Crosslinking peroxides for elastomers and thermoplastics

Perkadox® and Trigonox®

Nouryon

The world's largest range of crosslinking peroxides

Nouryon's range of organic peroxides for the crosslinking of elastomers and thermoplastics is the world's largest. 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:

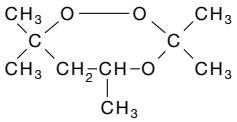
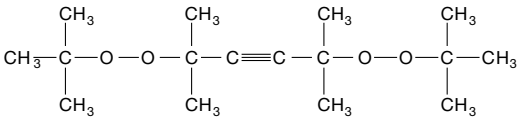
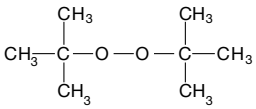
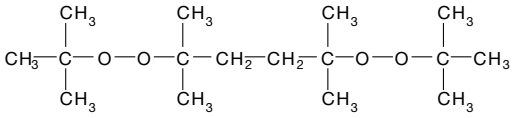
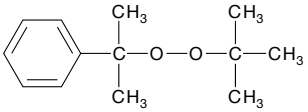
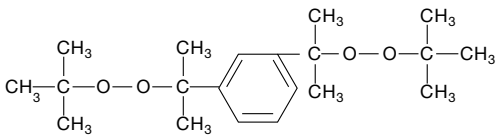
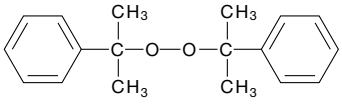
- **Trigonox 311**
  PEX pipes, rotomolding
- **Trigonox 145**
  PEX pipes, rotomolding
- **Trigonox 101**
  PEX pipes, polymer modification, technical rubber goods
- **Trigonox T**
  wire & cable (direct peroxide injection)
- **Perkadox 14**
  wire & cable, technical rubber goods footwear
- **Perkadox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

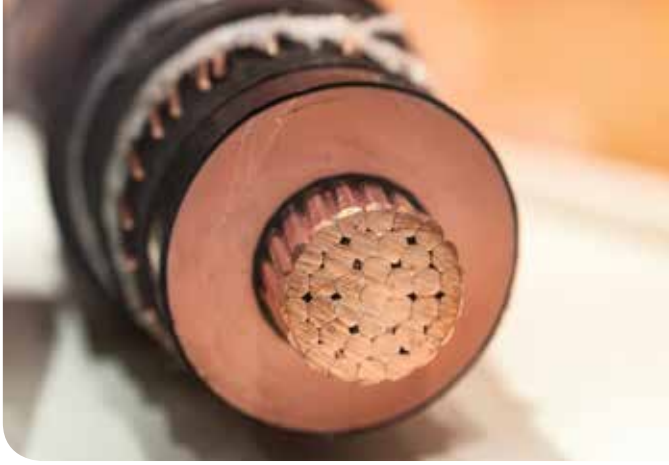
Much of our success is due to our philosophy of creating close partnerships with our customers. What do you want to achieve? From optimizing applications, improving efficiencies, resolving difficulties or even developing new crosslinking peroxides, we're happy to meet with you to discuss your requirements.

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

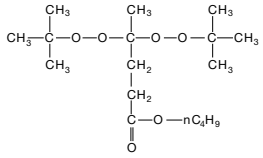
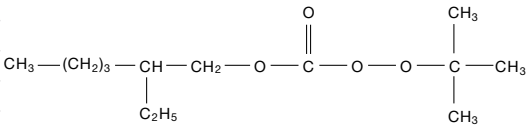
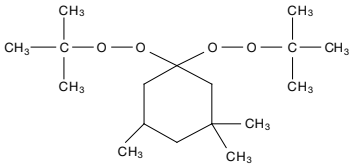
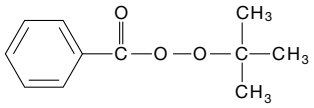
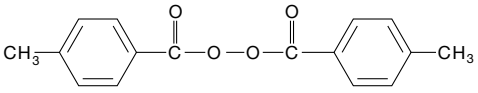
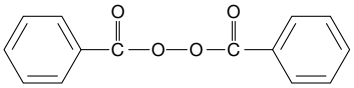
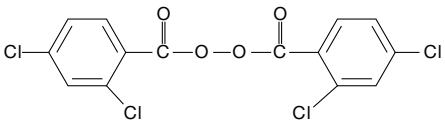
Formulations with phlegmatizers and carriers or concentrations other than those indicated, as well as unique custom made peroxide compositions can be made available with due observance of safety characteristics and the appropriate environmental and transportation regulations. Whatever your particular 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)	Processing data: Typical crosslink temperature (°C)
	3,3,5,7,7-Pentamethyl-1,2,4-trioxepane [215877-64-8]	174.3			180	220
Trigonox 311			95			
	2,5-Dimethyl-2,5-di(tert-butylperoxy)hexyne-3 [1068-27-5]	286.4			145	185
Trigonox 145-E85			85	mineral oil		
Trigonox 145-45B-PD			45	calcium carbonate		
	Di-tert-butyl peroxide [110-05-4]	146.2			145	180
Trigonox B [1]			99			
	2,5-Dimethyl-2,5-di(tert-butylperoxy)hexane [78-63-7]	290.4			135	175
Trigonox 101			92			
Trigonox 101-7.5PP-PD [2]			7.5	PP		
Trigonox 101-20PP-PD [2]			20	PP		
Trigonox 101-45S-PS			45	silicone oil		
Trigonox 101-45B-PD			45	calcium carbonat/silica		
	tert-Butyl cumyl peroxide [3457-61-2]	208.3			135	175
Trigonox T			95			
	Di(tert-butylperoxyisopropyl)benzene [25155-25-3; 2212-81-9]	338.5			135	175
Perkadox 14S-(FL)			98			
Perkadox 14-40B-PD			40	calcium carbonate		
Perkadox 14-40K-PD-S			40	clay		
Perkadox 14-40MB-GRS			40	EPR, calcium carbonate		
Perkadox 14-EP40			40	granules		
	Dicumyl peroxide [80-43-3]	270.4			130	170
Perkadox BC-FF			99			
Perkadox BC-40B-PD			40	calcium carbonate		
Perkadox BC-40K-PD			40	clay		
Perkadox BC-40S-PS			40	silicone oil		
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)	Processing data: Typical crosslink temperature (°C)
	Butyl 4,4-di(tert-butylperoxy)valerate [995-33-5]	334.5			125	160
Trigonox 17-40B-PD			40	calcium carbonate		
	tert-Butylperoxy 2-ethylhexyl carbonate [34443-12-4]	246.3			120	150
Trigonox 117			>98			
	1,1-Di(tert-butylperoxy)-3,3,5-trimethylcyclohexane [6731-36-8]	302.5			115	145
Trigonox 29-40B-PD			40	calcium carbonate		
	tert-Butyl peroxybenzoate [614-45-9]	194.2			100	140
Trigonox C			98			
Trigonox C-40B-PD			40	calcium carbonate		
	Di(4-methylbenzoyl) peroxide [895-85-2]	270.3			85	110
Perkadox PM-50S-PS			50	silicone oil		
	Dibenzoyl peroxide [94-36-0]	242.2			85	105
Perkadox L-50S-PS			50	silicone oil		
	Di(2,4-dichlorobenzoyl) peroxide [133-14-2]	380.0			75	90
Perkadox PD-50S-PS			50	silicone oil		

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
AU (ester type)	5.3 - 9.1	5.8 - 10.0	4.7 - 8.1	3.0 - 5.1	2.9 - 4.9
EPM; 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 1.1 - 2.3 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.
- 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.

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, consume 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.

Contact us

For product inquiry and ordering information, please contact your Nouryon account manager or regional Nouryon sales office.

Americas

US and other countries
Citadel Center
131 S Dearborn St, Suite 1000
Chicago IL 60603-5566
USA
T +1 800 828 7929 (US only)
E polymerchemistry.na@nouryon.com

Mexico
Av. Morelos No. 49
Col. Tecamachalco
Los Reyes La Paz Estado de Mexico
C.P. 56500 Mexico
T +52 55 5858 0700
E polymerchemistry.mx@nouryon.com

Brazil
Rodavia Nouryon no. 707
Portão A – Planta C
Bairro São Roque da Chave
13295-000 Itupeva - São Paulo
Brazil
T +55 11 4591 8800
E polymerchemistry.sa@nouryon.com

Europe, India, Middle East and Africa

France, Italy, Spain and Portugal
Autovia de Castelldefels, km 4.65
08820 El Prat de Llobregat
Barcelona
Spain
T +34 933 741991
E polymerchemistry.es@nouryon.com

India
North Block 801, Empire Tower,
Reliable Cloud City Campus,
Off Thane – Belapur Road
Airoli, Navi Mumbai - 400708
India
T +91(0) 22 68426700
E polymerchemistry.nl@nouryon.com

Middle East
Silicon park, Building A6
Office no 402, 4th floor
Dubai Silicon Oasis
Dubai
United Arab Emirates
T +971 4 2471500
E communications.me@nouryon.com

Russia and CIS
Smolnaya Str., 24D,
Commercial Tower Meridian
125445 Moscow
Russia
T +7 495 766 16 06
E info.moscow@nouryon.com

Other countries
Zutphenseweg 10
7418 AJ Deventer
The Netherlands
E polymerchemistry.nl@nouryon.com

Asia Pacific

22F, Eco City, 1788 West Nan Jing Road
Shanghai 200040
P.R. China
T +86 21 2220 5000
E polymerchemistry.ap@nouryon.com

Additional information

Product Data Sheets (PDS) and Safety Data Sheets (SDS) for our polymerization initiators are available at polymerchemistry.nouryon.com

All information concerning this product and/or suggestions for handling and use contained herein are offered in good faith and are believed to be reliable. Nouryon, however, makes no warranty as to accuracy and/or sufficiency of such information and/or suggestions, as to the product's merchantability or fitness for any particular purpose, or that any suggested use will not infringe any patent. Nouryon does not accept any liability whatsoever arising out of the use of or reliance on this information, or out of the use or the performance of the product. Nothing contained herein shall be construed as granting or extending any license under any patent. Customer must determine for himself, by preliminary tests or otherwise, the suitability of this product for his purposes. The information contained herein supersedes all previously issued information on the subject matter covered. The customer may forward, distribute, and/or photocopy this document only if unaltered and complete, including all of its headers and footers, and should refrain from any unauthorized use. Don't copy this document to a website.

Perkadox and Trigonox are registered trademarks of Nouryon Chemicals B.V. or affiliates in one or more territories.