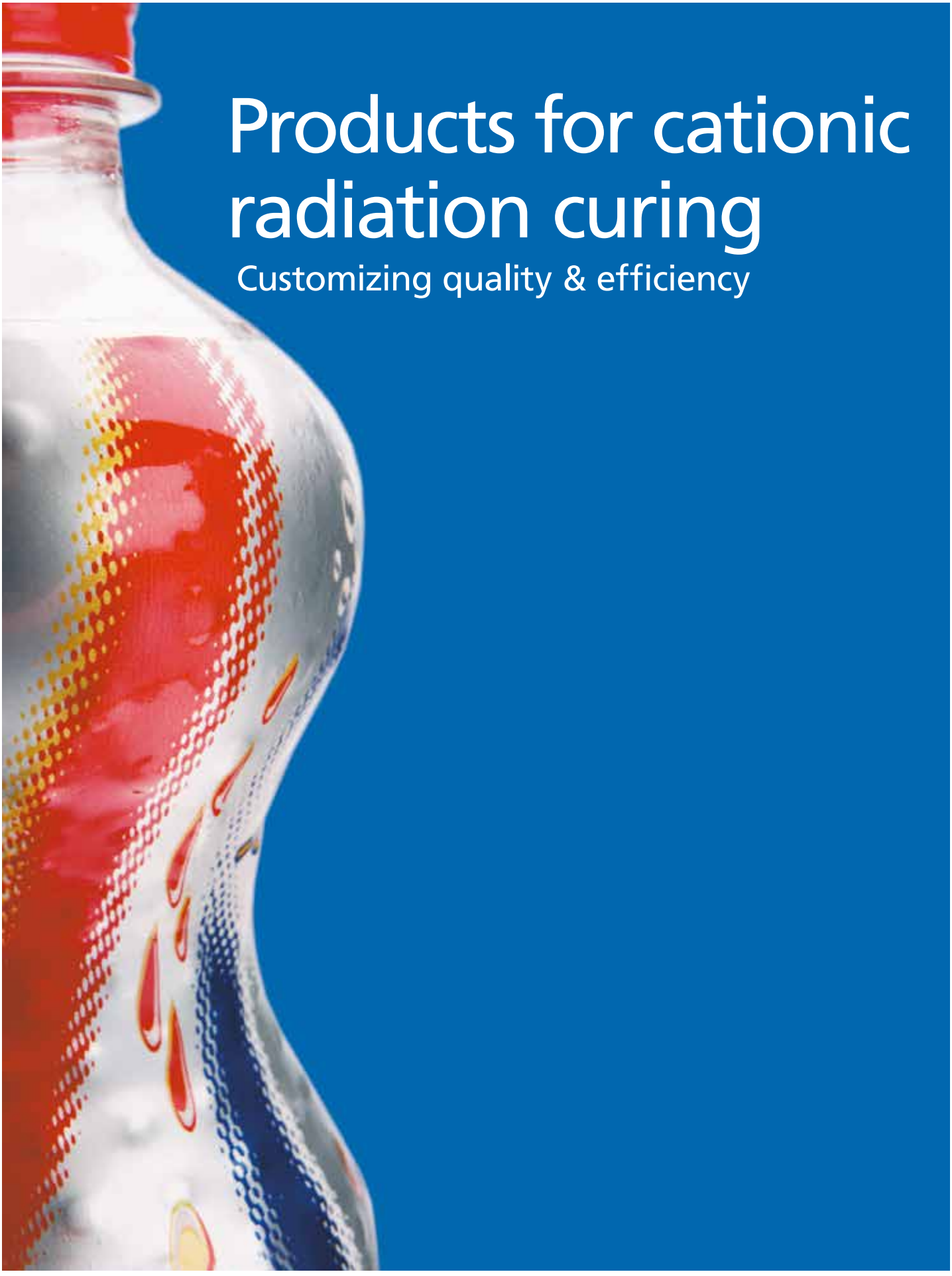


Products for cationic radiation curing

Customizing quality & efficiency

Perstorp

WINNING FORMULAS

The elements of success

You need a partner who can see the big picture when it comes to your products, your processes and your customers. Our experience and expertise in the special niches of organic chemistry, process technology and application development are at your service, providing you with a complete chain of solutions to enhance quality and profitability at every step.

Our versatile intermediates, an essential element of your winning formula, are specifically designed to add value and enhance end-product performance. Your solution to meeting the increasing demands for safer, lighter, more durable and environmentally friendly end-user products, begins here.

Innovation in everything we do

Innovation distinguishes every aspect of our business process. Developing smarter and safer solutions creates real value in new chemical applications. Focused innovation instills leadership and purpose in our business activities, improves internal processes and increases application and product competitiveness.

Delivering our promises globally

Our global presence provides you with reliable solutions and processes, consistent high quality, security of production and supply and delivery with precision. This commitment also means rapid response when product or application support is required and the very best in technical support.

Putting the care into chemicals

We take our responsibilities to heart and are committed to attentive, sustainable business practices. We minimize risks for our customers, our employees and the environment by working proactively to ensure safe products and processes.

Customizing quality & efficiency

Enhancing cationic radiation curing

Cationic ultraviolet/electron beam (UV/EB) radiation curing systems are an outstanding alternative to traditional radiation curing. The technical merits, environmentally friendly profile and the ready availability of suitable raw materials support the strong growth of this technology. Our products TMPO, Boltorn™, Capa™ and alkoxylated polyols are key components for UV/EB cationic systems and are essential to fine-tuning the properties of the end product.

A living polymerization

The cationic photo induced polymerization of epoxides and oxetanes ensures better adhesion on difficult substrates such as metals, plastics, glass and ceramics, thanks to low shrinkage and possible chemical bonding with the substrate. Shape forming is easily achieved for expandable or shrinkable systems after radiation exposure, creating a living polymerization that facilitates obtaining the full cure beneficial for low-migrating systems.

Unparalleled advantages

No other UV chemistry can achieve lamination of opaque substrates under UV radiation than the cationic dark cure. Other significant advantages include higher curing speed under air, greater durability with good barrier and electrical properties that withstand sterilization. Cationic radiation curing also ensures lower viscosity and low odor.

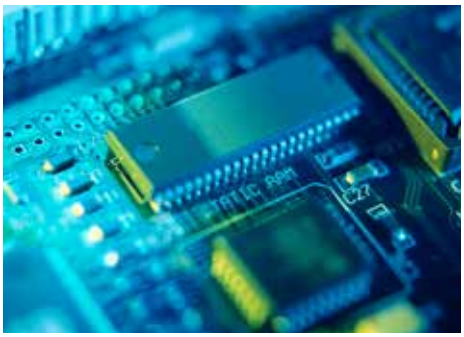
Our products for cationic radiation curing:

TMPO
Efficient reactive oxetane diluent

Boltorn™ H2004
Dendritic polyester polyol for improved flow pigment wetting and reactivity

Capa™
Capa™ polycaprolactones for increased reactivity and flexibility

Alkoxylated polyols
Fine-tuning with polyether polyols



We welcome your questions. More detailed information and specifications of each product are available on www.perstorp.com or through your Perstorp sales representative.

Designed to enhance

Expanding applications

The advantages of cationic UV/EB systems make them ideal for overprint varnishes and inks for rigid packaging application including metal can ends and rims, flexible packaging like plastic tubes, shrink sleeves and stand-up pouches. The main application areas include graphic arts, industrial coatings, adhesives, silicone release coatings, electronics and rapid prototyping and modeling (RPM).

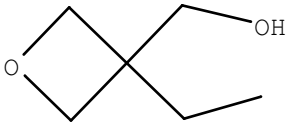
Main UV/EB cationic applications

- **Graphic Arts**
  - – Overprint varnishes
  - – Flexographic inks
  - – Screen inks
  - – Inkjet
- **Industrial Coatings**
  - – Metal coating (aluminum, steel)
  - – Plastic coating
- **Adhesives**
  - – Laminated adhesives
  - – Structural adhesives
  - – Pressure-sensitive adhesives
- **Silicone release coatings**
- **Electronics**
  - – Dielectric coatings for electronic metal parts
  - – Insulators
  - – Encapsulation
- **Rapid Prototyping & Modeling (RPM)**

Safer, stronger, better elements

TMPO – cationic reactive diluent of choice

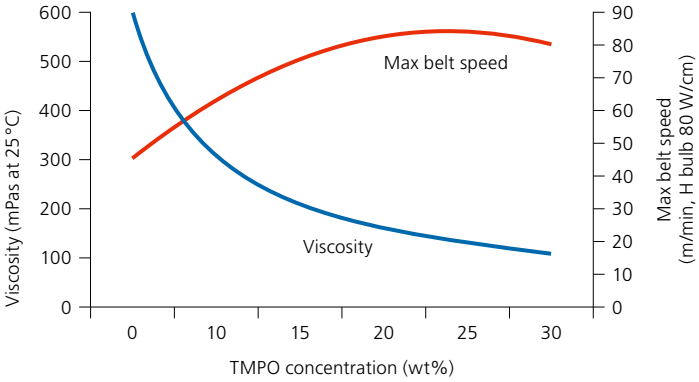
Our TMPO (trimethylolpropane oxetane) is one of the main components of UV/EB cationic formulations. These formulations are mostly made up of resins, diluents and photo initiators as exemplified by cycloaliphatic epoxides (3,4 epoxy cyclohexyl methyl-3,4 epoxy cyclohexane carboxylate) as the main resin, and TMPO as the reactive diluent. TMPO is a clear colorless, non skin-irritating reactive diluent. It combines increased reactivity, good diluting power of epoxy resins and increases end-product durability.



TMPO

TMPO – accelerates curing speed

TMPO is a very effective, non-irritant and reactive diluent for cycloaliphatic epoxides. It improves the curing speed by up to twice the speed for the same photo initiator concentration, thereby offering economical advantages. Furthermore, TMPO improves the through cure and increases chemical resistance. It can be used as up to 50-wt % of a formulation.



Effect of TMPO on viscosity reduction and curing speed in a basic overprint varnish formulation based on 3,4-epoxy cyclohexyl methyl-3,4 epoxy cyclohexane carboxylate

Tape adhesion test for UV cured 6 µm clear coatings, from 0 to 5 where 0 is best (1 pass at 15 m/min under 80 W/cm H Bulb, 100 mJ/ cm^2)

Adhesion on:	Cationic UV clear coat with TMPO, Polyol 4640 and cycloaliphatic epoxide	Free-radical UV formulation (epoxy acrylate, HDDA, GPTA)
Aluminum	0	3
Steel	0	2
Glass	0	3
PE	0	1
OPP	0	2
PA	0	2

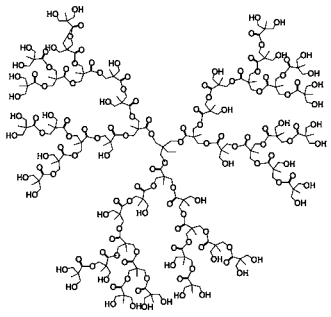
Precisely tailored end-product properties

Fine-tuning with polyols

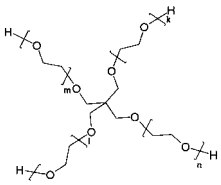
Control the properties of coatings and adhesives by choosing the right combination of polyols. The functionality and nature of the polyols determine end-product properties like flexibility and chemical resistance. Our wide range of polycaprolactones, alkoxylated polyols and Boltorn™ dendritic polyols offer the versatility to control these properties for precisely tailored results.

This ability to fine-tune helps you meet the high demands for excellent formability for applications such as rim and metal can-end coatings. The ring opening of the epoxide and/or the oxetane can be accompanied by cross-linking with hydroxy functional compounds like polycaprolactone polyols and Boltorn™ dendritic polymer polyols. These polyols act as chain-transfer cross-linkers and flexibilizers, which can be used as up to 30-wt % of the formulation.

Polycaprolactone



Boltorn™ dendritic polymer



Pentaerythritol based alkoxylate

	No polyol	With Capa® 3050	With Boltorn™ H2004	With Polyol 4640
Pendulum hardness (Ks)	165	205	214	215
Bending test, 180°	fail	pass	pass	pass

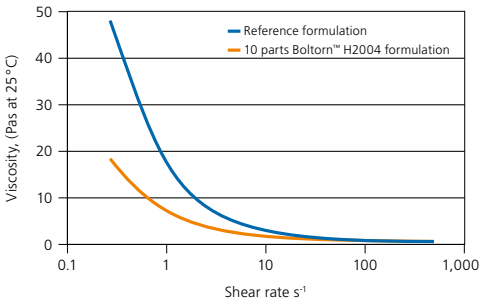
Ten parts of Capa™ 3050 or Boltorn™ H2004 or Polyol 4640 improves flexibility and hardness (12 µm clear coatings on glass and aluminium, cured with 2 passes at 70 m/min under 80 W/cm H-bulb, 100 mJ/cm^2, test after 24 h)

Adhesion on:	Free radical UV flexographic ink (polyester acrylate, TPGDA, GPTA)	Cationic UV flexographic ink (TMPO; Boltorn™ H2004 and cycloaliphatic epoxide)	Cationic UV flexographic ink (TMPO; Capa™ 3050 and cycloaliphatic epoxide)
PE	3	0	0
OPP	2	0	0
PP	2	0	0

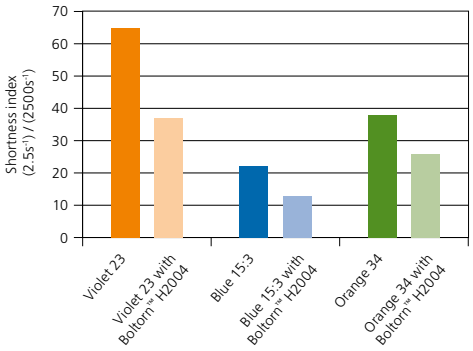
Tape adhesion test for UV cured blue flexographic inks applied with a 750 cells/inch anilox roller, from 0 to 5 where 0 is best (1 pass at 15 m/min under 80 W/cm H Bulb, 100 mJ/cm^2)

Boltorn™ H2004 – improves ink flow

This dendritic polyol not only offers the general advantages of polyols in cationic systems like improved flexibility, but also further improves the chemical resistance and rheological behavior of flexographic inks while maintaining high curing speed. The Newtonian behavior of printing inks containing Boltorn™ H2004 improves ink transfer at high speeds.



Lower viscosity at low shear obtained using 10 parts of Boltorn™ H2004 in a flexographic blue ink



Strong reduction of shortness index using 10 parts of Boltorn™ H2004 in several pigmented flexographic UV inks

Product data summary

Reactive diluent				
Product	OH-functionality	Equivalent weight OH- or oxetane mg KOH/g	Molecular weight g/mol	Viscosity (23°C) mPas
TMPO	1	116	116	25
Polyol cross-linkers & flexibilizers				
Dendritic polyester polyols				
Boltorn™ H2004	6	530	3,200	16,000
Polycaprolactone polyols				
Capa™ 3031	3	100	300	1,320
Capa™ 3050	3	181	540	1,290
Capa™ 3091	3	307	900	1,250
Polyether polyols				
Polyol R2490	2	110	220	170
Polyol 3610	3	92	275	800
Polyol 3165	3	340	1,014	350
Polyol 4640	4	90	355	1,600



Your winning formula

The Perstorp Group, a trusted world leader in specialty chemicals, places focused innovation at your fingertips. Our culture of performance builds on over 125 years of experience and represents a complete chain of solutions in organic chemistry, process technology and application development.

Matched to your business needs, our versatile intermediates enhance the quality, performance and profitability of your products and processes. Present in the aerospace, marine, coatings, chemicals, plastics, engineering and construction industries, they can also be found in automotive, agricultural, food, packaging, textile, paper and electronics applications.

Our chemistry is backed by reliable business practices and a global commitment to responsiveness and flexibility. Capacity and delivery security are ensured through strategic production plants in Asia, Europe and North and South America, as well as sales offices in all major markets. Likewise, we combine product and application assistance with the very best in technical support.

As we look to the future, we strive for the development of safer products and sustainable processes that reduce environmental impact. This principle of innovation and responsibility applies not only to our own business, but also to our work with yours. In fulfilling it, we partner with you to create a winning formula that benefits your business – as well as the people it serves.

Discover your winning formula at **www.perstorp.com**

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