

**Model Formula for Tire Innerliner**  
**Exxon™ Bromobutyl 2222 (80PHR), Natural Rubber (20PHR) Blend**

Material	Units	Amount
Exxon Bromobutyl 2222	PHR <sup>1</sup>	80.0
Natural Rubber TSR 20	PHR	20.0
Carbon Black Grade N660	PHR	60.0
Naphthenic Oil	PHR	8.0
Aromatic & Aliphatic Hydrocarbon Resin Blend	PHR	7.0
Phenolic Tackifying Resin	PHR	4.0
Stearic Acid	PHR	1.0
Zinc Oxide	PHR	1.0
Sulfur	PHR	0.5
Benzothiazyl disulfide (MBTS)	PHR	1.25

Properties	Test Method Based on	Units and Conditions	Typical Values <sup>2</sup>
Mooney Viscosity ML( 1+ 4 ) @ 100°C	ASTM D1646	MU, 100°C	49
Mooney Scorch (Tested at 125°C)	ASTM D1646		
Minimum Viscosity		MU	38
Time to 5pt rise		Minutes	13.1
Time to 10pt rise		Minutes	15.1
Rheometer (MDR)	ASTM D5289	160°C; 30 minutes; 0.5 deg. arc	
M <sub>l</sub> (Minimum torque)		dNm	1.4
M <sub>h</sub> (Maximum torque)		dNm	4.3
M <sub>h</sub> -M <sub>l</sub> (Delta torque)		dNm	2.9
Tc <sub>10</sub> (time to 10% torque increase)		Minutes	1.2
Tc <sub>50</sub> (time to 50% torque increase)		Minutes	3.6
Tc <sub>90</sub> (time to 90% torque increase)		Minutes	14.1
Cure rate (Peak Rate)		dNm/min	0.54
Rheometer (MDR)	ASTM D5289	180°C; 30 minutes; 0.5 deg. arc	
M <sub>l</sub> (Minimum torque)		dNm	1.3
M <sub>h</sub> (Maximum torque)		dNm	4.0
M <sub>h</sub> -M <sub>l</sub> (Delta torque)		dNm	2.8
Tc <sub>10</sub> (time to 10% torque increase)		Minutes	0.6
Tc <sub>50</sub> (time to 50% torque increase)		Minutes	1.1
Tc <sub>90</sub> (time to 90% torque increase)		Minutes	2.8
Cure rate (Peak Rate)		dNm/min	2.0

Properties	Test Method Based on	Units and Conditions	Typical Values <sup>2</sup>
Stress Strain Properties		Cure time <sup>3</sup> 16.1 minutes at 160°C	
Tensile Strength	ASTM D412	MPa	8.7
Elongation at Break		%	790
Modulus 100%		MPa	0.8
Modulus 200%		MPa	1.6
Modulus 300%		MPa	2.6
Energy to Break		Joules	9.2
Tear Strength (Die B)	ASTM D624	kN/m	40.8
Hardness	ASTM D2240	Shore A	39
Fatigue to Failure (Cycles)	ExxonMobil Method	Kilo Cycles @ 136% strain	412
Oxygen Permeability Coefficient @ 40°C	ExxonMobil Method	cc*mm(m <sup>2</sup> -day-mmHg)	0.63
ARES Dynamic Properties @ 0°C			
G'	ExxonMobil Method	2% Strain, 1.0 Hz. MPa	4.4
G''		MPa	1.1
tan_delta			0.25
ARES Dynamic Properties @ 30°C			
G'	ExxonMobil Method	2% Strain, 1.0 Hz. MPa	3.0
G''		MPa	0.40
tan_delta			0.13
ARES Dynamic Properties @ 0°C			
G'	ExxonMobil Method	2% Strain, 10.0 Hz. MPa	5.9
G''		MPa	2.9
tan_delta			0.50
ARES Dynamic Properties @ 30°C			
G'	ExxonMobil Method	2% Strain, 10.0 Hz. MPa	3.4
G''		MPa	0.64
tan_delta			0.19

1. Parts per Hundred Rubber.
2. Values given are typical and should not be interpreted as a specification.
3. Samples cured Tc<sub>90</sub> + 2 at 160°C

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