



Crosslinking peroxides for elastomers and thermoplastics

—
Perkadox[®] and Trigonox[®]

Nouryon

A complete range of crosslinking peroxides

Nouryon's range of organic peroxides for the crosslinking of elastomers and thermoplastics is very extensive. Companies all over the world depend on our Trigonox® and Perkadox® organic peroxide brands. Why? Because they are an important ingredient in the production of everything from hi-tech automotive parts such as hoses and belts to shoe soles and power distribution cables.

Examples include:

- **Trigonox® 311**
PEX pipes, rotomolding
- **Trigonox® 145**
PEX pipes, rotomolding
- **Trigonox® 101**
PEX pipes, polymer modification, technical rubber goods
- **Trigonox® T**
wire & cable (direct peroxide injection)
- **Perkadox® 14**
wire & cable, technical rubber goods, footwear
- **Perkadox® BC**
wire & cable, footwear, technical rubber goods
- **Trigonox® 117 and Trigonox® 131**
for EVA and POE encapsulant films
- **Trigonox® 29**
for fast on-set of cure
- **Perkadox® PM-50S-ps**
extruded silicone rubber articles such as silicone rubber cable, seals & tubes (halogen free)

Much of our success is due to our philosophy of creating close partnerships with our customers. What do you want to achieve? From optimizing applications, improving efficiencies, resolving difficulties or even developing new crosslinking peroxides, we're happy to meet with you to discuss your requirements.

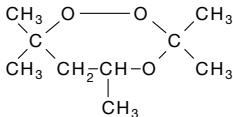
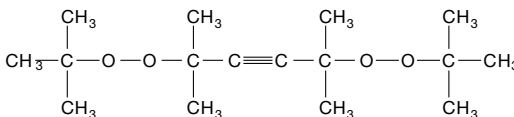
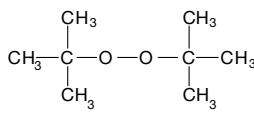
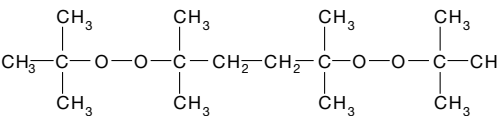
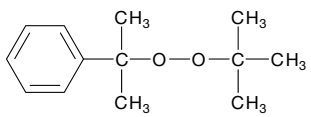
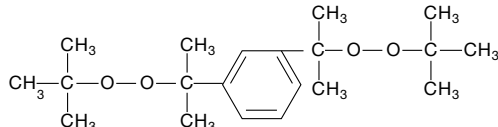
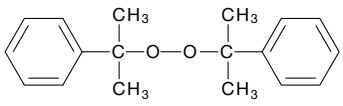
This product guide provides an overview of our main, commercially available crosslinking peroxides. We invite you to visit us at nouryon.com for complete product listings.

Formulations with phlegmatizers and carriers or concentrations other than those indicated, as well as unique custom made peroxide compositions can be made available with due observance of safety characteristics and the appropriate environmental and transportation regulations. Whatever your particular requirements, we can develop the product to match.



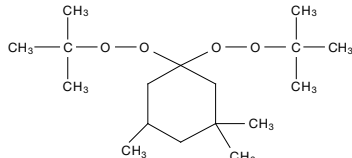
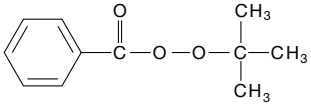
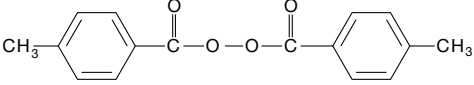
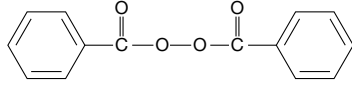
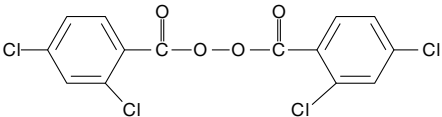
¹ Trigonox® B has a boiling point of 110°C and a flash point of 6°C. Therefore, it is not recommended for standard rubber mixing procedures carried out in closed mixers (kneeding mixer type) or on an open two-roll mill.

² Other concentrations are available on request

Product name	Chemical name [CAS no.]	Mol. weight	Assay (%)	Main carrier / solvent	Processing data	
					Safe processing temperature °C (°F)	Typical crosslink temperature °C (°F)
Trigonox 311	3,3,5,7,7-Pentamethyl-1,2,4-trioxepane [215877-64-8]	174.3	95		180 (356)	220 (428)
						
Trigonox 145-E85	2,5-Dimethyl-2,5-di(tert-butylperoxy)hexyne-3 [1068-27-5]	286.4	85	mineral oil	145 (293)	185 (365)
Trigonox 145-45B-PD			45	calcium carbonate		
						
Trigonox B ¹	Di-tert-butyl peroxide [110-05-4]	146.2	99		145 (293)	180 (356)
						
Trigonox 101	2,5-Dimethyl-2,5-di(tert-butylperoxy)hexane [78-63-7]	290.4	92		135 (275)	175 (347)
Trigonox 101-7.5PP ²			7.5	PP		
Trigonox 101-20PP ²			20	PP		
Trigonox 101-45B-PD			45	calcium carbonate/silica		
						
Trigonox T	tert-Butyl cumyl peroxide [3457-61-2]	208.3	95		135 (275)	175 (347)
						
Perkadox 14S-(FL)	Di(tert-butylperoxyisopropyl)benzene [25155-25-3; 2212-81-9]	338.5	98		135 (275)	175 (347)
Perkadox 14-40B-PD			40	calcium carbonate		
Perkadox 14-40K-PD-S			40	clay		
Perkadox 14-40MB-GR-S			40	EPR, calcium carbonate		
Perkadox 14-EP40			40	granules		
						
Perkadox BC-FF	Dicumyl peroxide [80-43-3]	270.4	99		130 (266)	170 (338)
Perkadox BC-40B-PD			40	calcium carbonate		
Perkadox BC-40K-PD			40	clay		
Perkadox BC-EP40			40	granules		
						



PD = powder
GR = granules
PS = paste
MB = EPR bound

Product name	Chemical name [CAS no.]	Mol. weight	Assay (%)	Main carrier / solvent	Processing data
					Safe processing temperature °C (°F) Typical crosslink temperature °C (°F)
Trigonox 17-40B-PD	Butyl 4,4-di(tert-butylperoxy)valerate [995-33-5]	334.5	40	calcium carbonate	125 (257) 160 (320)
					
Trigonox 117	tert-Butylperoxy 2-ethylhexyl carbonate [34443-12-4]	246.3	>98		120 (248) 150 (302)
					
Trigonox 29-40B-PD	1,1-Di(tert-butylperoxy)-3,3,5-trimethylcyclohexane [6731-36-8]	302.5	40	calcium carbonate	115 (239) 145 (293)
					
Trigonox C	tert-Butyl peroxybenzoate [614-45-9]	194.2	98		100 (212) 140 (284)
Trigonox C-40B-PD			40	calcium carbonate	
					
Perkadox PM-50S-PS	Di(4-methylbenzoyl) peroxide [895-85-2]	270.3	50	silicone oil	85 (185) 110 (230)
					
Perkadox L-50S-PS	Dibenzoyl peroxide [94-36-0]	242.2	50	silicone oil	85 (185) 105 (221)
					
Perkadox PD-50S-PS	Di(2,4-dichlorobenzoyl) peroxide [133-14-2]	380.0	50	silicone oil	75 (167) 90 (194)
					



Recommended dosage levels

Peroxide	Trigonox® 29-40	Trigonox® 17-40	Perkadox® BC-40	Perkadox® 14-40	Trigonox® 101-45
Safe processing temperature (°C)	115	125	130	135	135
Typical crosslink temperature (°C)	145	160	170	175	175
Polymer	parts of peroxide per 100 parts of polymer				
NR; IR	2.3 - 4.5	2.5 - 5.0	2.0 - 4.1	1.3 - 2.5	1.3 - 2.4
BR	1.0 - 2.1	1.1 - 2.3	0.9 - 1.9	0.5 - 1.2	0.5 - 1.2
CR	1.1 - 3.0	1.3 - 3.3	1.0 - 2.7	0.6 - 1.7	0.6 - 1.6
SBR	1.9 - 4.1	2.1 - 4.6	1.7 - 3.7	1.1 - 2.3	1.1 - 2.2
NBR	2.6 - 4.5	2.9 - 5.0	2.4 - 4.1	1.5 - 2.5	1.4 - 2.4
HNBR	6.8 - 11.3	7.5 - 12.5	6.1 - 10.1	3.8 - 6.3	3.7 - 6.1
POE ¹	6.8 - 11.3	7.5 - 12.5	6.1 - 10.1	3.8 - 6.3	3.7 - 6.1
EPDM ¹ ; EPDM	6.8 - 11.3	7.5 - 12.5	6.1 - 10.1	3.8 - 6.3	3.7 - 6.1
PE	1.5 - 7.6	1.7 - 8.4	1.4 - 6.8	0.8 - 4.2	0.8 - 4.0
CM ¹	6.8 - 10.6	7.5 - 11.7	6.1 - 9.5	3.8 - 5.9	3.7 - 5.7
EVA	2.6 - 5.3	2.9 - 5.8	2.4 - 4.7	1.5 - 3.0	1.4 - 2.9
Q ²			1.0 - 2.0	0.4 - 0.8	0.4 - 0.8

¹ Addition of a coagent is recommended.

² Silicone rubber can also be crosslinked with Perkadox® PD-50S, Perkadox® L-50S and Perkadox® PM-50S.

Required amounts of peroxide: 1.1 - 2.3 phr, 0.7 - 1.4 phr and 0.8 - 1.6 phr respectively.

Typical crosslink temperatures 90°C, 105°C and 110°C.

Peroxide versus sulfur crosslinking

Advantages of peroxide crosslinking in comparison to sulfur cure:

- Simple formulation.
- Relatively easy to trace decomposition products
- Storage of the peroxide-containing compound without bin scorch.
- High processing temperature.
- Rapid vulcanization without reversion.
- Good compression set, particularly at elevated temperatures.
- High temperature resistance.
- Limited extractable constituents from final product.
- No staining of the finished parts.
- No discoloration of crosslinked product by contact with metals and PVC.
- Most peroxides do not cause blooming.

- Co-vulcanization of saturated and unsaturated elastomers.
- Co-vulcanization of elastomers and thermoplastics.
- Copolymerization with polymerizable plasticizers or coagents to give controlled hardness and stiffness, coupled with easy processing.
- Zinc oxide-free formulations possible

Points of attention for peroxide crosslinking:

- Sensitivity to oxygen under curing conditions.
- Certain components of the rubber compound such as
 - fillers
 - extender oils
 - antioxidants
 - resins

must be selected with care because they may, under certain conditions, interfere with free radicals.

- Usually, tensile and tear strength properties are reduced by about 15%, when compared to a conventional sulfur based crosslinking system.
- Scorch and cure time are less flexible, since they are determined mainly by the temperature.
- During cure, some peroxides may lead to distinct odors.
- Post cure may be necessary.



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Additional information

Product Data Sheets (PDS) and Safety Data Sheets (SDS) for our polymer crosslinking products are available at nouryon.com

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