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NOROX[®]

Thermoset – Americas

PRODUCT CODE	DESCRIPTION	ACTIVE OXYGEN CONTENT	PEROXIDE CONTENT	SAFETY DATA	Recommended max. storage temp.	APPLICATION TEMPERATURE	Casting/Winding	Polymer Concrete & Marble, Buttons	Gel coats	Body Fillers	Chemical Anchors & Mine bolts	RTM, vacuum infusion	Cultured Marble	RTM	Cured In Place Pipes (CIPP)	Engineered Stone	Closed Molding	Continuous Laminating	Pultrusion	SMC, BMC, GMC, TMC	SPECIAL RESINS	Vinylesters	Acrylics	
		%	%	°F/°C	°F/°C	AMBIENT									ELEVATED				HIGH					
Methyl ethyl ketone peroxide – CAS No 1338-23-4																								
NOROX MEKP-925H	High Dimer, lowest H ₂ O ₂ available, designed for VE resins & gel coats. Less foaming	8.9		140 / 60	86 / 30	●	●	●	●	●		●	●	●							●			
NOROX MEKP-925	High Dimer for VE & Iso UPR, higher peak exotherm, more thorough cure	8.9		140 / 60	86 / 30	●	●	●	●	●		●	●	●							●			
NOROX MEKP-950	Medium gel time for low HAP gel coats	8.9		140 / 60	86 / 30	●	●	●	●	●		●	●	●							●			
NOROX MEKP-9H	Longer gel time but same gel-to-cure time as MEKP-9; best for gel coat	8.9		140 / 60	86 / 30	●	●	●	●	●		●	●	●							●			
NOROX MEKP-9	Medium gel time, general purpose use	8.9		140 / 60	86 / 30	●	●	●	●	●		●	●	●							●			
NOROX MEKP-900	Fast gel time, general purpose lamination	8.9		140 / 60	86 / 30	●	●	●	NR	●		NR	●	NR							●			
NOROX MEKP-30	Diluted MEKP-9, best used for when more volume is needed for metering equipment	5.5		140 / 60	86 / 30	NR ²	NR ²	NR ²	NR	NR ²		NR	NR ²	NR							NR ²			
NOROX MEKP-30HD	Diluted MEKP-925, best used for more accurate metering in filled systems	5.5		140 / 60	86 / 30	NR ²	NR ²	NR ²	NR ²	NR ²		NR ²	NR ²	NR ²							NR ²			
NOROX KP 900 LE	MEKP/TBHP blend for exotherm control without sacrificing gel time	8.9		140 / 60	86 / 30	●	●	●	NR	●		●	●	NR							NR			
NOROX FS 100/9	Fastest gel time, medium cure. Winter use	8.9		140 / 60	86 / 30	●	●	●	NR	NR		NR	●	NR							NR			
NOROX TLC-88	MEKP-925H blend with TBPB, faster cure, higher peak exotherm	8.8		140 / 60	86 / 30	●	●	●	NR	●		●	●	●							●			
Acetylacetone peroxide – CAS No 37187-22-7																		●						
NOROX PD-40	Standard AAP	4.1		>149 / 65	86 / 30	●	●	●	NR ¹	●		●	●	●				●			●			
NOROX AZOX	Improved AAP for more consistent application	4.5		140 / 60	86 / 30	●	●	●	NR ¹	●		●	●	●				●			●			
NOROX RTM-12	Long gel time, moderate cure and peak for VRTM	4.7		131 / 55	86 / 30	●	●	●	NR ¹			●		●				●			●			
NOROX SHP-90	AAP/TBPB blend for more heat, faster cure	4.5		131 / 55	86 / 30	●	●	●	NR ¹	●		●	●	●							●			
NOROX SHP-40	Diluted SHP-90	3.6		131 / 55	86 / 30	●	●	●				●	●	●				●						
NOROX FC-100	AAP with improved cure performance	4.5		131 / 55	86 / 30	●	●	●	NR ¹	●			●	●				●			●			
NOROX 750	AAP/CHP blend for fast cure, controlled exotherm	5.6		140 / 60	86 / 30	●	●	●	NR ¹	●			●	●							●			
NOROX 757	Diluted 750 for more accurate metering	3.5		140 / 60	86 / 30								●	●							●			
NOROX CHAP-21	AAP/CHP blend for RTM, moderate gel time, fast cure, controlled exotherm	7		140 / 60	86 / 30	●	●	●	NR ¹	●		●	●	●				●			●			
Others – CAS No 1338-23-4																								
NOROX MEC-EX	Fast gel & cure as compared to MEKP; devolped for low temp gel & cure	8.9		140 / 60	86 / 30	●	●	●	NR	●			●											
NOROX MEC	Cures well in thin film, not affected by temperature change as much as MEKP	8.9		140 / 60	86 / 30	●	●	●	●	●		●	●	●										
Methyl isobutyl ketone peroxide – CAS No 37206-20-5															●		●		●					
NOROX PULCAT AMB	Non refrigerated kick off initiator, modified for low odor; anchor for ETA system	8.9		>140 / 60	86 / 30												●	●						
NOROX PULCAT AWM	Blend with MEKP-925 for faster start in continuous panel production	8.9		>140 / 60	86 / 30													●						
tert-Butyl hydroperoxide – CAS No 75-91-2												●		●									●	
NOROX TBHP	70% aqueous solution convenient source of free radicals when water is present	12.5	70	>176 / 80	86 / 30																			
Dicumyl peroxide – CAS No 80-43-3																								
NOROX DCP	An excellent source of free radical above 150°C for SMC/BMC use	5.9	99	>158 / 70	86 / 30													●	●					
HYDROPEROXIDES																								
Cumyl hydroperoxide – CAS No 80-15-9																								
NOROX CHP	80-85%, low exotherm temperature for thicker laminates	8.5		>169 / 76	86 / 30	●	●	●	NR			●	●	●	●	●	●	●	●		●			
NOROX CHP-90	High Assay CHP, low exotherm for thicker parts	9	86-90	>169 / 76	86 / 30	●	●	●	NR			●	●	●	●	●	●	●	●		●			
NOROX CHM-50	Promoted CHP for fast curing of some VE resins	4.5	80-85	140 / 60	86 / 30	●	●	●	NR			●	●	●		●	●	●	●		●			
NOROX MCP	Lower exotherm temp, longer gel & cure time than MCP-21. For thicker laminates	8.8		140 / 60	86 / 30	●	●	●	NR			●	●	●				●			●			
NOROX MCP-21	Lower exotherm temp, longer gel & cure time than MCP-75. For thicker laminates	8.9		140 / 60	86 / 30	●	●	●	NR			●	●	●				●			●			
NOROX MCP-75	Lower exotherm temp, long gel time, good final cure. For thicker laminates	8.9		140 / 60	86 / 30	●	●	●	●			●	●	●				●			●			
NOROX HDP	High Dimer version of MCP	8.8		140 / 60	86 / 30	●	●	●	NR			●	●	●				●			●			
NOROX HDP-75	High Dimer version of MCP -75	8.9		140 / 60	86 / 30	●	●	●	●			●	●	●				●			●			
NOROX 771	Faster gel time version of MCP -75	8.9		140 / 60	86 / 30	●	●	●	●			●	●	●				●			●			

4 NR¹ = Not recommended for gel coats without testing for color shift.
NR² = Not recommended simply to extend gel time in hot weather. Many times that practice will result in an "undercure" state that will turn into a "postcure" problem later.
Recommended products are one of the MEKP/CHP blends.

PRODUCT CODE	DESCRIPTION	ACTIVE OXYGEN CONTENT	PEROXIDE CONTENT	SAFETY DATA	Recommended max. storage temp.	APPLICATION TEMPERATURE																		
		%	%	°F/°C	°F/°C	AMBIENT									ELEVATED				HIGH		SMC, BMC, GMC, TMC SPECIAL RESINS			Acrylics
DIALKYL PEROXIDES																								
NOROX 305	Technically pure flake	4.0	99	122 / 50	86/30													●			●		●	
NOROX DTBP	An excellent source of free radicals above 100°C	10.8	99	167 / 75	81/27																			
NOROX DTAP	t-Amyl version of DTBP	8.7	96	194 / 90	81/27																			
Dibenzoyl peroxide – CAS No 94-36-0																								
BENOX L40LV	40%, sprayable BPO dispersion	2.6	40	>122 / 50	32-77/0-25	●	●	●	NR	●	●	●	●	●			●	●		●		●	●	
BENOX L-50 E	50% BPO low viscosity, fine particle paste	3.3	50	>122 / 50	50-77/10-25	●	●	●	NR	●	●			●							●	●		
BENOX B-50	50% BPO paste in white color	3.3	50	>122 / 50	50-77/10-25	●	●	●	NR	●	●			●							●	●		
BENOX B-55	55% BPO paste in a plasticizer	3.6	55	>122 / 50	50-77/10-25	●	●	●	NR	●	●											●		
BENOX C-50	50% BPO free flowing, non-caking powder with a phthalate ester plasticizer	3.3	50	140 / 60	86 / 30	●	●	●	NR	●	●			●							●	●		
BENOX A-80	80% BPO granules in water	5.2	78	>149 / 65	32-77/0-25	●	●	●	NR	●	●						●					●		
BENOX A-75	75% BPO granules in water	5.0	75	>149 / 65	32-77/0-25	●	●	●	NR	●	●						●					●		
BENOX A-70	70% BPO granules in water	4.5	70	>149 / 65	32-77/0-25	●	●	●	NR	●	●						●					●		
PERESTERS																								
tert-Butyl perbenzoate – CAS No 4511-39-1																								
NOROX TBPB	Efficient perester, "kicker", helps reduce residual styrene	8.1	>98	140 / 60	50-77/10-25		●						●		●	●	●	●	●	●	●			
NOROX P-20	Promoted TBPB for elevated temperature processes with cobalt; ETA sub for 410	6.6	80	140 / 60	50-77/10-25		●						●		●	●	●	●	●	●	●			
tert-Amyl perbenzoate – CAS No 614-45-9																								
NOROX TAPB	High efficient perester, lowest residual styrene levels	7.6	98	149 / 65	50-77/10-25		●						●		●	●	●	●	●	●	●			
tert-Butyl peroxy-2-ethylhexyl carbonate – CAS No 34443-12-4																								
NOROX 400	High efficient, low TOC-emission	6.4	97	158 / 70	max 68/20														●	●	●	●		
tert-Amyl peroxy-2-ethylhexanoate – CAS No 686-31-7																								
NOROX 401	t-Amyl version, better cure, lower residual styrene	6.2	97	131 / 55	max 68/20														●	●	●	●		
tert-Butyl peroxy-2-ethylhexanoate – CAS No 3006-82-4																								
NOROX 410	Fast curing perester for reduced cycle times	7.3	99	95 / 35	max 50/10										●				●	●	●	●		
NOROX 410-50 OMS	50% diluted in Odorless Mineral Spirits (OMS) for better metering	3.8	50	104 / 40	59/15										●				●	●	●	●		
tert-Amyl peroxy-2-ethylhexanoate – CAS No 686-31-7																								
NOROX 411	t-Amyl version for lower residual stryene, better cure	7.3	99	104 / 40	max 68/20										●				●	●	●	●		
NOROX 411-75 OMS	25% dilution in OMS for better metering	5.2	75	95 / 35	50/10										●				●	●	●	●		
tert-Butyl peroxyperneodecanoate – CAS No 26748-41-4																								
NOROX 420-75 OMS	75% solution in OMS, fast starter, economical	6.2	75	59 / 15	23/-5														●	●	●	●		
tert-Butyl peroxy-3,5,5-trimethylhexanoate – CAS No 13122-18-4																								
NOROX 425	Environment friendly, high efficient perester, drinking water application	6.9	99	140 / 60	max 68/20										●		●		●	●	●	●		
NOROX 425 PR	Promoted TBPIN for elevated temperature processes	6.3	90	131/55	max 68/20							●		●	●	●	●		●	●	●	●		
PEROXYDICARBONATES																								
Di(4-tert.butylcyclohexyl)peroxydicarbonate – CAS No 15520-11-3																								
NOROX 600	Fast kick off peroxide for two-step curing	3.8	>96	113 / 45	max. 68/20								●		●		●		●	●	●			
NOROX 600CL2	Class II – Fast kick off peroxide for two step curing	3.55	89	104 / 40									●		●		●		●	●	●			
Dimyrisyl peroxydicarbonate – CAS No 53220-22-7																								
NOROX 605	Technically pure flake, low kick off temperature, economical	3	97	95 / 35	max 68/20										●				●	●				
NOROX TBIC	Most efficient styrene scavenger	6.8	75	140 / 60	81/27												●		●	●				
PERKETALS																								
1,1-Di(tert.butylperoxy)cyclohexane – CAS No 3006-86-8																								
NOROX 505-80 OMS	Hot curing initiator, long pot life, less affected by fillers and pigments	9.7	80	140 / 60	86/30															●				
1,1-Di(tert.amylperoxy)cyclohexane – CAS No 15667-10-4																								
NOROX 510-80 OMS	Hot curing initiator, long pot life, less affected by fillers and pigments	8.8	80	131/55	86/30															●				
1,1-Di(tert.butylperoxy) 3,3,5-trimethylcyclohexane – CAS No 6371-36-8																								
NOROX 500-75 OMS	Most efficient perketal, diluted version	5.3	75	158 / 70	86/30											●		●		●	●	●		
NOROX 802-75P	Most useful for pigmented systems above 100°C for Pultrusion, SMC/BMC	6.3	75	104 / 40	59/15											●								

● = Preferred for the application
 ● = Recommended for the application
 ● = Other possible application
 NR = Not recommended

Safety Information

Half-life

Peroxide decomposition rates are commonly reported in terms of half-life time or when 50% of the peroxide has decomposed at a certain temperature. Recommended organic peroxide heat temperatures commonly reflect the half-life time at 10 hours, 1 hour and 1 minute. The higher the half-life temperature, the more stable the peroxide. Half-life temperatures can vary based on formulations and solvents.

Using the Arrhenius equation, acronyms related to half-life time include:

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

k_d : Rate constant of the peroxide dissociation

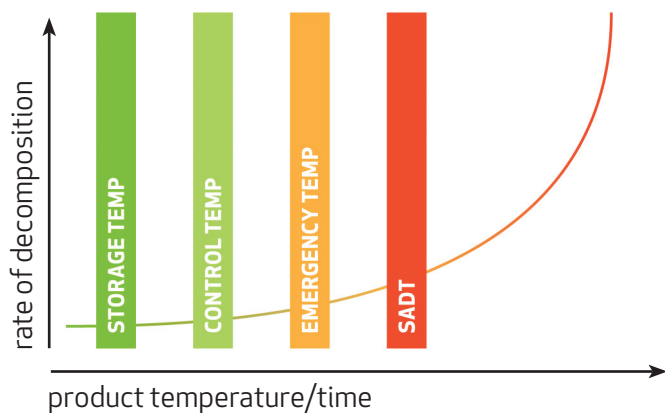
A: Arrhenius frequency factor

E_A : Activation energy for the dissociation

R: Ideal gas constant

T: Temperature

$t_{1/2}$: Half-life time



Controlling the temperature is the most important constant. If the temperature is maintained well below its self-accelerating decomposition temperature (SADT), most hazards are avoided when shipping, handling or storing. For storage over a longer period of time, follow the manufacturer's temperature recommendations.

Self-Accelerating Decomposition Temperature (SADT)

The SADT is the lowest constant temperature for self-accelerating decomposition when transporting packaged peroxides. At the SADT, when elevated heat temperatures from decomposition exceed the heat loss, over time, the peroxide's temperature increases and it decomposes faster or self accelerates. The final decomposition may be uncontrollable.

Minimum/Maximum recommended storage temperatures

The maximum recommended storage temperature is lower than the control temperature for quality assurance purposes not safety. Keep in mind, 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 transportation temperature recommended for the product's estimated time of arrival. T_c is not required if the SADT exceeds 50°C (122°F). Generally, the T_c mirrors SADT canister guidelines:

$$T_c = \text{SADT minus } 36^\circ\text{F if SADT} < 68^\circ\text{F}$$

$$T_c = \text{SADT minus } 27^\circ\text{F if SADT} < 95^\circ\text{F}$$

$$T_c = \text{SADT minus } 18^\circ\text{F if SADT} < 122^\circ\text{F}$$

SADT transportation temperatures are based on 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 such as dry or wet ice is available. However, if the T_e is reached, emergency procedures must be implemented immediately – for instance, cooling down the organic peroxides.

PRODUCT CODE	CHEMICAL NAME	STORAGE TEMP	EA [KJ/MOL]	HALF LIFE TIME [°F/°C]		
				10H	1H	1MIN
BENOX	Dibenzoyl-peroxide	●	126	162 / 72	196 / 91	266 / 130
NOROX 305	Dilauroyl-peroxide	●	126	144 / 62	176 / 80	248 / 120
NOROX 401	tert.Amylperoxy-(2-ethylhexyl)carbonate	●	151	203 / 95	235 / 113	302 / 150
NOROX 415	2,5-Dimethyl-2,5-di(2-ethylhexanoylperoxy)hexane	●	137	153 / 67	183 / 84	257 / 125
NOROX 411	tert.Amylperoxy-2-ethylhexanoate	●	126	162 / 72	196 / 91	266 / 130
NOROX 410	tert.Butylperoxy-2-ethylhexanoate	●	135	165 / 74	198 / 92	266 / 130
NOROX 400	tert.Butylperoxy-(2-ethylhexyl)carbonate	●	128	212 / 100	252 / 122	347 / 175
NOROX 420-75	tert. Butylperoxy-neodecanoate 75% ASSAY	●	121	117 / 47	147 / 64	212 / 100
NOROX 425	tert. Butylperoxy-3,5,5-trimethyl-hexanoate	●	147	212 / 100	246 / 119	320 / 160
NOROX 425 PR	tert. Butylperoxy-3,5,5-trimethyl-hexanoate	●	147	212 / 100	246 / 119	320 / 160
NOROX 500-75	1,1-Di(tert.butylperoxy)-3,5,5-trimethyl-cyclohexane	●	143	203 / 95	237 / 114	311 / 155
NOROX 505-80	1,1-Di(tert.butylperoxy)cyclohexane	●	138	207 / 97	243 / 117	320 / 160
NOROX 510-80	1,1-Di(tert.amylperoxy)cyclohexane	●	135	188 / 87	222 / 106	305 / 152
NOROX AZOX	Acetylacetone Peroxide	●	N/A*	N/A*	N/A*	N/A*
NOROX CHP	Cumyl Hydroperoxide	●	>75**	300 / 149	358 / 181	424 / 218
NOROX DCP	Dicumyl-peroxide	●	152	241 / 116	277 / 136	347 / 175
NOROX DHBP	2,5-Dimethyl-2,5-di(tert.butylperoxy)hexane	●	142	248 / 120	288 / 142	374 / 190
NOROX DTAP	Di(tert.amyl)peroxide	●	129	244 / 118	288 / 142	374 / 190
NOROX DTBP	Di(tert.butyl)peroxide	●	152	257 / 125	295 / 146	374 / 190
NOROX MEKP	Methyl Ethyl Ketone Peroxides	●	N/A*	N/A*	N/A*	N/A*
NOROX Pulcat	Methylisobutylketoneperoxide	●	125	194 / 90	230 / 110	311 / 155
NOROX TAPB	tert.Amylperoxy-benzoate	●	143	216 / 102	252 / 122	320 / 160
NOROX TBIC	tert. Butylperoxy-isopropylcarbonate	●	138	207 / 97	243 / 117	320 / 160
NOROX TBPB	tert. Butylperoxy-benzoate	●	143	219 / 104	255 / 124	329 / 165
NOROX P-20	Accelerated tert. Butylperoxy-benzoate	●	143	192 / 89	226 / 108	261 / 127
NOROX TBHP	tert. Butyl-hydroperoxide		149	343 / 173	392 / 200	500 / 260
PEROXYDICARBONATES						
NOROX 600	Di(4-tert.butylcyclohexyl)peroxydicarbonate	●		106 / 41	135 / 57	194 / 90
NOROX 600CL2	Di(4-tert.butylcyclohexyl)peroxydicarbonate	●		125 / 52	152 / 67	212 / 100
NOROX 605	Dimyristylperoxydicarbonate	●		106 / 41	135 / 57	194 / 90
NOROX 608-75	Di(2-ethylhexyl)peroxydicarbonate 75% ASSAY	●		106 / 41	135 / 57	194 / 90

Color code for storage temperature:

● = Deep refrigeration ● = Moderate refrigeration ● = Ambient temperature

For precise values, see specific product data sheets.

*No single values are stated due to the multi-species nature of these products.

**Hydroperoxides can be autocatalytic, therefore activation energy can vary with conditions and no single value is stated.



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