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NOROX®

Thermoset Applications

PRODUCT CODE	DESCRIPTION	ACTIVE OXYGEN CONTENT	PEROXIDE CONTENT	SAFETY INFORMATION Recommended max. storage temp.	SAFETY INFORMATION SADT	APPLICATION TEMPERATURE: Hand Lay-up/Spray-up	Casting/Winding	Polymer Concrete & Marble, Buttons	Gelcoats	Body Fillers	Chemical Anchors & Mine bolts	RTM, vacuum infusion	Coatings	Resin Transfer Molding (RTM)	Cured In Place Pipes (CIPP)	Artificial marble	Continuous Laminating	Pultrusion	SMC, BMC, GMC, TMC	SPECIAL RESINS: Vinylesters	Acrylics
KETONE PEROXIDES		%	%	°C	°C	AMBIENT								ELEVATED				HIGH			
Methyl ethyl ketone peroxide (CAS No. 1338-23-4)																					
NOROX KP-9 *	General purpose MEKP with medium reactivity	9,1		30	60	●	●	●	●	●		●		●			●				
NOROX KP-100 *	Faster gel & cure than KP-9	9,7		30	60	●	●	●	●	●		●		●			●				
NOROX SG-10 *	Faster gel than KP-100	9,7		30	60	●	●	●	○					○			●				
NOROX KP-200 *	Faster gel than KP-100	9,5		30	60	●	●	●						○			○				
NOROX KP-925H	MEKP designed for VE resins, less foaming	8,9		30	60	●	●		●			●	○	●			●			●	
NOROX KP-925	MEKP for VE, UP & gelcoats	8,9		30	60	●	●		●			●	○	●			○			○	
NOROX KPM	Mixture with similar gel time but faster cure than KP-9	7,7		30	60	●	●	●				●		●			●				
Methyl ethyl ketone peroxide (phthalatefree) (CAS No. 1338-23-4)																					
NOROX ENP-90	General purpose MEKP with medium reactivity, approved gelcoat type	8,9		30	60	●	●	●	●	●		●		●			●				
NOROX ENP-92	General purpose MEKP, faster gel than Norox KP-100	9,8		30	60	●	●	●						○			○				
NOROX ENP-95	General purpose MEKP with medium reactivity	9,5		30	60	●	●	●	○	●				●			●				
Acetylacetone peroxide (CAS No. 37187-22-7)																					
NOROX PD-40 *	Standard AAP	4,1		0 – 25	>65	●	●	●				●		●			●				
NOROX DEP	Low exotherm temp AAP with longer gel & cure for thicker laminates	3,1		5 – 25	>70	●	●	○				●		●							
NOROX RTM-12	Two step AAP for RTM at elevated temperature with cobalt	4,7		0 – 25	60									●			●				
NOROX FC-100	AAP with improved cure performance	4,5		0 – 25	60	●	●					●		●			●				
NOROX WPC-100	AAP for potable water application with improved cure performance	3,9		0 – 25	60	●	●					●		●			●				
Methyl isobutyl ketone peroxide (CAS No. 37206-20-5)																					
NOROX Pulcat S	MIBKP in aliphatic hydrocarbons	10,5		max 25	50		○	○					○				●	●		○	
Others (CAS No. 1338-23-4)																					
NOROX MEC	Similar gel time but faster cure than KP-9, premium initiator for gelcoats	9,7		30	60	●	●		●			●	●	●							
HYDROPEROXIDES																					
Cumyl hydroperoxide (CAS No. 80-15-9)																					
NOROX CHP	80-85%, low exotherm temperature for thicker laminates	8,5	80 – 85	30	>76	○	○					○					○			●	
NOROX CHM-50 *	Promoted CHP for fast curing of some VE resins	4,5		30		●	●					●		●			○			●	
NOROX MCP *	Lower exotherm temp, longer gel & cure than MCP-75, for thicker laminates	8,8		30	60	●	●					●		●						●	
NOROX MCP-99 *	Similar to MCP-75 but with faster gel time, for thicker laminates	9,3		30	60	●	●					●		●							
NOROX MCP-75 *	Lower exotherm temp, long gel time, good final cure, for thicker laminates	8,9		30	60	●	●					●		●						○	
NOROX KP-LE *	Lower exotherm temperature for thicker laminates, similar geltime as KP-9	8,8		30	60	●	●					●		●							

* Available as colored-discolorizing system for improved homogenization during mixing. Natural resin color is restored during curing (optional).

● = Recommended application ○ = Other possible application

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DIACYL PEROXIDES		%	%	°C	°C	AMBIENT								ELEVATED				HIGH			
Dibenzoyl peroxide (CAS No. 94-36-0)																					
BENOX L-40LV	40%, sprayable BPO dispersion	2,6	40	0 – 25	>50	●		●		●	●	●	●	●						●	●
BENOX C-50S	50 % BPO powder with phtalate, free flowing	3,3	50	30	60	●		●		●	●		●	●						●	●
BENOX A-75	75% BPO granules in water	5,0	75	0 – 25	>65	●		●													●
PERESTERS																					
tert-Butylperbenzoate (CAS No. 614-45-9)																					
NOROX TBPB	High efficient perester, lowest residual styrene levels	8,1	>98	10 – 25	60									●	●	●		●	●	●	
NOROX P-20	Promoted TBPB for elevated temperature processes	6,6	80	10 – 25	60							●		●	●	●		●	●	●	
tert-Butylperoxy-2-ethylhexylcarbonate (CAS No. 34443-12-4)																					
NOROX 400	High efficient, low TOC-emission	6,4	97	max 20	70													●	●	●	
tert-Butylperoxy-2-ethylhexanoate (CAS No. 3006-82-4)																					
NOROX 410	Fast curing perester for reduced cycle times	7,3	99	max 10	40										●			●	●		
tert-Butylperoxy-3,5,5-trimethylhexanoate (CAS No. 13122-18-4)																					
NOROX 425	High efficient perester, drinking water application	6,9	99	max 20	60										●	●		●	●	●	
NOROX 425 PR	Promoted TBPIN for elevated temperature processes	6,3	90	max 20	55							●		●	●	●		●	●	●	
PEROXYDICARBONATES																					
Di(4-tert.butylcyclohexyl) peroxydicarbonate (CAS No. 15520-11-3)																					
NOROX 600	Fast kick off peroxide for two step curing	3,8	>96	max 20	45								●		●			●	●		●
NOROX 600-CL2	Fast kickoff peroxide blend, low burning rate	3,5	mix	20	45										●			●			●
PERKETALS																					
1,1-Di(tert.butylperoxy)cyclohexane (CAS No. 3006-86-8)																					
NOROX 505-80	Hot curing initiator, long pot life, less affected by fillers and pigments	9,7	80	30	60													●	●		
1,1-Di(tert.butylperoxy)-3,3,5-trimethylcyclohexane (CAS No. 6731-36-8)																					
NOROX 500-90	Most efficient perketale	9,5	90	30	60													●	●		
NOROX 802-75	Accelerated curing performance	5,8	mix	max 20	50													●	●		

● = Recommended application ● = Other possible application

Safety Information

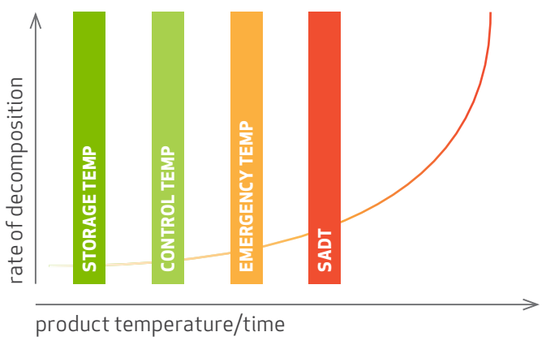
Half-life

Decomposition rates of peroxides are commonly reported in terms of half-life time. The half-life time is a measure of a peroxide's rate of decomposition at a certain temperature. It indicates the time when 50% of the peroxide has decomposed. The thermal stability of organic peroxides is commonly characterised by giving the temperature at which the half-life time of the product is 10 hours, 1 hour and 1 minute. The higher the temperature corresponding to the half-life, the more stable the peroxide. Half-life temperatures can vary based on the manner in which they are determined, especially the solvent used.

The half-life time can be derived from the Arrhenius equation:

$$k_d = A \cdot e^{-E_A/RT} \text{ and } t_{1/2} = \ln(2/k_d)$$

k_d: Rate constant of the peroxide dissociation
A: Arrhenius frequency factor
E_A: Activation energy for the dissociation
R: Ideal gas constant
T: Temperature
$t_{1/2}$: Half-life time



No single parameter is as important as the control of the temperature. Whether shipping, handling or storing, if the temperature is maintained well below its self-accelerating decomposition temperature (SADT), most hazards are avoided. For storage over a longer period of time, the manufacturer's recommended temperature for storage should be rigorously followed.

Self-Accelerating Decomposition Temperature (SADT)

The SADT is the lowest temperature at which selfaccelerating decomposition occurs for a peroxide formulation in its packaging used for transport when held at that temperature. At the SADT, the rate of evolution of heat from decomposition exceeds the rate of heat loss to the surroundings so that the peroxide's temperature increases with time and the decomposition becomes increasingly more rapid or selfaccelerating. The final decomposition may be uncontrollable.

Minimum/Maximum recommended storage temperatures

The maximum recommended storage temperature is lower than the control temperature, not for safety, but to maintain product quality. On the other hand, some liquid or paste organic peroxides must not be stored below a certain minimum temperature as turbidity, phase separation, crystal deposits or solidification can occur.

Control Temperature T_C

The T_C is the maximum temperature at which the product can be safely transported for an extended period of time. T_C is not required if the SADT exceeds 50°C (122°F). Generally the T_C is derived from the SADT as shown for canisters:

T_C = SADT minus 20°C if SADT < 20°C
T_C = SADT minus 15°C if SADT < 35°C
T_C = SADT minus 10°C if SADT < 50°C

Transportation temperatures are derived from the SADT according to the recommendations by the UN Committee of Experts on the Transport of Dangerous Goods.

Emergency Temperature T_e

The Control Temperature T_C is supplemented by an Emergency Temperature T_e which is higher than the T_C but still well below the SADT. The T_C may be exceeded if maintenance is necessary or until alternative cooling (e.g. dry ice or wet ice) is available. However, if the Emergency Temperature T_e is reached, emergency procedures must be implemented immediately, e.g. cooling down the organic peroxides.

	PRODUCT CODE	CHEMICAL NAME	STORAGE TEMP	EA [KJ/MOL]	HALF LIFE TIME [°C] 10 H	1 H	1 MIN
	DIPND	Di(2-neodecanoylperoxy-isopropyl)benzene	●	114	37	54	85
	CUPND	Cumylperoxy-neodecanoate	●	115	38	55	90
	TOPND	1,1,3,3-Tetramethylbutylperoxy-neodecanoate	●	117	40	57	92
	TAPND	tert. Amylperoxy-neodecanoate	●	113	44	62	100
	*)	Peroxydicarbonates	●	144	47	61	90
	TBPND	tert. Butylperoxy-neodecanoate	●	121	47	64	100
	TBPNH	tert. Butylperoxy-neoheptanoate	●	116	51	69	107
	TAPPI	tert. Amylperoxy-pivalate	●	121	53	71	110
	DCLBP	Di(2,4-dichlorobenzoyl)peroxide	●	121	54	72	110
	TBPPI	tert. Butylperoxy-pivalate	●	121	56	74	110
	INP	Di(3,5,5-trimethyl-hexanoyl)peroxide	●	117	59	78	120
	DP	Didecanoyl-peroxide	●	126	62	80	120
	LP	Dilauroyl-peroxide	●	126	62	80	120
	AIBN	2,2'Azobis(isobutyronitrile)	●	130	62	80	120
	DHPEH	2,5-Dimethyl-2,5-di(2-ethylhexanoylperoxy)hexane	●	137	67	84	125
	APS	Ammoniumperoxodisulfate	●	135	69	87	125
	PMBP	Di(4-methylbenzoyl)peroxide	●	125	70	89	130
	BP	Dibenzoyl-peroxide	●	126	72	91	130
	TAPEH	tert.Amylperoxy-2-ethylhexanoate	●	126	72	91	130
	NOROX 410	tert.Butylperoxy-2-ethylhexanoate	●	135	74	92	130
	TBPIB	tert.Butylperoxy-isobutyrate	●	130	77	96	135
	TBPM	tert.Butyl-monoperoxy-maleate	●	116	82	104	150
	NOROX Pulcat S	Methylisobutylketoneperoxide	●	125	90	110	155
	TAPEHC	tert.Amylperoxy-(2-ethylhexyl)carbonate	●	151	95	113	150
	NOROX 500-50	1,1-Di(tert.butylperoxy)-3,5,5-trimethyl-cyclohexane	●	143	95	114	155
	NOROX 505-80	1,1-Di(tert.butylperoxy)cyclohexane	●	138	97	117	160
	TBPIC	tert.Butylperoxy-isopropylcarbonate	●	138	97	117	160
	NOROX 425	tert.Butylperoxy-3,5,5-trimethyl-hexanoate	●	147	100	119	160
	DHPBZ	2,5-Dimethyl-2,5-di(benzoylperoxy)hexane	●	147	100	119	160
	NOROX 400	tert.Butylperoxy-(2-ethylhexyl)carbonate	●	128	100	122	175
	TBPA	tert.Butylperoxy-acetate	●	149	102	121	160
	TAPB	tert.Amylperoxy-benzoate	●	143	102	122	160
	NOROX TBPB	tert.Butylperoxy-benzoate	●	143	104	124	165
	BU	2,2-Di(tert.butylperoxy)butane	●	143	104	124	165
	NBV	n-Butyl-4,4-di(tert.butylperoxy)valerate	●	141	110	131	175
	EBU	Ethyl-3,3-di(tert.butylperoxy)butyrate	●	144	114	135	180
	DCUP	Dicumyl-peroxide	●	152	116	136	175
	BCUP	tert.Butylcumyl-peroxide	●	154	118	138	180
	DTAP	Di(tert.amyl)peroxide	●	129	118	142	190
	DIPP	Di(2-tert.butylperoxy-isopropyl)benzene	●	142	120	142	190
	DHBP	2,5-Dimethyl-2,5-di(tert.butylperoxy)hexane	●	142	120	142	190
	DTBP	Di(tert.butyl)peroxide	●	152	125	146	190
	DYBP	2,5-Dimethyl-2,5-di(tert.butylperoxy)hexyne-3	●	154	128	149	195
	HMCN	3,3,6,6,9,9,-Hexamethyl-1,2,4,5-tetraoxa-cyclononane	●	146	135	158	205
	TBHP	tert.Butyl-hydroperoxide	●	149	173	200	260
	CUROX CC-DC	2,3-Dimethyl-2,3-diphenylbutane	●	195	210	234	285

*) PEROXYDICARBONATES					
EHPC	Di(2-ethylhexyl)peroxydicarbonate	●	CHPC	Dicyclohexylperoxydicarbonate	
SBPC	Di(sec-butyl)peroxydicarbonate	●	NBPC	Di(n-butyl)peroxydicarbonate	
NOROX 600	Di(4-tert.butylcyclohexyl)peroxydicarbonate	●	MYPC	Dimyristylperoxydicarbonate	
CEPC	Dicetylperoxydicarbonate	●			

Colour code for storage temperature:
● = Deep refrigeration ● = Moderate refrigeration ● = Ambient temperature
For precise values see specific product data sheets

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