



# Our Curing Systems for Thermoset Resins

**Nouryon**

# Nouryon is Your Partner in Essential Solutions for a Sustainable Future

Nouryon is a global, specialty chemicals leader. Markets and consumers worldwide rely on our essential solutions to manufacture everyday products, such as personal care, cleaning goods, paints and coatings, pharmaceuticals, agriculture and food, and building products. Furthermore, the dedication of approximately 8,200 employees with a shared commitment to our customers, business growth, safety, sustainability and innovation has resulted in a consistently strong financial performance. We operate in over 80 countries around the world with a portfolio of industry-leading brands.

Throughout our history, we built up a wealth of expertise, forged long-term partnerships, and earned a place among the best performing companies in our industry. Now that we're Nouryon, we're putting even greater focus on what it takes to be a global specialty chemicals leader

We are a responsible organization that takes its obligations seriously – to the planet, to our customers and to our own people. We believe the only way to grow is by developing sustainable, innovative solutions that benefit our customers and we're constantly looking for ways to reduce our impact on the environment.

Within our Polymer Specialties business, we produce everyday essentials for the global polymer and electronics industries. We are among the world's leading producers of organic peroxides, metal alkyls, organometallic specialties and polymer additives, which are essential ingredients for the thermoplastic, composite and rubber industries. We are widely known for our world-class products, including Butanox®, Cadox®, Perkadox®, Trigonox® and Ketjenblack® brands.

**Butanox®**  
**Trigonox®**

Our innovation continues unabated and we are leading the way with a new generation of sustainable thermoset accelerators. Our cobalt-free accelerators can be used as alternatives for conventional cobalt-based accelerators, simplifying compliance and helping the environment.

These products were developed as part of our continuous drive towards a more sustainable composites world. We strive to offer sustainable curing systems for all your applications.

Our cobalt-free accelerators may not be a one-to-one replacement for conventional cobalt octoate, but offer different curing characteristics which can be highly beneficial for your process. We have broad experience in most applications and offer our technical expertise to help tune your process to maximize performance.

## A global partner

Our manufacturing sites and distribution centers are found all around the globe. Our global distribution network allows us to deliver our products to you anywhere in the world. That's how we ensure security of supply and easy access to quality products wherever you are.

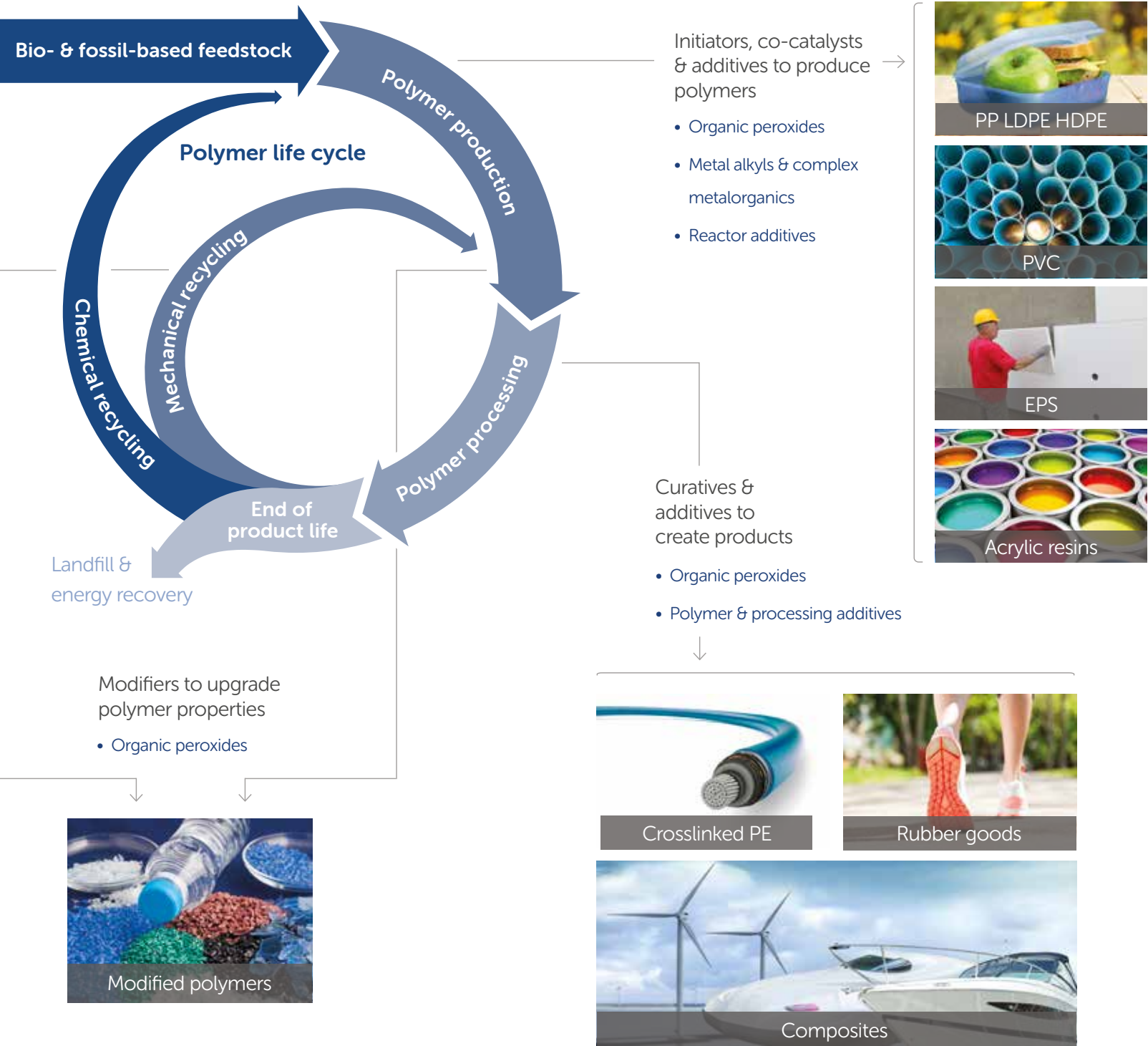
All our sites are ISO 9001 and ISO 14001 certified to ensure the highest product quality and strict compliance with environmental regulations. We continually invest in manufacturing techniques, high quality standards, safety, innovation, active technical support and a reliable supply chain.





# Enabling the Polymer Cycle

Building on a sustainability driven strategy. We provide essential ingredients to enable the polymer cycle.



# Nouryon

Your partner in essential solutions for a sustainable future

## Our Sustainability Ambition



We partner with our customers, suppliers and employees to deliver innovative solutions, drive progress and create a safe and sustainable today and tomorrow for everyone.

## Our Commitment to a Sustainable Future

		
<b>CONTINUOUSLY IMPROVE</b> our safety and environmental performance	<b>GROW AND INNOVATE</b> to create Sustainable Solutions, enabling customers to be more sustainable	<b>ENGAGE AND PARTNER</b> with employees, customers, suppliers, and society to drive sustainable progress



# Your Safety is Our Priority

We are recognized as the global leader in organic peroxide safety. Our proven success in safely handling organic peroxides is due to our long-term commitment to developing and maintaining high safety standards. We always place safety as our top priority.

Sharing our experience in safety is one of the most important resources we offer. Through our safety programs we provide expert advice on the handling of our products including:

- classroom review of how to safely handle organic peroxides
- consultation on storage and dosing facility design
- demonstrations on the safe use, handling and control of organic peroxides
- online E-learning module on safe handling and use of organic peroxides

Our Safety Research Laboratory in Deventer, The Netherlands is heavily involved in R&D, ensuring the development of safe products and processes. Studies are carried out, to provide a high level of safety in the manufacturing, handling and transport of dangerous goods.

In general, organic peroxides are thermally unstable components which can decompose at relatively low temperatures. However, knowledge of proper handling techniques, carefully designed facilities and thorough training of personnel can overcome the hazards. Personnel who understand and pay proper attention will be better able to handle organic peroxides confidently and safely.

## UN numbers

All products accepted for transport are assigned to generic entry numbers according to classification principles as described in the recommendations by the United Nations Committee of Experts on the Transport of Dangerous Goods. An explanation of all relevant UN numbers is given in Table 1.

## Storage temperatures

### SADT: Self-Accelerating Decomposition Temperature

The SADT is the lowest temperature at which self-accelerating decomposition may occur with a substance in the packaging as used in transport. Transportation temperatures are derived from the SADT according to the recommendations by the United Nations Committee of Experts on the Transport of Dangerous Goods.

### $T_{s \text{ max.}}$

The  $T_{s \text{ max.}}$  given in the product list on pages 8-10 is the recommended maximum storage temperature at which the product is stable and quality loss will be minimal.

### $T_{s \text{ min.}}$

A minimum storage temperature ( $T_{s \text{ min.}}$ ) is given if phase separation, crystallization or solidification of the product is known to occur below the temperature indicated. We recommend that you store the product above the  $T_{s \text{ min.}}$  indicated for quality and in some cases safety reasons.

### $T_{em}$ : Emergency temperature

The  $T_{em}$  is derived from the SADT and is the temperature at which emergency procedures must be triggered.

### $T_c$ : Control temperatures

The  $T_c$  is also derived from the SADT and is the maximum temperature at which the product can be safely transported. A  $T_c$  is not required if the SADT exceeds 50°C.

Both the  $T_{em}$  and  $T_c$  are related to safety and do not relate to product quality. To maintain product quality the recommended storage temperatures ( $T_{s \text{ min.}}$  and  $T_{s \text{ max.}}$ ) should be observed.

**In case of emergency please call  
+31 (0)570 679 211**

## Survey of thermal stability

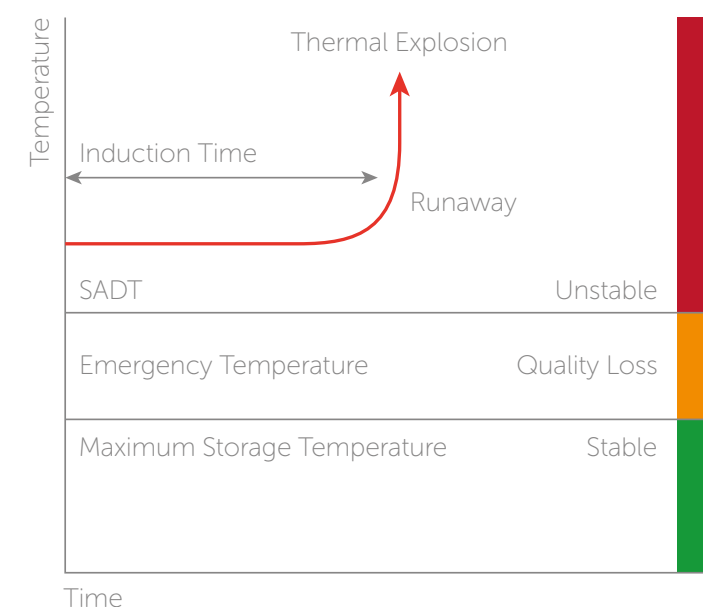


Table 1. Classification of curing agents

UN no.	Classification	Nouryon hazard rating	Maximum container size
<b>Organic peroxides</b>			
3103	type C; liquid	High	50 kg
3113	type C; liquid, temperature controlled	High	50 kg
3114	type C; solid, temperature controlled	High	50 kg
3105	type D; liquid	Medium	50 kg
3106	type D; solid	Medium	50 kg
3116	type D; solid, temperature controlled	Medium	50 kg
3107	type E; liquid	Low	400 kg
3108	type E; solid	Low	400 kg
3109	type F; liquid	Very low	IBC's / Tanks
3110	type F; solid	Very low	IBC's / Tanks
<b>Self-reactive substances</b>			
3234	type C; solid, temperature controlled	High	50 kg
3236	type D; solid, temperature controlled	Medium	50 kg

# Nourytainer® Packaging

## Your safety our priority

We are recognized as the global leader in organic peroxides. We always place safety as our top priority. Safety does not stop with our chemicals. As a company of innovation, we also understand the need to innovate our packaging. Our Nourytainer® HDPE can for example, the benchmark in safe handling, transport and storage of liquid organic peroxides.

We offer a variety of packaging options for both liquid and solid organic peroxides.

### Enhanced advantages and safety features

- Easy operating, screw cap anti-glug device
- Ergonomically designed handle for ease and safety of handling
- Opaque exterior to protect contents from harmful UV rays
- Shaped for promotion of optimal air circulation while stacked
- Unique interior features allow more complete drainage

Ventilation screw-cap to prevent splashing

4 interlocking points for improved stacking stability

2 types of caps

Made of 100% HDPE

Unique design that makes it fully drainable

Profile ribs on each corner to improve strenght

Grip-aid in the bottom for easy handling

2 special caps

Depending on the type of organic peroxide, we have developed special caps to meet all safety requirements

Venting cap

Membrane type

Standard cap

Closed cap type



**Size**  
20 liter: 324x324 mm  
30 liter: 337x424 mm

**Stable palletizing**  
4 interlocking points to improve palletizing

**Palletization on pallets of 1000x1200mm:**  
20 liter: 36 per pallet  
30 liter: 24 per pallet

**Ventilation**  
Temperature control is vital. Our Nourytainer is designed to have optimal air circulation when stacked.

## Directives for the safe handling and storage of organic proxides

### Storage

Organic peroxides should be protected against all sources of heat, even direct sunlight. Storage together with other chemicals, especially accelerators, other reducing materials and inflammable products must be avoided.

### Handling

#### Fire hazard

No smoking, no naked lights, no sparks, or other sources of ignition.

#### Explosion hazard

Avoid direct contact of organic peroxides with accelerators - add each component seperately to the resin. Contamination with dust, heavy metals and their compounds, as well as chemicals in general, should be avoided.

#### Eye and skin injury

Always wear safety goggles and protective gloves, since organic peroxides have a corrosive effect on eyes and skin.

### Additional information

On request we also provide specific publications on the use and the safe handling and storage of our products.



Check out our video about our safety services





# Butanox® M-50

## Track record of 60 years consistency

Nouryon is home to the best-known ketone peroxide brand, Butanox® M-50, the work horse of the thermoset composites industry. The material was introduced to the Thermoset composites industry in the 1960's and ever since has been the reference grade for MEKP's. The quality of Butanox® M-50 peroxide is outstanding and is the product of choice for most composite applications, such as boats, pipes, engineered stone, gelcoats and others.

### Quality in every step we take

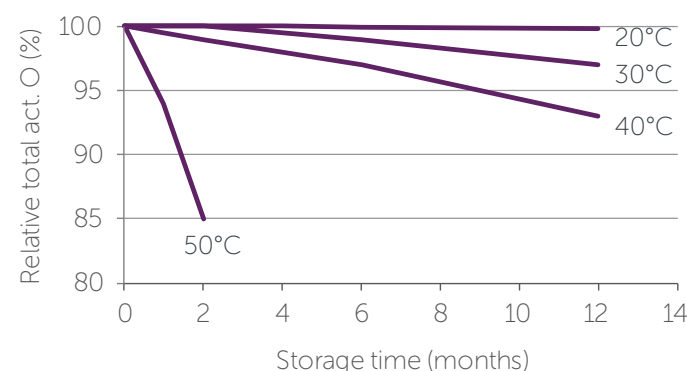
Our customers need to be able to rely on a cure system with reproducible consistent performance. They know Butanox® is the safe choice for more than 60 years.

Manufacturing a safe and high-quality ketone peroxide with consistent curing performance requires a lot of dedication and attention to detail. From the automated process to the raw materials used through the packaging and quality control systems employed we have mastered the art of producing consistent quality.

Butanox® is produced without additives and the absence of polar solvents making Butanox® products suitable for the most demanding applications, such as gelcoats. We pride ourselves on being so reliable in quality that many UP Resin manufacturers use our Butanox® products as the calibration standard to set the reactivity of their resins.

### Storage stability

The quality composition of Butanox® M-50 peroxide provides excellent storage stability which supports sales across the globe including areas with high ambient temperatures such as the Middle East. The higher temperatures in certain areas have limited effect on the quality as shown in stability graph below.



When kept according to recommended storage conditions, the products will remain in specifications for an extended time. Even if the product is exposed to slightly higher temperatures for a limited amount of time there is limited influence on the stability. The graph below is representative for Butanox® M-50 product, but not for other competitive MEKP grades on the market. Graph above is representative for Butanox® M-50 not for competitor's MEKP grades in the market.

**Butanox®**

### Vanishing Red, seeing is believing

Our Vanishing Red curing systems allows you to monitor the curing process without the disadvantages of red peroxides which stay red. With VRN, you can visually monitor curing conditions to improve efficiency and to help reduce cycle times.

The Vanishing Red series of organic peroxides includes a red in- dicator system that literally disappears in front of your eyes. The red color vanishes during the cure and is only there when you need it to monitor. When the red color has completely disappeared, it is safe to demold the fully cured part.



Advantages include:

- Monitoring of the cure progress in the mold
- Visualize thermal effects (hot/ cold spots) from core materials

In addition they indicate

- Initiator presence in the resin and dosing lines
- Good mixing (control on homogenous mixing in resin)
- Helps identify dead flow zones in the mold



Scan QR code to check our video on Vanishing Red

# Main Applications of Our Curing Agents

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Available in VRN version      Available as low cumene (LC) version      Industry standard      Added value - special purpose      • Alternative curing characteristics

Please contact us for advice on the best curing system for your specific application.



## Our Curing Agents

Product name	Assay (%)	Active Oxygen (%)	Physical form	Storage temperatures		SADT (°C)	UN no.	Reactivity	Features
				T <sub>s</sub> max. (°C)	T <sub>s</sub> min. (°C)				
Ketone peroxides									
Methyl ethyl ketone peroxide [1338-23-4]									
BUTANOX HBO-50		9.9	liquid, mixture in phthalate	25		65	3105	high	very short gel time
BUTANOX LPT-IN		8.5	liquid, mixture in phthalate	25		60	3105	very low	very long gel time
BUTANOX M-50		8.9	liquid, mixture in phthalate	25	-25	60	3105	medium	standard gel time, general purpose, optimal for gelcoats (high quality)
BUTANOX M-50 VRN		8.9	liquid, mixture in phthalate	25		55	3105	medium	vanishing red version, especially for cure control
BUTANOX M-60		9.9	liquid, mixture in phthalate	25		60	3105	medium	standard gel time, general purpose, slightly higher reactive then Butanox® M-50
BUTANOX M-60 VRN		9.9	liquid, mixture in phthalate	25		55	3105	medium	vanishing red version, especially for cure control
CADOX M-50A		8.9	liquid, mixture in aliphatic solvent	25		60	3105	medium	standard gel time, phthalate-free alternative for Butanox® M-50
Methyl isopropyl ketone peroxide [33372-83-7]									
BUTANOX P-50		6.4	liquid, mixture in phthalate	25	-10	50	3109	high	standard gel time, fast gelcoat cure, reduced VOC, good surface aspect
Acetylacetone peroxide (3,5-Dimethyl-1,2-dioxolane-3,5-diol) [37187-22-7]									
TRIGONOX 44B		4.1	liquid, mixture in solvents	25	-10	60	3107	high	standard gel time with very fast cure and hardness build-up
TRIGONOX 44B VRN		4.1	liquid, mixture in solvents	25	-10	60	3105	high	vanishing red version, especially for cure control
Peroxide mixtures									
Mixture of methyl ethyl ketone peroxide + acetylacetone peroxide [37187-22-7; 1338-23-4]									
TRIGONOX 61		7.8	liquid, mixture in phthalate	25	-10	50	3105	high	standard gel time, faster cure compared to Butanox® M-50
TRIGONOX 65		5.5	liquid, mixture in phthalate	25	-10	60	3105	high	standard gel time, fast cure, reactivity between Trigonox® 44B and Trigonox® 61
Methyl ethyl ketone peroxide and tert-butyl hydroperoxide [1338-23-4; 75-91-2]									
TRIGONOX 75 VRN		9.9	liquid, mixture in phthalate	25		60	3105	medium	standard gel time, reduced peak exotherm
TRIGONOX 82		8.5	liquid, mixture in phthalate	25	-20	60	3105	low	very long gel time, very low peak exotherm
TRIGONOX 82-30BA		2.6	liquid, mixture in phthalate	25		70	3105	low	diluted version on butyl acetate for spray application
Methyl ethyl ketone peroxide and cumyl hydroperoxide [1338-23-4; 80-15-9]									
TRIGONOX 249 VRN		8.5	liquid, mixture in phthalate	25		60	3105	low	longer gel time, reduced peak exotherm, also suitable in VE resins
TRIGONOX 249 VRN LC		8.5	liquid, mixture in phthalate	25		60	3105	low	longer gel time, reduced peak exotherm, also suitable in VE resins , low cumene
Acetylacetone peroxide and tert-butyl peroxybenzoate [614-45-9; 37187-22-7]									
TRIGONOX 279		4.5	liquid, mixture in solvents	25	-5	60	3105	high	standard gel time, very fast and efficient cure
TRIGONOX 524		4.9	liquid, mixture in solvents	25	-5	60	3103	high	longer gel time, fast and efficient cure at elevated temperatures
Diacyl peroxides									
Dibenzoyl peroxide [94-36-0]									
PERKADOX 20S	20	1.4	powder, mixture with inert fillers	25		70	3077	low	non ADR 5.2
PERKADOX 33	33	2.2	powder, mixture with inert fillers	25		60	3077	medium	non ADR 5.2
PERKADOX GB-50L	50	3.3	powder	25		55	3106	medium	low water content, clear applications, phthalate free
PERKADOX GB-50X	50	3.3	powder	25		55	3106	medium	general purpose, free flowing, phthalate free
PERKADOX L-40 RPS	40	2.6	suspension, mixture in solvents	25	5	50	3109	medium	low viscosity, very stable formulation, easy sprayable for road marking
PERKADOX L-W75	75	5.0	wet powder	40		70	3104	high	general purpose



# Our Curing Agents

Product name	Assay (%)	Active Oxygen (%)	Physical form	Storage temperatures		SADT (°C)	UN no.	Reactivity	Features
				T <sub>s</sub> max. (°C)	T <sub>s</sub> min. (°C)				
Dilauroyl peroxide [105-74-8]									
LAUROX	99	4.0	flakes	30		50	3106	high	acrylic curing
Peroxyesters									
tert-Butyl peroxybenzoate [614-45-9]									
TRIGONOX C	98	8.0	liquid	25	10	60	3103	low	general purpose
TRIGONOX 93	79	6.5	liquid, solution with Promotor™	25	-5	65	3103	medium	very efficient cure system, allowing lower process temperature
2,5-Dimethyl-2,5-di(2-ethylhexanoylperoxy)hexane [13052-09-0]									
TRIGONOX 141	>92	6.8	liquid	15	-20	35	3113	medium	very efficient for optimal surface aspect surface aspect in SMC/BMC
tert-Butyl peroxy-2-ethylhexanoate [3006-82-4]									
TRIGONOX 21S	97	7.2	liquid	20	-30	35	3113	medium	suitable as 'kicker' peroxide
tert-Butyl peroxy-3,5,5-trimethylhexanoate [13122-18-4]									
TRIGONOX 42S	97	6.7	liquid	25	-20	55	3105	medium	general purpose, non-hazardous decomposition products
TRIGONOX 42PR	89	6.2	liquid, solution with Promotor™	25	-20	55	3105	medium	very efficient cure system, allowing lower process temperature
Peroxyketals									
1,1-Di(tert-butylperoxy)-3,3,5-trimethylcyclohexane [6731-36-8]									
TRIGONOX 29-C90	90	9.52	liquid, solution in isododecane	25		60	3103	medium	for long compound shelf life and pigmented formulations, smooth curing, low VOC contribution phlegmatizer
TRIGONOX 77C		6.2	liquid, mixture in isododecane	25	0	60	3107	low	
1,1-Di(tert-butylperoxy)cyclohexane [3006-86-8]									
TRIGONOX 22-C50	50	6.1	liquid, solution in isododecane	25		70	3105	medium	for long compound shelf life and pigmented formulations, smooth curing
Hydroperoxides									
Cumyl hydroperoxide [80-15-9]									
TRIGONOX 239	44	4.6	liquid, mixture with Promotor™	25	-25	55	3109	high	suitable for curing VE resins, no gassing and low peak exotherm
TRIGONOX 239 LC	44	4.6	liquid, mixture with Promotor™	25	-25	55	3109	high	suitable for curing VE resins, low cumene
TRIGONOX 239C		5.0	liquid, mixture with Promotor™	25	-25	60	3103 <sup>1</sup>	high	efficient curing for VE resins at elevated temperature
TRIGONOX 239C LC		5.0	liquid, mixture with Promotor™	25	-25	55	3103	high	efficient curing for VE resins at elevated temperature, low cumene
TRIGONOX K-80	80	8.94	liquid, mixture in solvents	40	-25	75 <sup>2</sup>	3109	low	curing VE resins for thick parts
TRIGONOX K-90	88	9.3	liquid	40	-25	75 <sup>3</sup>	3109	low	curing VE resins for thick parts
TRIGONOX K-LC	92	9.7	liquid	40	-30	70	3109	low	curing VE resins for thick parts, low cumene
Peroxy(di)carbonates									
Di(4-tert-butylcyclohexyl) peroxydicarbonate [15520-11-3]									
PERKADOX 16	94	3.9	powder	20		40	3114	high	highest reactive peroxide for UPR curing, 'kicker' peroxide
PERKADOX 16S	94	3.9	powder	20		40	3114	high	for clear and transparent acrylic applications, faster solubility
tert-Butylperoxy isopropyl carbonate [2372-21-6]									
TRIGONOX BPIC-C75	75	6.8	liquid, solution in isododecane	25	-15	60	3103	medium	high efficiency, smooth cure
tert-Butylperoxy 2-ethylhexyl carbonate [34443-12-4]									
TRIGONOX 117	95	6.2	liquid	20		60	3105	low	high efficiency, smooth cure, low VOC

<sup>1</sup> UN 3019 for ADR

<sup>2</sup> < 200 kg packaging, 70°C for IBC and 70°C for Bulk

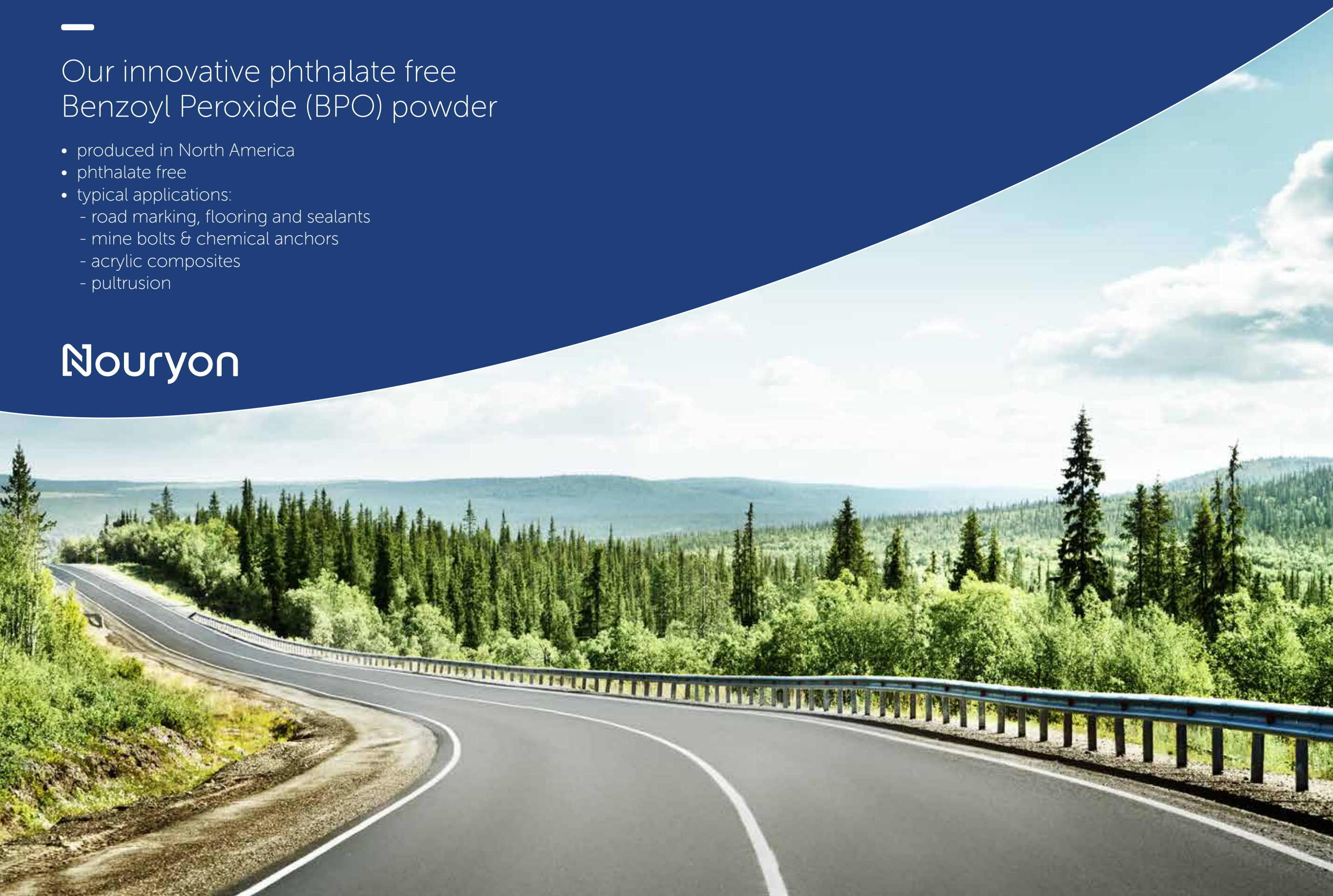
<sup>3</sup> < 200 kg packaging and 70°C for Bulk

# Perkadox<sup>®</sup> GB-50L/X

Our innovative phthalate free  
Benzoyl Peroxide (BPO) powder

- produced in North America
- phthalate free
- typical applications:
  - road marking, flooring and sealants
  - mine bolts & chemical anchors
  - acrylic composites
  - pultrusion

Nouryon





### Cobalt and cobalt-free auxiliaries

Butanox M-50® product is used for room temperature cure and is used in combination with a metal accelerator, often cobalt, like our Accelerator™ NL-49PN for example. cobalt however is subject to ECHA reclassification and may become a SVHC in due course. Nouryon is prepared for more sustainable metal accelerators and offers Nouryact® products from a cobalt-free accelerator portfolio.

This portfolio has been thoroughly tested and proven suitable for use in combination with all standard peroxide grades and in all standard available UP/VE and acrylic modified resins.



Nouryact® accelerators are ready made accelerators for direct use in a standard cure system. In case you need more freedom to formulate your resins cobalt-free there is the option to use the base technology for making cobalt-free resins. This is what BluCure® technology is about. The BluCure® technology is licensed out to resin manufacturers to enable them to formulate their resins to cobalt-free with the maximum degree of freedom to formulate. The BluCure® seal is an additional option for labelling your end product and clearly mark it as cobalt-free.



Check out our  
video about  
Biocomposites



## Our Range of Auxiliaries

Product name	Chemical name [CAS number]	Assay (%)	Description
<b>Cobalt-free accelerators</b>			
NOURYACT CF12N	Copper accelerator in solvent mixture		general use for room temperature cure, not sensitive to water traces
NOURYACT CF30	Iron accelerator in solvent mixture		for elevated temperature cure, such as engineered stone
NOURYACT CF40	Iron accelerator in 2-hydroxy-ethylmethacrylate		general purpose accelerator, little color impact
ACCELERATOR CF13	Copper accelerator in solvent mixture		high reactive, general use for room temperature cure
ACCELERATOR CF31	Metal mix in solvent mixture		high reactive, general use for room and elevated temperature cure
ACCELERATOR CF32	Metal mix in solvent mixture		high reactive, general use for room and elevated temperature cure
<b>Special cobalt accelerators</b>			
ACCELERATOR 383SN	Metal mix in solvent mixture	4	for less gel time drift in ISO/NPG resins, less sensitive to fillers
ACCELERATOR 553SN	Metal mix in solvent mixture	1.9	for non-gassing vinylester resin cure, less gettime drift
ACCELERATOR 55028N	Metal mix in aliphatic solvents	2.2	less sensitive to fillers (such as ATH)
<b>Cobalt accelerators</b>			
ACCELERATOR NL-49PN	Cobalt octoate [136-52-7]	1	mixture in solvents
ACCELERATOR NL-51PN	Cobalt octoate [136-52-7]	6	mixture in solvents
ACCELERATOR NL-53N	Cobalt octoate [136-52-7]	10	mixture in solvents
<b>Amine accelerators</b>			
ACCELERATOR NL-64-100	Diethyl aniline [91-66-7]	99	liquid, low reactive
<b>Inhibitors</b>			
INHIBITOR NLC-10	4-tert-Butyl-1,2-dihydroxybenzene [98-29-3]	10	in aliphatic solvents, for gel time extention, general purpose
<b>Promoters</b>			
PROMOTOR C	2,4-Pentanedione [123-54-6]	99	liquid, to increase reactivity, general purpose
PROMOTOR D	N,N-Diethylacetoacetamide [2235-46-3]	97	liquid, to increase reactivity, especially suitable for vinylesters
<b>Release agents</b>			
RELEASE AGENT NL-1	Mixture of waxes [64742-82-1]		in odorless mineral spirits, wax



# 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 [polymer.amer@nouryon.com](mailto:polymer.amer@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 [polymer.es@nouryon.com](mailto:polymer.es@nouryon.com)

### Other countries

Zutphenseweg 10  
7418 AJ Deventer  
The Netherlands  
E [polymer.emeia@nouryon.com](mailto:polymer.emeia@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 [polymer.mx@nouryon.com](mailto:polymer.mx@nouryon.com)

### India

North Block 102, 1st Floor, Empire Tower  
Reliable Cloud City Campus  
Off Thane – Belapur Road, Airoli  
Navi Mumbai – 400708 Maharashtra  
India  
T +91(0) 22 68426700  
E [polymer.india@nouryon.com](mailto:polymer.india@nouryon.com)

### Asia Pacific

Room 2501 & 26F, Building A  
Caoheijing Center  
No. 1520 Gumei Road, Xuhui District  
Shanghai 200233  
P.R. China  
T +86 21 2289 1000  
E [polymer.india@nouryon.com](mailto:polymer.india@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 [polymer.sa@nouryon.com](mailto:polymer.sa@nouryon.com)

### Middle East

Nouryon Saudi Arabia  
King Saud Road, Kanoo Tower  
P.O. Box 37  
31411 Dammam  
Saudi Arabia  
T + 96 61383 46526  
E [communications.me@nouryon.com](mailto:communications.me@nouryon.com)



## The first online safety training for Thermoset

We offer an interactive E-learning module with certification in 12 languages to all our customers. Please ask your Nouryon representative to be enrolled to the course.

## Additional information

Product Data Sheets (PDS), Safety Data Sheets (SDS) and ISO Certificates are available at [nouryon.com](http://nouryon.com) and you can follow us @Nouryon and on LinkedIn.

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