>BLANK</u>	<u>A 60</u>	<u>WB 16</u>	<u>FLUORO ADDITIVE</u>	<u>A 60/WB 16</u>	<u>A 60/ FLUORO ADDITIVE</u>
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MS @ 250°F

Minimum	38.0	36.5	33.0	38.0	31.0	33.4
T ₂	8.4	11.2	10.8	10.4	10.6	11.4
T ₅	8.9	11.8	11.2	11.1	11.1	12.0

ODR @ 320°F, 3° ARC

Minimum	13.4	13.0	13.0	14.2	10.6	10.2
Torque, in/lbs:						
T ₂ , minutes:	1.7	1.95	2.0	1.95	1.9	2.05
T ₉₀ , minutes:	2.9	3.55	3.15	3.15	3.3	3.45
Maximum	88.4	87.6	78.0	94.0	79.0	81.6
Torque, in/lbs:						

SPIRAL MOLD FLOW

3571 PSI @ 320°F

Ave. grams flow	3.1	2.8	3.1	2.8	3.1	3.1
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PROPERTIES

Specimens cured 7'/302°F

ORIGINALS

Hardness, Shore A, ¼" disc	77	78	79	79	78	79
Tensile Strength, psi	2465	2290	2480	2490	2460	2355
Elongation, %	270	230	270	230	270	260
Modulus @ 100% E, psi	1015	1060	950	1120	970	990
Tear, Die "C", ppi	170	170	205	175	155	165

Compression Set, ½" discs (15'/302°F)
22 Hrs. @ 212°F

% Deflection	36.8	33.0	34.4	35.9	34.8	38.1
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STUDY 3 - NEOPRENE BLANK WB 16 A 60 FLUORO ADDITIVE

FORMULAE

Neoprene M 2.7	100.00			
N 550	2.00			
Hard Clay	75.00			
Whiting	15.00			
Sundex 790	15.00			
D.O.S.	10.00			
Wingstay 100 AZ	4.00			
Maglite D	4.00			
Stearic Acid	0.50			
STRUKTOL® WB 16 Powder	---	3.50		
STRUKTOL® A 60			3.50	---
Fluoro Additive			---	1.00

SECOND PASS

ZnO	5.00
ETU-75	1.30
MBTS	0.50

TOTALS **232.30** **235.80** **235.80** **233.30**

MIXING

First Stage: Lab BR Mixer @ 161 RPM.

O – Load Neoprene, MgO, Whiting, Process Aid, Black.

30 sec - Add PA. Balance of ingredients.

5 min - Dump

Final Stage: Add curatives to ½ MB on mill.

Add all to BR @ 161 RPM. Dump at 210°F.

MIXING COMMENTS

Blank build up heat faster than the others. All Batches stick to rotors. No mill roll sticking problems with First Stage mixing. On the Final Stage mix, Control and A 60 stuck slightly to mill rolls. STRUKTOL® WB 16 gave better mill release, Fluoro Additive gave good mill release.

COOL MILL HANDLING (104°F)

Blank	- Splits, runs to back roll and sticks.
Control & A 60	- Runs on front roll with slight tendency to backroll. Sticks to front roll but can be stripped off.
WB 16	- Runs to front roll. Sticks and is difficult to strip off.
Fluoro Additive	- Runs to front roll. Difficult to strip and sticks.

EXTRUDATE – GARVEY DIE BLANK WB 16 A 60 FLUORO ADDITIVE

ASTM D 2230, Method A

40 RPM; Head & Die: 230°F

Barrel: 158°F

Rate, in/min:	125	72	68	77
Rating: Swell & porosity -	3	3	3	3
Edge -	1	2	2	
Surface -	2	3	3	2
Corners -	1	2	2	1

1 = Worst

4 = Best

MOONEY VISCOSITY

ML 1+4 @ 212°F	40.5	28.5	29.0	39.0
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ODR @ 320°F, 3° ARC

Minimum Torque, in/lbs:	8.8	6.2	6.0	8.0
T2, minutes:	3.0	3.0	3.2	2.8
Torque @ 12 min, in/lbs:	44.5	34.0	34.0	44.5

SPIRAL MOLD FLOW

3571 psi @ 320°F

Ave. grams flow	5.9	6.9	7.1	5.4
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<u>PROPERTIES</u>	<u>BLANK</u>	<u>WB 16</u>	<u>A 60</u>	<u>FLUORO ADDITIVE</u>
Specimens cured 20'/320°F				
<u>Originals</u>				
Hardness, Shore A, ¼" disc	57	55	53	58
Tensile Strength, psi	1935	1785	1710	1915
Elongation, %	730	750	750	730
Modulus @ 300% E, psi	425	260	275	415
Tear Strength, Die "C", ppi	190	125	135	180
<u>Oven Aged 70 Hrs. @ 212°F</u>				
Hardness Change, points	+1	0	+2	0
Tensile Change, %	+8.0	+12	+17.3	+11.5
Elongation Change, %	-1.4	-2.7	0	-1.4
<u>Compression Set, ½' Discs (40'/320°)</u>				
<u>22 Hrs. @ 212°F</u>				
% Original Deflection	27.1	26.8	31.0	29.8

STUDY 4 – ECO – PART B

<u>FORMULAE</u>	<u>CONTROL</u>	<u>MgSt WB 222</u>	<u>A 60 WB 222</u>	<u>MgSt FLUORO ADDITIVE</u>	<u>A 60/ FLUORO ADDITIVE</u>
Hydrin 200	100.00				
Dyphos	4.00				
DLS/80 E	5.00				
N 330	40.00				
Paraplex G 50	8.00				
Magnesium Stearate	1.00	1.00		1.00	
STRUKTOL® PEH-100	3.00				
STRUKTOL® WB 222		3.00	3.00		
Fluoro Additive				1.00	1.00
<u>Second Pass</u>					
Vanox NBC	0.75				
Isobutyl Niclate	1.25				
ETU-75	1.30				
TOTALS	164.30	164.30	164.05	162.30	162.05

MIXING

First Stage: Lab BR Mixer @ 161 RPM
O – ECO, Mg Stearate, A 60

0.5 min - Dyphos, DLS
1.5 min - Remainder of dry material.
220°F - Sweep
250°F - Paraplex
265°F - Dump

Final Stage: Add MB, AO, ETU @ 161 RPM.
Dump at 220°F.
Refine on mill.

MIXING COMMENTS

Masterbatch

Control	- Sticks in mixer, must be pulled free. Backrolls on mill, sticks and splits.
MgSt/Fluoro Additive-	Not as bad as control.
MgSt/WB 222	- Slight sticking to mixer side. Runs good on mill front roll.
A 60/WB 222	- Slight sticking to mixer side. Runs excellent on mill front roll. Better than M/222.
A 60/Fluro Additive	- Clean drop. Strong tendency to backroll on mill with slight sticking.

FINAL PASS

Control /MgSt/Fluoro Additive	- Sticks in mixer. Must be scraped off mill roll.
A 60/Fluro Additive	- Same as MgSt/Fluoro Additive but not as sticky on the mill.
MgSt/WB 222, A 60/WB 222	- Slight sticking to side. Runs good on mill front roll.

<u>MOONEY</u> <u>VISCOSITY</u>	<u>CONTROL</u>	<u>MgSt/</u> <u>WB 222</u>	<u>A 60/</u> <u>WB 222</u>	<u>MgSt/</u> <u>FLUORO</u> <u>ADDITIVE</u>	<u>A 60/</u> <u>FLUORO</u> <u>ADDITIVE</u>
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ML 1+4 @ 212°F	58.0	59.0	59.0	62.0	60.0
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ODR @ 340°F, 3° ARC

Minimum Torque, in/lbs:	10.0	9.5	10.0	10.5	11.0
T ₂ , minutes:	1.4	1.4	1.3	1.4	1.4
Torque @ 12 min, in/lbs:	42.5	36.5	41.0	49.5	49.5
Torque @ 24 min, in/lbs:	52.5	44.0	50.0	62.5	62.0

SPIRAL MOLD FLOW

3571 psi @ 340°F Ave. grams flow:	4.0	5.3	4.0	3.3	3.4
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PROPERTIES

Specimens cured 15'/340°F

ORGINIALS

Hardness, Shore A	57	60	60	59	59
Tesnile Strength, psi	2315	2300	2165	2200	2090
Elongation, %	820	820	780	760	840
Modulus @ 100% E, psi	225	235	230	240	235

COMPRESSION SET, 22 Hrs @ 257°F

Plied Discs

% Original Deflection	44.3	44.4	39.6	42.3	48.2
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Bloom Study

Slabs conditioned 2 Hrs. @ 300°F:

None None ← very slight haze →

SUMMARY

PEROXIDE CURED EPDM

No improvements in mixing or mill handling. No significant improvements in mold flow.

80 SHORE A NATURAL RUBBER

Fluro Additive speeded an already fast masterbatch mix cycle. The mold flow was not improved as much with Fluoro Additive as it was with STRUKTOL® WB 16 and Struktol® A 60.

MINERAL LOADED, LOW VISCOSITY NEOPRENE

Fluro Additive provided the best mill release. However, mill roll sticking did occur with Fluoro Additive. Fluoro Additive provided no improvement over the control in the Garvey die test. STRUKTOL® WB 16 and STRUKTOL® A 60 provided improvements in the edge, corners, and surface ratings. All process aids except Fluoro Additive improved mold flow.