

EPR ethylene-propylene rubber

PARAMETER	UNIT	VALUE	REFERENCES
GENERAL			
Common name	-	ethylene-propylene rubber	
CAS name	-	1-propene, polymer with ethene	
Acronym	-	EPR	
CAS number	-	9010-79-1; 61789-00-2	
Linear formula		$[\text{CH}_2\text{CH}(\text{CH}_3)]_x(\text{CH}_2\text{CH}_2)_y$	
HISTORY			
Person to discover	-	Ziegler, K; Natta, G	
Date	-	1951; 1962	
Details	-	discovery of catalyst essential in polymerization; commercial production	
SYNTHESIS			
Monomer(s) structure	-	$\text{CH}_2=\text{CH}_2$; $\text{CH}_3\text{CH}=\text{CH}_2$	
Monomer(s) CAS number(s)	-	74-85-1; 115-07-1	
Monomer(s) molecular weight(s)	dalton, g/mol, amu	28.05; 42.08	
Ethylene content	%	45-78	
Method of synthesis	-	ethylene and propylene are copolymerized in the presence of catalyst solution (e.g., metallocene) and cocatalyst (e.g, MAO)	Lu, L; Niu, H; Dong, J-Y; Zhao, X; Hu, X, J. Appl. Polym. Sci., 118, 3218-26, 2010.
Temperature of polymerization	°C	40-100	
Heat of polymerization	J g ⁻¹	55-188	
Mass average molecular weight, M_w	dalton, g/mol, amu	80,000-1,000,000	
Polydispersity, M_w/M_n	-	1.1-5.6	
STRUCTURE			
Crystallinity	%	20.1-43.8	van Reene, A J; Shebani, A N, Polym. Deg. Stab., 94, 1558-63, 2009.
Crystallite size	nm	1.5-2.2	
COMMERCIAL POLYMERS			
Some manufacturers	-	Lanxess	
Trade names	-	Buna	
PHYSICAL PROPERTIES			
Density at 20°C	g cm ⁻³	0.86-0.91	
Color	-	colorless, white, off-white	
Haze	%	5-10	
Odor		odorless	
Melting temperature, DSC	°C	120-170	
Degradation temperature	°C	250-300	
Thermal conductivity, melt	W m ⁻¹ K ⁻¹	0.3	
Thermal diffusivity	cm ² s ⁻¹	0.0012	

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Glass transition temperature	°C	-35 to -69	
Specific heat capacity	J K ⁻¹ kg ⁻¹	2800	
Maximum service temperature	°C	260 (without presence of oxygen)	
Long term service temperature	°C	-55 to 150	
Heat deflection temperature at 0.45 MPa	°C	68-102	
Relative permittivity at 100 Hz	-	3-4	
Volume resistivity	ohm-cm	10 ¹⁵	
Permeability to nitrogen, 25°C	cm ³ mm m ⁻² day ⁻¹ atm ⁻¹	553	
Permeability to water vapor, 25°C	cm ³ cm cm ⁻² s ⁻¹ Pa ⁻¹ x 10 ¹²	15.7	
MECHANICAL & RHEOLOGICAL PROPERTIES			
Tensile strength	MPa	5.5-38	
Tensile stress at yield	MPa	19-35.2	
Elongation	%	200-730	
Tensile yield strain	%	5	
Flexural modulus	MPa	550-1,650	
Izod impact strength, notched, 23°C	J m ⁻¹	37-480	
Shore A hardness	-	70-80	
Rockwell hardness	-	R80-106	
Intrinsic viscosity, 25°C	dl g ⁻¹	0.89	
Mooney viscosity	-	25-69	
Melt index, 230°C/2.16 kg	g/10 min	0.5-35	
CHEMICAL RESISTANCE			
Acid dilute/concentrated	-	fair/poor	
Alcohols	-	very good	
Alkalis	-	good	
Aliphatic hydrocarbons	-	poor	
Aromatic hydrocarbons	-	poor	
Esters	-	good	
Greases & oils	-	poor	
Halogenated hydrocarbons	-	poor	
Ketones	-	good	
FLAMMABILITY			
Ignition temperature	°C	250	
Volatile products of combustion	-	CO, CO ₂ , soot	
WEATHER STABILITY			
Spectral sensitivity	nm	300-360	

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Activation wavelengths	nm	300, 310	
Depth of UV penetration	μm	>3000; 1500	
Stabilizers	-	UVA: 2-hydroxy-4-octyloxybenzophenone; 2,2'-methylenebis(6-(2H-benzotriazol-2-yl)-4-1,1,3,3-tetramethylbutyl)phenolHAS: 1,3,5-triazine-2,4,6-triamine, N,N''[1,2-ethane-diyl-bis[[[4,6-bis[butyl(1,2,6,6-pentamethyl-4-piperidiny) amino]-1,3,5-triazine-2-yl]imino]-3,1-propanediyl]bis[N',N''-di-butyl-N',N''-bis(1,2,2,6,6-pentamethyl-4-piperidiny)]; Phenolic antioxidant: 1,3,5-tris(3,5-di-tert-butyl-4-hydroxybenzyl)-1,3,5-triazine-2,4,6(1H,3H, 5H)-trione	
TOXICITY			
NFPA: Health, Flammability, Reactivity rating	-	1/0-1/0	
Carcinogenic effect	-	not listed by ACGIH, NIOSH, NTP	
Oral rat, LD₅₀	mg kg ⁻¹	>5,000	
Skin rabbit, LD₅₀	mg kg ⁻¹	>2,000	
PROCESSING			
Typical processing methods	-	calendering, coating, extrusion, molding	
Additives used in final products	-	Fillers: aluminum hydroxide, antimony trioxide, calcinated clay, calcium borate, calcium carbonate, huntite, hydromagnesite, magnesium carbonate, magnesium hydroxide, nanoclay, silica, talc, titanium dioxide, zinc oxide; Release: fluoropolymer; Slip: erucamide, graphite	
Applications	-	automotive (including bumper, instrument panel), blending, cables, o-rings, roofing sheets, seals	
Outstanding properties	-	paintable, low temperature impact resistance	
BLENDS			
Suitable polymers	-	PA6, PE, PP, PS	
ANALYSIS			
FTIR (wavenumber-assignment)	cm ⁻¹ /-	carbonyl – 1712, 1737, 1780; aldehyde – 1735; hydroxyl – 3400; vinylidene – 888	