Initiators for Acrylics Manufacturing

Nouryon

Nouryon Creates Everyday Essentials

Nouryon is your partner in essential solutions for a sustainable future

We are 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, agriculture and food, pharmaceuticals, 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.

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

Trigonox®

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.

Empowering the Polymer Cycle

Building on a sustainability driven strategy. We deliver essential ingredients that enhance and support the polymer cycle.

Contributing to a Sustainable Future

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,' is based on three pillars:

CONTINUOUSLY IMPROVE

our safety and environmental performance

GROW AND INNOVATE

to create sustainable solutions enabling customers to be more sustainable

ENGAGE AND PARTNER

with employees, customers, suppliers, and society to drive sustainable progress

Our effort to **IMPROVE** our environmental performance includes ambitious targets:

Safety ambition: zero injuries and harm
2030
By the end of 2030, we have targeted reducing our absolute Scope 1 & 2 Greenhouse Gas (GHG) emissions by **40%**, vs. a 2019 base year
By the end of 2030, we have targeted reducing our total waste intensity by **10%**, and water consumption intensity by **10%**, vs. a 2019 base year
2050
By 2050, we aspire to be a **net zero** organization

Polymerization Initiators for Acrylics

Laurox®, Perkadox®, Trigonox®

Nouryon's range of organic peroxides for the manufacture of acrylics is the world's largest. We cover classes such as peroxy(di) carbonates, diacyl peroxides, peroxyketals, peroxyesters, dialkyl peroxides and hydroperoxides. In addition we supply azo (N=N) and carbon-carbon (C-C) initiators.

We have a long history in organic peroxides, starting with dibenzoyl peroxide used for the bleaching of flour in the early 1920s. Since then, we have added many new organic peroxides to our product portfolio, including those which produce plastics used in everyday life. Today, we are the world's leading producer of organic peroxides. We are home to the best known brands in the business. Examples include Laurox®, Perkadox® and Trigonox® brands.

Our products are used in a huge range of industrial and consumer goods, such as solvent and water based coating resins, acrylic sheets and castings, toner and inks, adhesives and sealants, acrylic fibers, super absorbers, detergents and flocculants and many others.

Our range of initiators meet the requirements in each area of application, from polymerization temperature, rate of radical formation and storage facilities.

This product guide provides an overview of our main, commercially available initiators for the free radical polymerization of (meth)acrylate monomers.

As a company of innovation, we have recently introduced new initiators, which have an improved performance in selectivity and HSE profile, including such products as Trigonox® 421 and Trigonox® 301.

Please visit nouryon.com for complete product listings. Formulations with phlegmatizers or concentrations other than those indicated can also be made available.

Your Safety is Our Priority

Nouryon is 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 at Nouryon 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 safety and handling of organic peroxides
- consultation on storage and dosing facility design
- demonstrations on the safe use, handling and control 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, in order to provide a high level of safety in manufacturing, handling and transport of dangerous goods.

In general organic peroxides are thermally unstable compounds, decomposing 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 able to handle organic peroxides confidently and safely.

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 max.

The T_s max. given in the product list is the recommended maximum storage temperature at which the product is stable and quality loss will be minimal.

T_s min.

A minimum storage temperature (T_s 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 Ts 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 implemented.

T_c Control temperature

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 no apply to product quality. To maintain product quality the recommended storage temperatures (T_s min. and max.) have to be observed.

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.

Survey of thermal stability

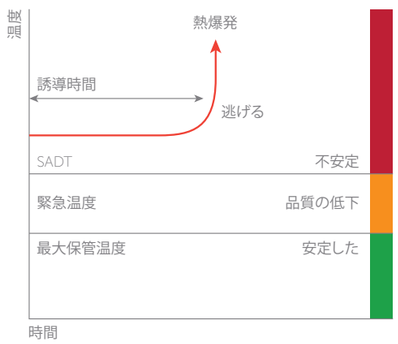


Table 1. Classification of organic peroxides

Un no.	Classification	Nouryon hazard rating	Maximum container size
3101	type B; liquid	Very high	25 kg (55 lb)
3103	type C; liquid	High	50 kg (110 lb)
3104	type C; solid		
3113	type C; liquid, temperature controlled		
3114	type C; solid, temperature controlled		
3105	type D; liquid	Medium	50 kg (110 lb)
3106	type D; solid		
3115	type D; liquid, temperature controlled		
3116	type D; solid, temperature controlled		
3107	type E; liquid	Low	400 kg (880 lb)
3117	type E; liquid, temperature controlled	Low	
3108	type E; solid		
3109	type F; liquid		
3110	type F; solid		
3119	type F; liquid, temperature controlled		
None	Non-dangerous good	No	Unrestricted
Self-reactive substances			
3234	type C; solid, temperature controlled	High	50 kg (110 lb)
3236	type D; solid, temperature controlled		

Packaging

We continuously develop new and innovative packaging to make logistics more efficient and according to safety standards beyond existing transport regulations. From bottles to tank trucks we offer a variety of packaging options for both liquid and solid organic peroxides.

Liquid organic peroxides

Liquid peroxides from us are available in packages shown in Table 2.

We also understand the need to innovate our packaging. For instance our Nourytainer®. Developed by us it is recognized as the world's benchmark in liquid organic peroxide packaging. We were also the first organic peroxide producer to introduce intermediate bulk containers (IBC's). And we're continually looking for new ways to optimize safe transport, handling and storage of organic peroxides.

Most recently we've led the way with our new unique composite IBC's for dilute type F organic peroxides. Due to their weight and dimensions, these IBC's offer benefits in safety and handling during transport and storage while giving all the advantages of our stainless steel containers. The specially designed lid, used as an emergency vent, is an Nouryon invention and has been patented. In addition, they are readily available and have a lower environmental impact.

We provide recollection and recycling, showing our commitment to developing new products and packages which are more sustainable, without compromising on performance.

Our continuous investment in refrigerated trucks, bulk tankers and dedicated reefers (refrigerated containers) specifically designed to safely transport our products is another demonstration of our commitment to security of supply.

Solid initiators

Standard packages for our solid initiators are shown in Table 3.

Most solid initiators are packaged in polyethylene bags inside non-returnable corrugated boxes. The number of bags per box varies, depending on the weight of initiator per bag.

For the availability of our products in IBC's, bulk or non-standard packages, please consult your Nouryon account manager.

Table 2. Standard packages for liquid peroxides

Package	Volume	Net Weight	Comments
Bottle	1 gallon*	7-8 lb	packaged as 4 polyethylene bottles per non-returnable carton
HDPE can	20-30 liter (5.3-8 gallon)	15-25 kg (6.8-11.3 lb)	single component, polyethylene container (Nourytainer®)
Akzopak	approx. 18 liter	20 kg	
Drum	200 liter	150 kg	steel drum
	220 liter	165-190 kg	returnable polyethylene drum
	15 gallon	100 lb	returnable polyethylene drum
	55 gallon	300-410 lb	polyethylene or steel drum
IBC	1000 liter	800-1000 kg	recollectable composite container (for emulsions and suspensions)
	1000 liter	800-1000 kg	recollectable, conductive composite container
	1250 liter	850-1000 kg	reusable stainless steel container
	330 gallon	2000 lb	reusable stainless steel container
Tank truck	7000 gallon	varies with product	for transport of bulk shipments of dilute type F organic peroxides
	20 m^3		

Table 3. Standard packages for solid initiators

Package	Net Weight	Comments
Carton	varies with product	polyethylene bags inside non-returnable cardboard box
Drum	20-25 kg (45-55 lb)	fiber drum

* Package sizes expressed in gallons and lb are only available in North America.

Different solutions in dilluted peroxide formulations **(see tables on page 12-21)**

In diluted peroxide formulations the letter 'C' refers to Isododecane which is used exclusively in Europe, Middle East, India and Africa.

In the America's 'odorless mineral spirits' is used and products are indicated with "CH" to distinguish the different solvent.

In Asia our 'odorless mineral spirits' based products are indicated by "CL".

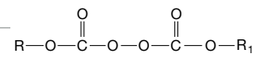
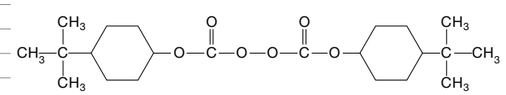
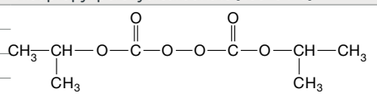
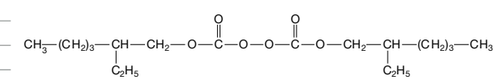
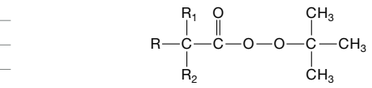
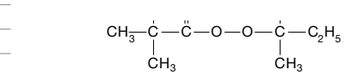
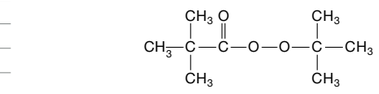
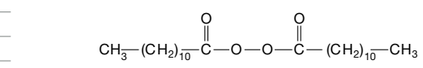
Main Areas of Application

End use		**Coating resins**						**Sheets & castings**			**Toners & inks**		**Adhesives & sealants**		**Fibers**	**Super absorbers**	**Detergents & Flocculants, Ion exchange**	**Personal care**	**Lenses**
Segment		Solvent & solution based					Water based	P(M)MA			Styrene-Acrylics toner resin		Water based	Solvent based	Acrylic & modacrylic	Water soluble resins	Water treatment	PMMA	Lenses
Application		Medium solids			High solids	Clear coat	Latex	1)	2)	3)	Inks	Inks	Adhesives & sealants	Adhesives & sealants	Fibers		Water treatment		Lenses
Process																			
Solution & solvent polymerisation		•	•	•	•	•		•			•		•		•				
Suspension & emulsion polymerisation							Emulsion		Suspension			Suspension		Both	Emulsion		Both		
Bulk & mass polymerization										•						•			•
Inversed emulsion & slurry polymerisation																•	•		
Temperature during polymerization		70-90	90-140	140-180	50-180	70-180	90							90-110		60-90	90-100		
Initiator	t½ 1 hr																		
Trigonox ADC	62																		•
Perkadox 16 / Perkadox 16S [11]	64									•				•		•	•		
Trigonox EHPS	64									•				•		•	•	•	
Trigonox 23 [α]	64	•			α	α		•	•	•	•	•							
Perkadox IPP	64																		•
Trigonox 125	72			•	•			•	•	•			•	•					
Trigonox 25	75	•	•		α	α		•	•	•				•				•	
Laurox [11]	79	•	•		α	α		•	•	•	•	•		•		•	•	•	
Perkadox AIBN	82	•	•		•			•	•	•	•	•	•	•	•	•	•		
Perkadox AMBN [9 11 12]	84	•	•				•	•	•	•	•	•	•	•	•	•	•	•	
Trigonox 141	86																	•	
Trigonox 421 [α 10 12]	88	•	•			α		•	•	•			•		•	•	•		
Trigonox 121 [α]	91	•	•		α	α	•	•	•	•	•	•	•						
Perkadox L-W75 [6 11]	91	•	•		•	•	•			•	• [4]	• [4]	•			•	•		
Trigonox 21S [α]	91	•	•		α	α	•	•	•	•	•	•	•	•			•		
Trigonox 27	93										•	• [7]							
Perkadox ACCN	103	•	•					•						•	•				
Trigonox 29	105								•					•					
Trigonox 122	106			•	•		•												
Trigonox 131	113		•	•	•														
Trigonox 22	113				•									•					
Trigonox 42S	114		•	•	•	•		•	•	•							•		
Trigonox 133	114		•	•	•														
Trigonox D	116				•	•													
Trigonox BPIC	117		•	•	•									•					
Trigonox 117	117		•	•	•		•				•	• [8]							
Trigonox 127 [6]	118		•	•	•														
Trigonox F	119		•	•	•	•													
Trigonox C [6]	122		•	•	•		•	•	•	•	•	•	•	•			•		
Perkadox BC-FF	132			•	•		•				•	•		•					
Trigonox 101	134			•	•														
Trigonox B	141			•	•		•	•			• [5]	•	•				•		
Trigonox 301	146			•	•								•						
Trigonox K-90	166			•	•		•						•	•					
Trigonox A-W70	185						•	•	•	•	•	•		•	•	•	•	•	
Trigonox TAHP	190			•	•		•						•	•					

•	Industry standard
•	Recommended grade
α	Alpha branched (selective) peroxide. Relevant for high solid acrylics and clear coats
1	Molding & extrusion
2	Molding & extrusion to beads & powders
3	Casted & extruded sheet & injection and extrusion grades
4	General purpose
5	Higher temp polymerization for lower MW
6	Benzene containing decomposition products
7	For low VOC formulation
8	Monomer cut for suspension process
9	Less toxic decomposition product and better solubilty than Perkadox AIBN
10	Maximized beta-scission for low polydispersity and optimized radical efficiency
11	Oil soluble peroxide for inversed suspension polymerization
12	Suitable alternative for Perkadox AIBN without formation of toxic decomposition products

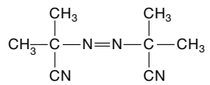
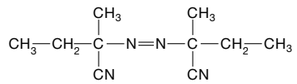
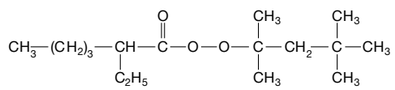
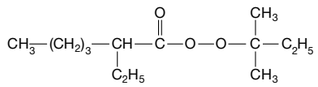
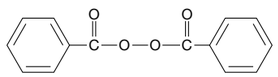
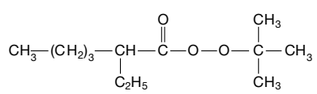
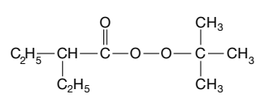
Our Initiators for Acrylics

* see explanation on page 9

Product name	Chemical name [CAS number]	General data				Storage data		Kinetic data T (°C) for t1/2					Safety data				Standard package type
		Molecular weight	Assay (%)	Active oxygen (%)	Physical form	Ts max. (°C)	Ts min. (°C)	0.1 h	1.0 h	10 h	A (1/s)	Ea (kJ/mole)	SADT (°C)	Tem (°C)	Tc (°C)	UN No.	See page 9
	Mixture of peroxydicarbonates [78350-78-4; 19910-65-7; 105-64-6]			4.01				80	62	45	7.69E+15	125.61					
TRIGONOX ADC-NS30			30	2.09	solution in diethylene glycol bis(allyl carbonate)	-20	-30						0	-10	-20	3115	20 kg Akzopak
TRIGONOX ADC-NS60			60	4.32	solution in diethylene glycol bis(allyl carbonate)	-20	-30						0	-10	-20	3115	4 x 8 lb box
	R, R_1 : isopropyl or sec-butyl																
	Di(4-tert-butylcyclohexyl) peroxydicarbonate [15520-11-3]	398.5		4.01				82	64	48	7.44E+15	126.39					
PERKADOX 16S			96	3.85	powder	20							40	35	30	3114	carton
	Diisopropyl peroxydicarbonate [105-64-6]	206.2		7.76				82	64	47	3.35E+15	124.01					
PERKADOX IPP-RAV27			27	2.10	liquid	-15	-15						5	-5	-15	3115	HDPE can
PERKADOX IPP-CR27			27	2.10	liquid	-15	-15						5	-5	-15	3115	HDPE can
	Di(2-ethylhexyl) peroxydicarbonate [16111-62-9]	346.5		4.62				84	64	46	1.52E+14	115.47					
TRIGONOX EHPS			98	4.53	liquid	-20							0	-10	-20	3113	HDPE can
	tert-Butyl peroxyneodecanoate [26748-41-4]	244.4		6.55				84	64	46	1.52E+14	115.47					
TRIGONOX 23			95	6.22	liquid	-10	-30						15	5	-5	3115	HDPE can
TRIGONOX 23-C75*			75	4.91	solution	-10	-20						20	10	0	3115	HDPE can
	R + R_1 + R_2 = C_8H_{19}																
	tert-Amyl peroxypivalate [29240-17-3]	188.3		8.50				91	72	55	4.12E+15	127.76					
TRIGONOX 125-C75			75	6.37	solution in odorless mineral spirits	-10	-30						25	15	10	3113	HDPE can
	tert-Butyl peroxypivalate [927-07-1]	174.2		9.18				94	75	57	7.09E+14	123.59					
TRIGONOX 25-C75*			75	6.89	solution	-5	-15						20	10	0	3113	HDPE can
	Dilauroyl peroxide [105-74-8]	398.6		4.01				99	79	61	3.92E+14	123.37					
LAUROX			99	3.97	flakes	30							50	45	40	3106	carton

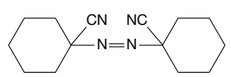
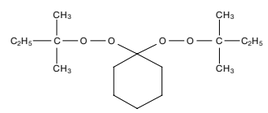
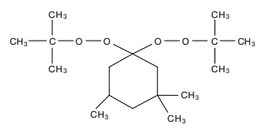
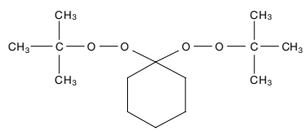
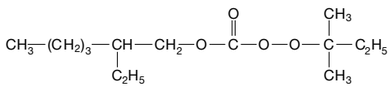
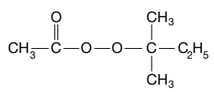
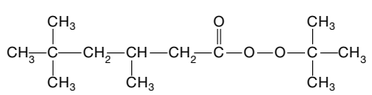
Our Initiators for Acrylics

* see explanation on page 9
** 3117 in US

Product name	Chemical name [CAS number]	General data				Storage data		Kinetic data T (°C) for t1/2					Safety data				Standard package type
		Molecular weight	Assay (%)	Active oxygen (%)	Physical form	T_s max. (°C)	T_s min. (°C)	0.1 h	1.0 h	10 h	A (1/s)	E_a (kJ/mole)	SADT (°C)	T_{em} (°C)	Tc (°C)	UN No.	See page 9
	2,2'-Azobis(isobutyronitrile) [78-67-1]	164.2						101	82	64	2.89E+15	130.23					
PERKADOX AIBN			98		solid	25							50	45	40	3234	carton / fiber drum
	2,2'-Azobis(2-methylbutyronitrile) [13472-08-7]	192.3						104	84	66	1.38E+15	128.93					
PERKADOX AMBN			98		solid	25							45	40	35	3236	carton
PERKADOX AMBN-GR			98		granules	25							45	40	35	3236	carton / fiber drum
	1,1,3,3-Tetramethylbutyl peroxy-2-ethylhexanoate [22288-43-3]	272.4		5.87				109	88	69	1.62E+14	123.80					
TRIGONOX 421			90	5.29	liquid	5	-20						30	20	15	3115	HDPE can
	tert-Amyl peroxy-2-ethylhexanoate [686-31-7]	230.3		6.95				111	91	73	1.77E+15	132.11					
TRIGONOX 121			95	6.60	liquid	5	-20						35	25	20	3115	HDPE can
	Dibenzoyl peroxide [94-36-0]	242.2		6.61				113	91	71	6.94E+13	122.35					
PERKADOX L-W75			75	4.95	wet powder	40							80			3104	carton
	tert-Butyl peroxy-2-ethylhexanoate [3006-82-4]	216.3		7.40				113	91	72	1.54E+14	124.90					
TRIGONOX 21S			97	7.17	liquid	10	-30						35	25	20	3113	HDPE can
TRIGONOX 21-C50*			50	3.70	solution	10	-30						40	35	30	3119**	HDPE can / IBC
	tert-Butyl peroxydiethylacetate [2550-33-6]	188.3		8.50				113	93	75	2.45E+15	134.00					
TRIGONOX 27			96	8.16	liquid	15	-30						35	25	20	3113	HDPE can

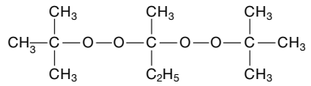
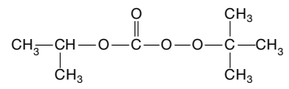
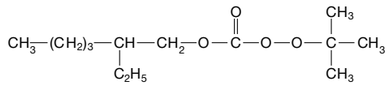
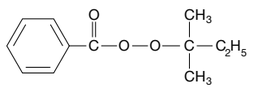
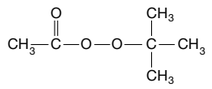
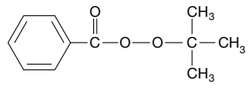
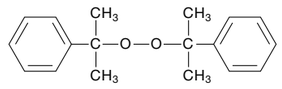
Our Initiators for Acrylics

* see explanation on page 9

Product name	Chemical name [CAS number]	General data				Storage data		Kinetic data T (°C) for t1/2					Safety data				Standard package type
		Molecular weight	Assay (%)	Active oxygen (%)	Physical form	T_s max. (°C)	T_s min. (°C)	0.1 h	1.0 h	10 h	A (1/s)	E_a (kJ/mole)	SADT (°C)	T_{em} (°C)	Tc (°C)	UN No.	See page 9
	1,1'-Azodi(hexahydrobenzonitrile) [2094-98-6]	244.3						123	103	85	1.10E+16	142.					
PERKADOX ACCN			98		powder	35							80			3226	fiber drum
	1,1-Di(tert-amylperoxy)cyclohexane [15667-10-4]	288.4		11.09				126	106	87	3.29E+15	139.46					
TRIGONOX 122-C80			80	8.88	solution	30							55			3103	HDPE can
	1,1-Di(tert-butylperoxy)-3,3,5-trimethylcyclohexane [6731-36-8]	302.5		10.58				128	105	85	7.59E+13	127.52					
TRIGONOX 29-C75*			75	7.93	solution	25							60			3103	HDPE can
TRIGONOX 29-C90*			90	9.52	solution	25							60			3103	HDPE can
	1,1-Di(tert-butylperoxy)cyclohexane [3006-86-8]	260.4		12.29				134	113	94	3.47E+15	142.40					
TRIGONOX 22-C50*			50	6.14	solution	25							60			3103	HDPE can
TRIGONOX 22-C80*			80	9.83	solution	25							60			3103	HDPE can
	tert-Amylperoxy 2-ethylhexyl carbonate [70833-40-8]	260.4		6.14				134	113	95	2.22E+16	148.41					
TRIGONOX 131			94	5.77	liquid	20							55			3105	HDPE can
	tert-Amyl peroxyacetate [690-83-5]	146.2		10.94				134	114	96	6.59E+16	152.16					
TRIGONOX 133-CK60			60	6.57	solution	30							60			3105	HDPE can
	tert-Butyl peroxy-3,5,5-trimethylhexanoate [13122-18-4]	230.3		6.95				135	114	94	1.94E+15	140.78					
TRIGONOX 42S			97	6.74	liquid	25	-20						55			3105	HDPE can

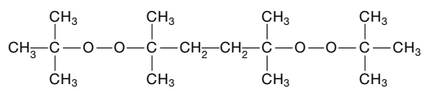
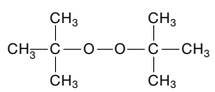
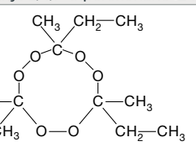
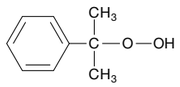
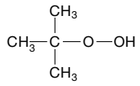
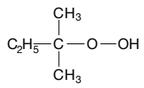
Our Initiators for Acrylics

* see explanation on page 9

Product name	Chemical name [CAS number]	General data				Storage data		Kinetic data T (°C) for t1/2					Safety data				Standard package type
		Molecular weight	Assay (%)	Active oxygen (%)	Physical form	T_s max. (°C)	T_s min. (°C)	0.1 h	1.0 h	10 h	A (1/s)	E_a (kJ/mole)	SADT (°C)	T_{em} (°C)	Tc (°C)	UN No.	See page 9
	2,2-Di(tert-butylperoxy)butane [2167-23-9]	234.3		13.66				136	116	98	9.30E+16	154.08					
TRIGONOX D-C50			50	6.83	solution	30							70			3103	HDPE can
	tert-Butylperoxy isopropyl carbonate [2372-21-6]	176.2		9.08				137	117	98	2.49E+16	150.15					
TRIGONOX BPIC-C75*			75	6.81	solution	25	-20						70			3103	HDPE can
	tert-Butylperoxy 2-ethylhexyl carbonate [34443-12-4]	246.3		6.49				137	117	98	4.07E+16	151.72					
TRIGONOX 117			95	6.17	liquid	20							60			3105	HDPE can
	tert-Amyl peroxybenzoate [4511-39-1]	208.3		7.68				139	118	99	8.38E+15	147.02					
TRIGONOX 127			94	7.22	liquid	20							60			3103	HDPE can
	tert-Butyl peroxyacetate [107-71-1]	132.2		12.11				139	119	100	1.57E+16	149.36					
TRIGONOX F-C50*			50	6.05	solution	10	-15						70			3103	HDPE can
	tert-Butyl peroxybenzoate [614-45-9]	194.2		8.24				142	122	103	2.23E+16	151.59					
TRIGONOX C			98	8.07	liquid	25	10						60			3103	HDPE can
	Dicumyl peroxide [80-43-3]	270.4		5.92				154	132	112	9.24E+15	152.67					
PERKADOX BC-FF			99	5.86	crystals	30							75			3110	carton

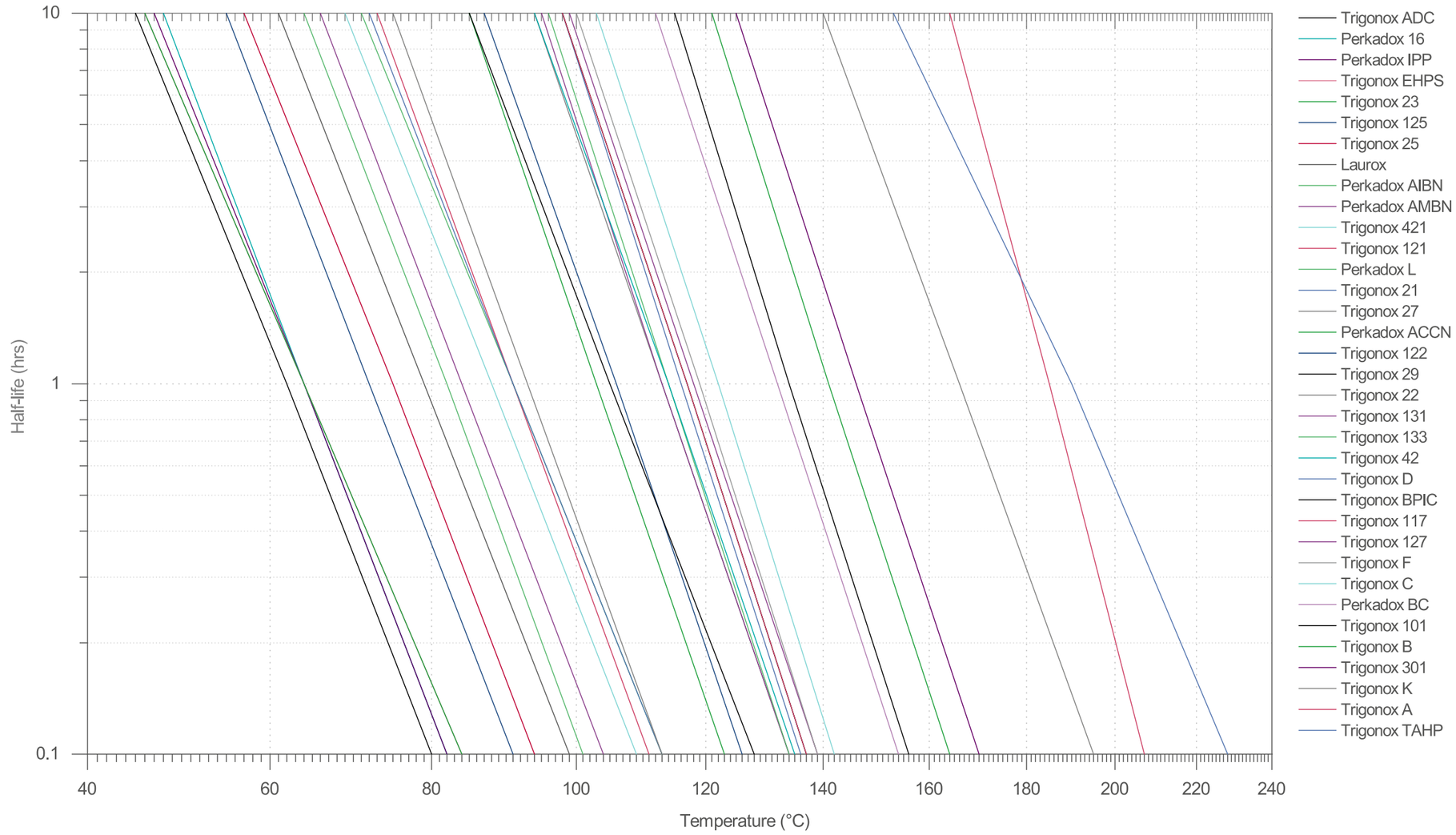
Our Initiators for Acrylics

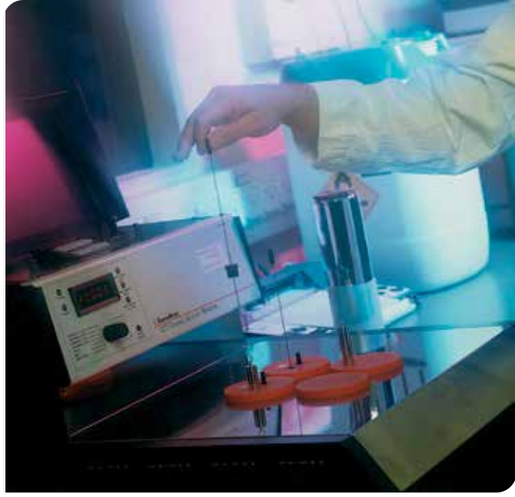
* see explanation on page 9

Product name	Chemical name [CAS number]	General data				Storage data		Kinetic data T (°C) for t1/2					Safety data				Standard package type
		Molecular weight	Assay (%)	Active oxygen (%)	Physical form	T_s max. (°C)	T_s min. (°C)	0.1 h	1.0 h	10 h	A (1/s)	E_a (kJ/mole)	SADT (°C)	T_{em} (°C)	Tc (°C)	UN No.	See page 9
	2,5-Dimethyl-2,5-di(tert-butylperoxy)hexane [78-63-7]	290.4		11.02				156	134	115	1.68E+16	155.49					
TRIGONOX 101			92	10.14	liquid	40	10						80			3103	HDPE can / HDPE drum
	Di-tert-butyl peroxide [110-05-4]	146.2		10.94				164	141	121	4.20E+15	153.46					
TRIGONOX B			99	10.83	liquid	40	-30						80			3107	HDPE can / steel drum
	3,6,9-Triethyl-3,6,9-trimethyl-1,4,7-triperoxonane [24748-23-0]	264.3		18.16				170	146	125	1.02E+15	150.23					
TRIGONOX 301			41	7.45	solution in isoparaffins	40	10						110			3105	HDPE can
	Cumyl hydroperoxide [80-15-9]	152.2		10.51				195	166	140	1.15E+12	132.56					
TRIGONOX K-80			80	8.40	solution in aromatic solvent mixture	40	-30						70			3109	HDPE can
TRIGONOX K-90			90	9.46	solution in aromatic solvent mixture	40	-30						70			3109	HDPE can
TRIGONOX K-LC			92	9.67	low cumene formulation	40	-25						70			3109	HDPE drum
	tert-Butyl hydroperoxide [75-91-2]	90.1		17.75				207	185	164	3.18E+17	186.01					
TRIGONOX A-W70			70	12.43	solution in water	35	0						80			3109	HDPE can / HDPE drum
						35	0						70			3109	steel IBC
						35	0						65			3109	plastic IBC
	tert-Amyl hydroperoxide [3425-61-4]	104.1		15.36				228	190	153							
TRIGONOX TAHP-W85			85	13.06	solution in water	30	-5						80			3109	HDPE drum

Kinetic Data/Half-life Chart

The most important characteristic of a polymerization initiator is its rate of decomposition expressed by its half-life ($t_{1/2}$). The half-life is the time required to reduce the original amount of peroxide at a given temperature by 50%.





Kinetic Data

With the exception of hydroperoxides, the half-life is determined by differential scanning calorimetry-thermal activity monitoring (DSC-TAM) of a dilute solution of the initiator in monochlorobenzene. Kinetic data of the decomposition of hydroperoxides in monochlorobenzene are determined titrimetrically.

The tables in this catalog list the temperatures at which the half-lives are 0.1 hour, 1.0 hour and 10 hours.

The half-life can be calculated from the Arrhenius equation

$k_d = A \cdot e^{-Ea/RT}$ and $t_{1/2} = \ln 2 / k_d$

The Arrhenius frequency factor (A) and activation energy (Ea) are given in the tables on pages 12-21.

The residual concentration of the initiator can be calculated by means of the equation

$[I] = [I_0] \cdot e^{-k_d \cdot t}$

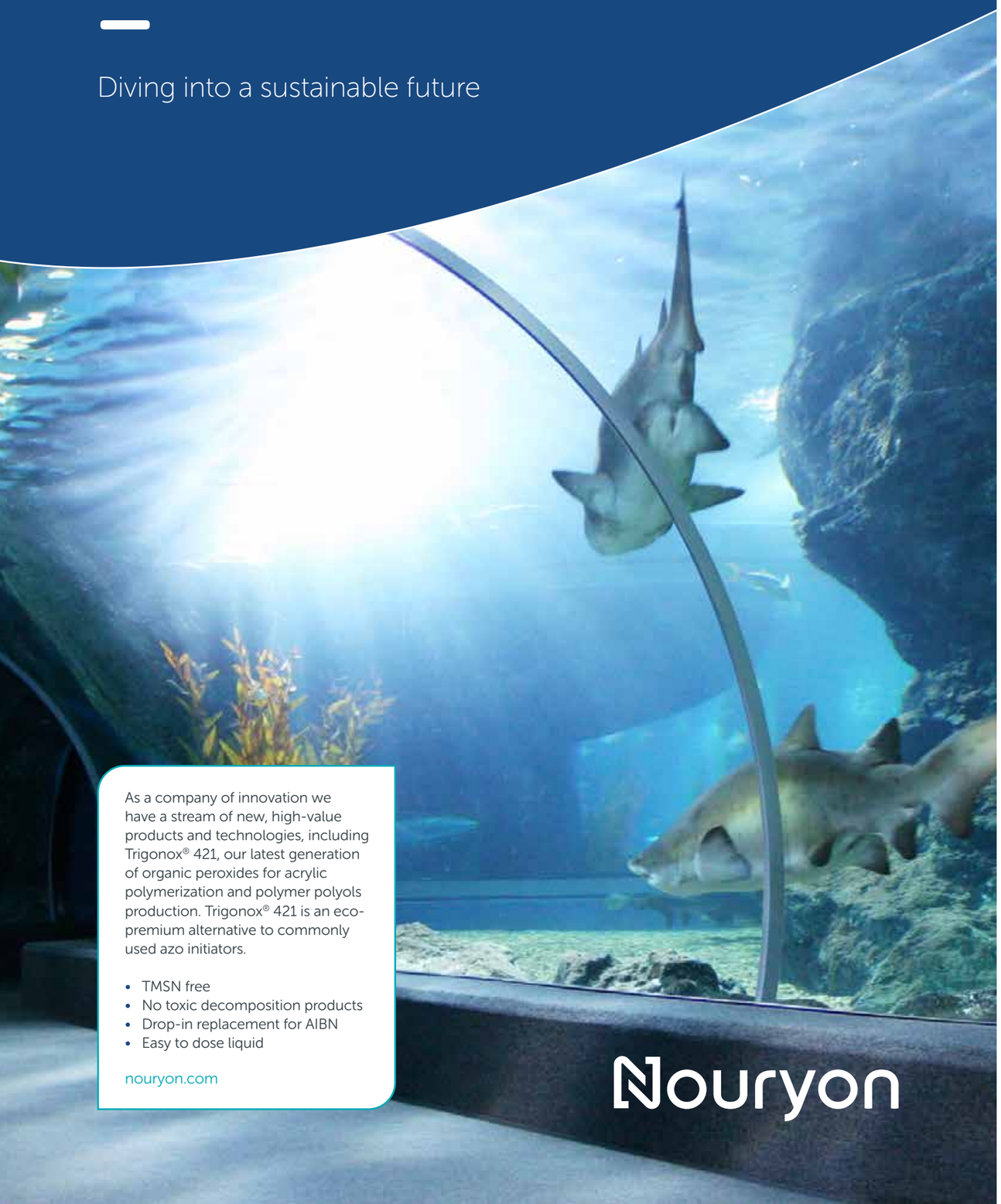
The initiators in the tables on pages 12-21 are arranged in descending order of activity, based on the 1.0 hour half-life temperature.

k_d = rate constant for the initiator dissociation in s^{-1}
A = Arrhenius frequency factor in s^{-1}
E_a = Activation energy for the initiator dissociation in J/mole
R = 8.3142 J/mole.K
T = temperature in K
$t_{1/2}$ = half-life in s

$[I_0]$ = original initiator concentration
$[I]$ = initiator concentration at time t
t = time measured from the start of decomposition in s

Trigonox® 421

Diving into a sustainable future



As a company of innovation we have a stream of new, high-value products and technologies, including Trigonox® 421, our latest generation of organic peroxides for acrylic polymerization and polymer polyols production. Trigonox® 421 is an eco-premium alternative to commonly used azo initiators.

- TMSN free
- No toxic decomposition products
- Drop-in replacement for AIBN
- Easy to dose liquid

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Nouryon

Initiators for Cast Acrylic Lenses

We are a leading supplier of organic peroxides for the manufacturing of polymer acrylics. A particular acrylics segment is the manufacturing of lenses.

The manufacturing of acrylic lenses requires dedicated products to fulfil the high market quality standards. We provide a dedicated series of peroxides which are used in this segment and which are shown in the table below.

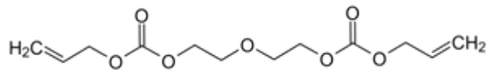
Trigonox® ADC and Perkadox® IPP are the products of choice for all major manufacturers in this segment.

The products are all phlegmatized with diethylene glycol bis (allylcarbonate) which is the major monomers used for the manufacturing of acrylic ophthalmic lenses.

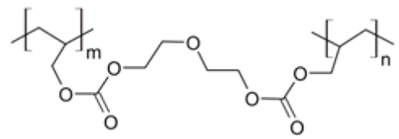
The phlegmatizer will therefore fully incorporate in the 3D polymer network during the polymerization. This way it assures the desired refractive index of the polymer, reaching excellent transparency with no haze and discoloration of the lens.
With Trigonox® ADC and Perkadox® IPP formulations the polymerization process is under control to meet shrinkage requirements and secure easy and safe mold release.

Some grades, depending on the region, are available in different concentrations and packaging types. Please contact your local Nouryon sales representative for further details.

The monomer: diethylene glycol bis (allylcarbonate):



The polymer: poly(allyl diglycol carbonate) (PADC)



Leading the Way in Safety

Nouryon is recognized as the global leader in organic peroxide safety and your trusted supplier of Butanox®, Cadox®, Perkadox® and Trigonox® products. We always place safety as our top priority.

Sharing our experience in safety is one of the most important resources we offer. Classroom reviews of safety and handling of organic peroxides, online trainings, consultation on storage and peroxide dosing equipment as well as demonstrations and publications on the safe use and handling of organic peroxides are just some of the services we offer. Please contact your Nouryon representative or nouryon.com for more information.

How to store peroxides

- Store in a cool room away from direct sunlight.
- Observe maximum and minimum storage temperature as printed on the packaging and SDS.
- Leave in the original packaging.
- Close packaging after use.

- Do not store together with accelerators or other chemicals.
- Do not mix peroxides with accelerators.
- Avoid any contact with dust, metal or other chemicals.

How to handle peroxides

- Wear safety goggles.
- Wear appropriate protective gloves and clothing.
- Remove spillages immediately.
- Only use compatible materials when handling

- Do not smoke.
- Avoid heat sources.
- Avoid open fire.
- Never heat peroxides.

Scan QR code to watch our short video on how our safety services can support you.

In case of emergency, call the following telephone number:
+31 570 679211 or
+1 800 424 9300

How to act in case of:

Fire

Alert fire department. Fight small fire with powder or carbon dioxide and apply water.

Spillage

Liquids: absorb with inert material and add water.
Solids/pastes: take up with compatible aids and add water. Move to safe place and arrange disposal as soon as possible.

Skin contact

Wash with water and soap.

Eye contact

First rinse with water for at least 15 minutes. Always seek medical attention.

Ingestion

Drink large amounts of water and consult doctor immediately. Do not induce vomiting.

Butanox® Perkadox® Trigonox®

Nouryon

Contact Us

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

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Additional information
Please visit nouryon.com for complete product listings, Product Data Sheets (PDS) and Safety Data Sheets (SDS). Formulations with phlegmatizers or concentrations other than those indicated can also be made available.

Nouryon

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, agriculture and food, pharmaceuticals, 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. Visit our website and follow us @ Nouryon and on LinkedIn.

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