

CAB cellulose acetate butyrate

PARAMETER	UNIT	VALUE	REFERENCES
GENERAL			
Common name	-	cellulose acetate butyrate	
ACS name	-	cellulose, acetate butanoate	
Acronym	-	CAB	
CAS number	-	9004-36-8	
HISTORY			
Date	-	1935	
Details	-	introduced into the photographic film industry	Schilling, M; Bouchard, M; Khanjian, H; Learner, T; Phenix, A; Rivenc, R, Accounts Chem. Res., 43, 6, 888-96, 2010.
SYNTHESIS			
Monomer(s) structure	-	cellulose, butyric acid, acetic acid	
Monomer(s) CAS number(s)	-	9004-36-8; 107-92-6; 64-19-7	
Monomer(s) molecular weight(s)	dalton, g/mol, amu	typical of raw material; 88.1; 60.05	
Acetyl content	%	2-29.5	
Butyryl content	%	16.5-54	
Hydroxyl content	%	0.8-4.8	
Number average molecular weight, M_n	dalton, g/mol, amu	12,000-70,000	
Polydispersity, M_w/M_n	-	3.2-3.5	
STRUCTURE			
Crystallinity	%	0; amorphous	Suttiwijitpukdee, N; Sato, H; Zhang, J; Hashimoto, T; Ozaki, Y, Polymer, 52, 461-71, 2011.
COMMERCIAL POLYMERS			
Some manufacturers	-	Eastman	
Trade names	-	Cellulose Acetate Butyrate	
PHYSICAL PROPERTIES			
Density at 20°C	g cm ⁻³	1.16-1.26	
Bulk density at 20°C	g cm ⁻³	0.224-0.512; 0.256-0.612 (tapped)	
Color	-	white	
Refractive index, 20°C	-	1.4740-1.48	
Transmittance	%	90	
Haze	%	8.5	
Odor	-	slight, characteristic	
Melting temperature, DSC	°C	150-240	
Decomposition temperature	°C	313-350; 175-180 (plasticized)	
Thermal expansion coefficient, 23-80°C	10 ⁻⁴ °C ⁻¹	1.2-1.7	
Thermal conductivity, melt	W m ⁻¹ K ⁻¹	0.17-0.33	

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Glass transition temperature	°C	85-161; 113.5	Schilling, M; Bouchard, M; Khanjian, H; Learner, T; Phenix, A; Rivenc, R, Accounts Chem. Res., 43, 6, 888-96, 2010.
Maximum service temperature	°C	60-100	
Long term service temperature	°C	-40 to 60	
Heat deflection temperature at 0.45 MPa	°C	54-108	
Heat deflection temperature at 1.8 MPa	°C	43-94	
Vicat temperature VST/B/50	°C	65-102	
Hansen solubility parameters, δ_D , δ_P , δ_H	MPa ^{0.5}	17.2, 13.8, 2.8	
Interaction radius		12.6	
Hildebrand solubility parameter	MPa ^{0.5}	22.2	
Surface tension	mN m ⁻¹	calc.=34.0	
Dielectric constant at 100 Hz/1 MHz	-	3.2-3.8	
Dissipation factor at 100 Hz		100-150	
Volume resistivity	ohm-m	1E9 to 1E13	
Surface resistivity	ohm	1E13 to 1E14	
Electric strength K20/P50, d=0.60.8 mm	kV mm ⁻¹	10-98	
Permeability to oxygen, 25°C	cm ³ cm cm ⁻² s ⁻¹ Pa ⁻¹ x 10 ¹²	0.356	
Contact angle of water, 20°C	degree	71.5-75	
Surface free energy	mJ m ⁻²	15-51	
MECHANICAL & RHEOLOGICAL PROPERTIES			
Tensile strength	MPa	16-51	
Tensile modulus	MPa	300-2,000	
Tensile stress at yield	MPa	17-44	
Elongation	%	19-90	
Tensile yield strain	%	4-4.7	
Flexural strength	MPa	21-70	
Flexural modulus	MPa	620-2,400	
Elastic modulus	MPa	345-1,380	
Compressive strength	MPa	14-52	
Charpy impact strength, unnotched, 23°C	kJ m ⁻²	NB	
Charpy impact strength, notched, 23°C	kJ m ⁻²	10-30	
Charpy impact strength, notched, -30°C	kJ m ⁻²	7-8	
Izod impact strength, unnotched, 23°C	J m ⁻¹	260	
Izod impact strength, notched, 23°C	J m ⁻¹	80-530	

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Izod impact strength, notched, -40°C	J m ⁻¹	100	
Rockwell hardness	-	R26-116	
Ball indentation hardness at 358 N/30 S (ISO 2039-1)	MPa	30-65	
Shrinkage	%	0.3-0.9	
Melt volume flow rate (ISO 1133, procedure B), 210°C/2.16 kg	cm ³ /10 min	5-40	
Water absorption, equilibrium in water at 23°C	%	1.3-2.2; 1.4 (24 h)	
Moisture absorption, equilibrium 23°C/50% RH	%	0.8-1.2	
CHEMICAL RESISTANCE			
Acid dilute/concentrated	-	poor	
Alcohols	-	poor	
Alkalis	-	poor	
Aliphatic hydrocarbons	-	poor	
Aromatic hydrocarbons	-	poor	
Esters	-	good	
Greases & oils	-	poor	
Halogenated hydrocarbons	-	poor	
Ketones	-	poor	
Good solvent	-	acetone, amyl acetate, chloroform, cyclohexanone, dioxane, methanol (hot) nitromethane, tetrachloroethylene, toluene	
Non-solvent	-	aliphatic hydrocarbons, diethyl ether, ethanol, methanol	
FLAMMABILITY			
Limiting oxygen index	% O ₂	17	
Volatile products of combustion	-	CO, CO ₂ , acetic acid	
UL 94 rating	-	HB	
TOXICITY			
NFPA: Health, Flammability, Reactivity rating	-	1/1/0; 1/1/0 (HMIS)	
Carcinogenic effect	-	not listed by ACGIH, NIOSH, NTP	
Reproductive toxicity	-	not reported	
TLV, ACGIH	mg m ⁻³	3 (respirable), 10 (total)	
OSHA	mg m ⁻³	5 (respirable), 15 (total)	
Oral rat, LD ₅₀	mg kg ⁻¹	>6,400	
Skin rabbit, LD ₅₀	mg kg ⁻¹	>1,000	
PROCESSING			
Typical processing methods	-	compression molding, extrusion, injection molding	
Preprocess drying: temperature/time/residual moisture	°C/h/%	70/2	
Processing temperature	°C	129-199 (compression molding); 168-249 (injection molding)	

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Additives used in final products	-	Antistatic: hydroxyethyl cellulose; Antiblocking: silica; Release: fluorochemical, microcrystalline wax, polyethylene wax, silicone; Slip: alumina, magnesium stearate, polyethylene wax, silica	
Applications	-	aircraft, automotive, coatings (for automotive plastics, cloth, leather, paper/paperboard, plastics, wood); lacquers (for automotive, paper, plastics, wood), nail care, panel for illuminated signs, printing inks, tool handles	
Outstanding properties	-	toughness, dimensional stability, resistance to extreme weather	
BLENDS			
Suitable polymers	-	acrylics, alkyds, amino resins, isocyanate resins, PC, PMMA, polyesters	
ANALYSIS			
FTIR (wavenumber-assignment)	cm ⁻¹ /-	major bands: C=O stretch of ester group – 1746; asymmetric stretching of C-C-O of ester group – 1234; asymmetric stretching of O-C-C bond attached to carbonyl	Schilling, M; Bouchard, M; Khanjian, H; Learner, T; Phenix, A; Rivenc, R, Accounts Chem. Res., 43, 6, 888-96, 2010.

