



# Products for radiation curing

Protecting product performance



# Protecting product performance

## Enhancing radiation curing

As the global leader in supplying high performance polyols and special products for radiation curing raw materials, we offer particular know-how and expertise. The extensive versatility of radiation curing technology makes it suitable for a wide range of applications in industrial coatings, graphic arts, 3D modelling, electronics and adhesives.

## Sustainable performance

Radiation curing technology is distinguished by excellent environmental compliance. Liquid coatings cure instantaneously without emissions and can be 100% VOC-free. Radiation curing technology also minimizes energy consumption and space requirements. Curing is fast and without heat so it can be applied to heat sensitive substrates and achieve end products that are highly resistant to physical and chemical assault.

Some of the main areas where Perstorp products are ideal for enhancing radiation curing are:

- Industrial coatings, in protective surface coatings for wood and plastics, anti-static coatings for CDs and DVDs, hard coats for displays and scratch resistant coatings for the automotive industry
- Graphic arts, in overprint varnishes and printing inks for litho, flexo, gravure, screen and digital ink processes
- Additive modelling technologies, stereolithography and 3D-printing
- Display screens, OLEDs, optical fibres, hardcoats, photoresists, circuit boards and other opto-electronics.
- Adhesives, such as structural adhesive for jewellery and plastic assembly, laminating adhesive for packaging and pressure sensitive adhesives

## Polyols for acrylate monomers & oligomers

Radiation curing coatings and inks are typically composed of reactive diluents derived from the acrylic ester of our polyols and acrylate oligomers such as polyester and urethane acrylates using our polyols as building blocks. Our polyols offer extensive design possibilities and allow you to develop raw materials for radiation curing coatings, inks and adhesives. We also offer a range of products for cationic radiation curing that is presented in a separate brochure.

*Our products for radiation curing:*

### CTF, BEPD, NEO, TMP, Penta & 1,6-Hexanediol

Mono, di and multifunctional polyols as precursors for acrylate monomers or building blocks for oligomers

### Alkoxyated polyols R-series

Di- to hexa-functional polyols for non skin-irritant acrylates, reactive diluents, oligomers and tailored properties

### Di-TMP, Di-Penta & Boltorn™ dendritic polymers

High functionality polyols for acrylate monomers and oligomers of high reactivity and for improving durability of coatings and inks

### TMPDE 80 & 90

Trimethylolpropane di-allyl ether for improved curing speed and reduced air inhibition of unsaturated polyesters in UV curing

### Bis-MPA & Ymer™ N120

Anionic and nonionic dispersing monomers for preparation of UV curable polyurethane dispersions (UV PUDs)

### Capa™ & Oxymer™

Capa™ polycaprolactones, precursors for urethane acrylate oligomers, building blocks for UV PUDs and oligomers with low viscosity and high flexibility. Oxymer™ polycarbonate diols for preparation of UV PUDs or urethane acrylate oligomers with superior hydrolytical stability and outdoor resistance

We welcome your questions. More detailed information and specifications of each product are available on [www.perstorp.com](http://www.perstorp.com) or through your Perstorp sales representative.



# Fine-tuning with polyols

## Delivering raw materials globally

We are the global leader in manufacturing and supplying basic polyols such as TMP (Trimethylolpropane), Penta (Pentaerythritol), and Neo (Neopentyl Glycol) as well as the more flexible and hydrophobic BEPD (Butyl Ethylpropane Diol). They are used in production of conventional acrylate monomers such as trimethylolpropane triacrylate or pentaerythritol tetraacrylate, and as building blocks for preparing polyester, urethane and amino acrylate oligomers.

## CTF – specialty alcohol for low-odor, high Tg monofunctional acrylate monomer

When acrylated, CTF (Cyclic Trimethylolpropane Formal) is a unique monofunctional yet rigid alcohol that maintains higher curing speed and hardness and lower residual odor compared

Monoacrylate (8 wt% in a clear coat formulation)	CTF acrylate	Ethoxylated (2) phenol acrylate	IBOA	Lauryl acrylate
Adhesion on corona treated PE	0	1	1	2
Adhesion on corona treated OPP	1	3	1	2
Adhesion on Al	0	4	0	1

CTF acrylate best in its class of monofunctional acrylate for improving the adhesion of radiation curing coating on difficult substrates like PE, OPP or aluminium (from 0 to 5 where 0 is best)

to conventional monoacrylate monomers. As a monofunctional monomer, it improves the adhesion of coatings on plastic, ceramic, metal and other difficult substrates.

## Alkoxyated polyols R-series – dedicated & safe

Our alkoxyated polyols R-series, including Polyol R2490, Polyol R3600 and Polyol R4631, is developed especially for radiation curing to meet raw material demands such as low glycol and low unreacted starting polyol. These products offer significant benefits, yielding acrylate monomers with no skin-irritation index, for safer handling.

## Alkoxyated polyols R-series – polymeric grades

Several of the polyols in our R-series fulfill the REACH definition of a polymer and are therefore exempted from registration in REACH. The alkoxyates fulfilling the REACH definition of a polymer are:

- Polyol R3215
- Polyol R3430
- Polyol R4630
- Polyol R4631
- Polyol R6400



### Polyol R2490 – for safety, durability & print quality

This diol yields monomers with excellent dilution power yet much lower irritation index, allowing Xi-free formulations in contrast to commonly used TPGDA and HDDA. The reactive diluent derived from Polyol R2490 increases the durability of protective coatings and improves the rheology control of inks for better print quality.

### Precursors for low surface tension acrylates

The acrylate of Polyol R3530 provides lower surface tension and improved wetting of plastic substrates.

### Tri- & tetrafunctional polyols for superior properties

Polyol R3600 is a triol that is useful in preparing highly reactive triacrylate monomers for a variety of applications. Other trifunctional polyols, of various OH numbers and alkoxylation nature, customize basic properties such as hardness, flexibility, surface tension and wetting.

Polyol R3430 and Polyol R3215 are triols of increased molecular weight that provide both high flexibility and very low shrinkage. Polyol R4631, a tetrafunctional polyol for acrylate monomers, imparts high reactivity and scratch resistance.

### Polyol R6405 – our alkoxyated polyol with highest functionality

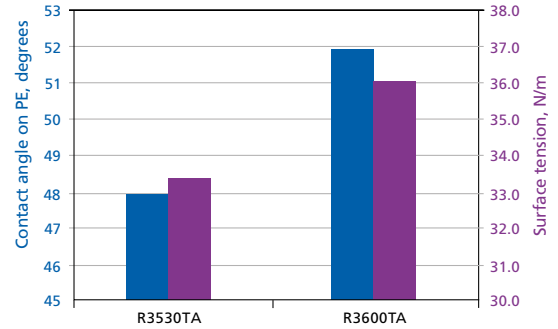
Polyol R6405 combines good diluting power, reactivity, low viscosity and good flexibility for superior end-product performance.

### High-purity alkoxyates

Polyol R3540 is a high-purity polyol specifically designed for applications with high demands on high-purity products.

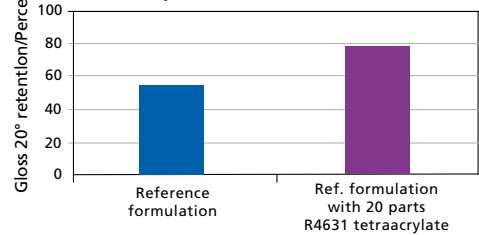
R4630 and R4410 have been developed with higher purity to allow manufacture of lower extractable tetraacrylate monomers.

### Wetting & adhesion control



The surface tension and contact angle on PE of the acrylates of trifunctional polyols, Polyol R3530 and Polyol R3600

### Durability: abrasion resistance



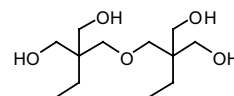
Gloss 20° retention after 200 scrub scotch-brite test showing improved scratch resistance with the acrylates of polyol R4631



# Designed to enhance

## Di-TMP – high functionality & balanced properties

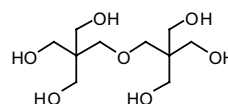
This tetrafunctional polyol provides low toxicity acrylate monomer with excellent pigment wetting behavior. It also improves reactivity and scratch resistance where low viscosity is required, making Di-TMP ideal for applications such as flexographic inks.



Di-TMP

## Di-Penta – exceptional scratch resistance

Achieve the acrylate of the highest hardness and scratch resistance of all available high functionality polyols with Di-Penta. It is an essential component of hard coats and is important in securing the desired properties in end products such as polycarbonate headlamps and the protective coating of LCDs.



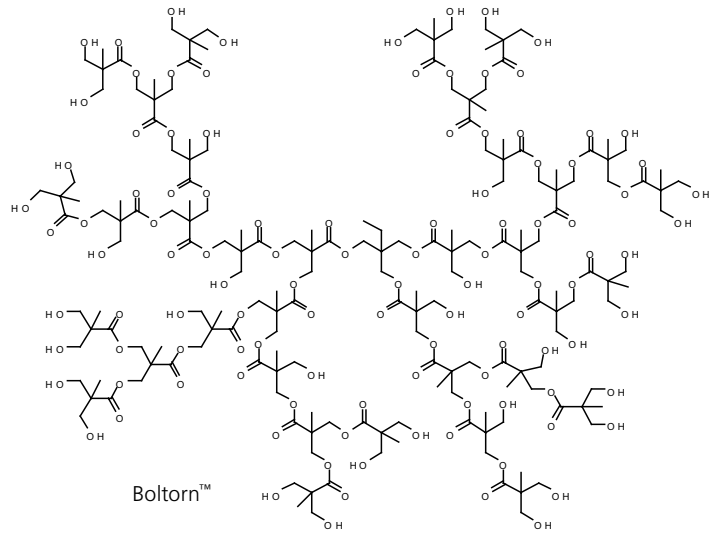
Di-Penta



## Boltorn™ dendritic polymers – unique, versatile chemistry

Our dendritic polymers are used as precursors for acrylate oligomers with high average molecular weight but also a high average acrylate concentration combined with a low intrinsic viscosity. The acrylates of Boltorn™ P500 and Boltorn™ P501 achieves an ideal balance between viscosity, reactivity and flexibility for preparing a hard coat for plastics with enhanced adhesion and flexibility.

Boltorn™ P1000 is a low-viscosity polymer polyol allowing monomer-free formulation. It combines the low viscosity and low shrinkage required in applications such as UV digital printing.



Acrylated Polyol type			Di-Penta acrylate (DPHA)	Acrylate of Boltorn™ P501	Acrylate of Boltorn™ P500
Viscosity, mPas @ 23°C			13 000	600	500
Pencil hardness	PC sheet (250µ)	30mins	5H-6H	3H-4H	H-2H
	Glass	72Hours	5H-6H 8H-9H	5H-6H 8H-9H	3H-4H 8H-9H
Scratch (scotch brite, 50 rubs)	Δ% Gloss		0,4	1,6	3,6
	Final Gloss		90,3	88,1	80,5
Erichsen-flex (Aluminium, mm)			0,4	1,7	2,2
Adhesion (cross-cut, PC Sheet)			No	Yes	Yes

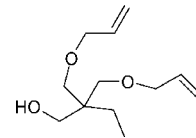
Choose Di-Penta, Boltorn™ P500 or Boltorn™ 501 to achieve best balance of hardness, flexibility and scratch resistance.



# Innovative performance

## TMPDE 80 – allyl-ether for unsaturated polyester

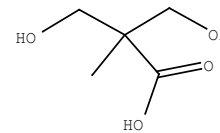
TMPDE 80 (trimethylolpropane di-allylether) is an essential element of unsaturated polyester for UV curing that decreases air inhibition. This results in better curing and productivity in the UV curing of wood surfaces.



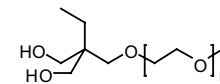
TMPDE 80

## Specialty diols – for UV polyurethane dispersions

The range of applications for UV curable polyurethane dispersions (UV PUDs) has increased in recent years, for example in sprayable and low-gloss UV wood coatings. We are a leading supplier of Bis-MPA (2,2 dimethylolpropionic acid), a diol with an acidic group providing water dispersability for polyurethane dispersions after neutralization with a base. For nonionic stabilization of UV PUDs, Perstorp offers the nonionic diol Ymer™ N120. These specialty diols can be combined with Oxymer™ polycarbonate macrodiols for enhanced hydrolytic stability and outdoor durability, or Capa™ polycaprolactone diols for maximum flexibility and improved abrasion resistance.



Bis-MPA



Ymer™ N-120

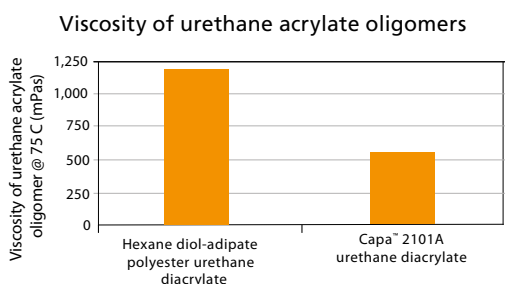




# Caprolactones

## Capa™ caprolactones – spearheading performance in products & processes

Capa™ is our range of caprolactones, comprising monomer and polycaprolactones of varying molecular weight and functionality. The Capa™ polycaprolactones display a very narrow molecular weight distribution, which results in very low viscosity products when compared to adipate polyesters, for example. The low viscosity of Capa™ is ideal for making low-viscosity acrylate oligomers, which can reduce the need for monomers in the final formulation. The Capa™ polycaprolactone diols can be used as macrodiols for UV PUDs, where they offer outstanding flexibility, good hydrolytical stability and outdoor resistance.



## Capa™ caprolactones – providing endless possibilities

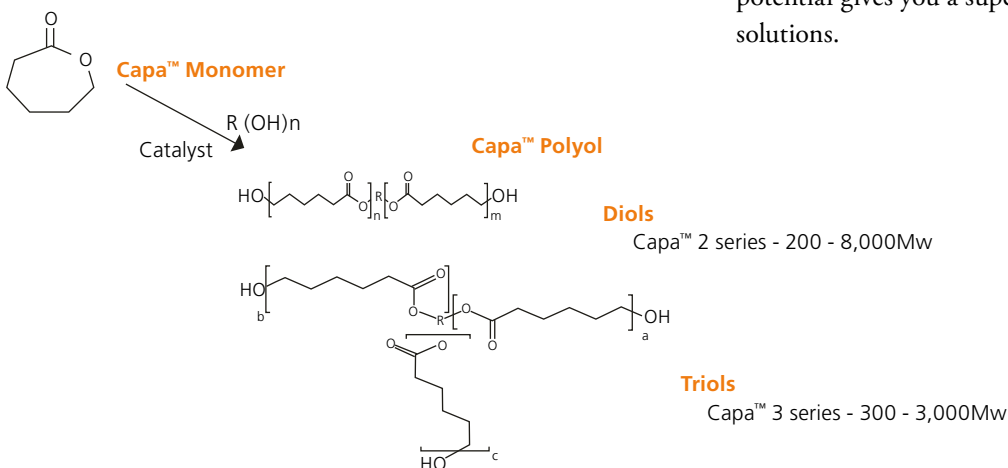
The Capa™ molecule gives you endless possibilities in properties and performance to suit your needs. These unique aliphatic polyester polyols are made via ring opening polymerization. This chemistry gives you:

- No by-products
- Low level of catalyst
- Narrow Mw distribution
- Very low acid number
- Clearly defined functionality

These benefits, in combination with tight manufacturing specifications, compared with other polyols, allows for grades to be tailored to required properties by variation of choice of "initiator" (OH-functional starting point) that is used. The functionality of the "initiator" is repeated exactly in the resultant polymer polyol, so di-, tri- and multi functional polyols can be produced.

## Capa™ caprolactones - giving you total quality & control

Oligomers based on Capa™ deliver highly desirable properties. They are flexible and tough, and show lower viscosity for equivalent Mw. In terms of durability they have a high abrasion resistance with exterior durability and through control of glass transition  $-T_g$  – provide the possibility of soft feel plastic coatings. Capa's high quality and greater customization potential gives you a superior end result compared to alternative solutions.



Higher OH functional polyols are also available

## Product data summary

Product	Appearance	OH-Functionality	Type of OH-group	Hydroxyl number mg KOH/g	Molecular weight, g/mol	Viscosity, mPas, (°C)
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### *Products for acrylic esters reactive diluents & building blocks for oligomers*

CTF	Liquid	1	Primary	388	146	80 (23)
2-Ethylhexanol	Liquid	1	Primary	431	130	9.7 (20)
Neo	Solid/flakes	2	Primary	1,075	104	
BEPD	Semi-crystalline	2	Primary	695	161	50 (60)
1,6-Hexanediol	Waxy solid	2	Primary	950	118	37 (50)
Polyol R2490	Liquid	2	Secondary	490	220	170 (23)
Capa™ 2054	Liquid	2	Primary	204	550	60 (60)
TMP	Solid/flakes	3	Primary	1,250	134	150 (80)
Polyol R3215	Liquid	3	Primary	215	795	340 (23)
Polyol R3430	Liquid	3	Primary	430	398	400 (23)
Polyol R3530	Liquid	3	Secondary	530	308	2,000 (23)
Polyol R3540	Liquid	3	Primary	540	310	550 (23)
Polyol R3600	Liquid	3	Primary	600	75	700 (23)
Capa™ 3031	Liquid	3	Primary	560	300	170 (60)
Capa™ 3050	Liquid	3	Primary	310	540	160 (60)
Capa™ 3091	Liquid	3	Primary	183	900	165 (60)
Penta	Solid/crystal	4	Primary	1,650	135	
Di-TMP	Solid/flakes	4	Primary	895	250	
Polyol R4630	Liquid	4	Primary	630	350	1,500 (23)
Polyol R4631	Liquid	4	Primary	631	356	1,500 (23)
Polyol R4410	Liquid	4	Primary	410	565	700
Capa™ 4101	Liquid	4	Primary	218	1,000	260 (60)
Di-Penta	Solid/crystal	6	Primary	1,325	254	
Boltorn™ P500	Liquid	Hydroxyl	Primary	600	N/A	15,000 (23)
Boltorn™ P501	Liquid	Hydroxyl	Primary	720	N/A	20,000
Boltorn™ P1000	Liquid	Hydroxyl	Primary	470	N/A	5,000 (23)
Polyol R6405	Liquid	6	Primary	405	827	1,900 (23)

Product	Appearance	Functional groups	Hydroxyl number mg KOH/g	Molecular weight, g/mol	Viscosity, mPas, (°C)
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### *Products for unsaturated polyesters*

TMPDE 80	Liquid	1 hydroxyl, 2 allyl	280	211	15 (23)
TMPDE 90	Liquid	1 hydroxyl, 2 allyl	265	214	20 (23)
BEPD	Semi-crystalline	2 hydroxyl	695	161	50 (60)

Product	Appearance	Functional groups	Hydroxyl number mg KOH/g	Molecular weight, g/mol	Viscosity, Pas, (°C)	Acid number mg KOH/g
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*Products for UV PUDs*

Bis-MPA	Crystal	2 hydroxyl, 1 carboxyl	835	134.4		415
Ymer™ N120	Amorphous	2 hydroxyl	110	1000	0.06 (50)	

Product	Appearance	Functional groups	Hydroxyl number mg KOH/g	Molecular weight, g/mol	Viscosity, Pas, (°C)	Polymer chemistry
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*Products for UV PUDs & acrylate oligomers*

Capa™ 2054	Liquid	2 hydroxyl	204	550	0.06 (60)	Polyester
Capa™ 2101A	Solid	2 hydroxyl	112	1,000	0.15 (60)	Polyester
Capa™ 2201A	Solid	2 hydroxyl	56	2,000	0.48 (60)	Polyester
Oxymer™ HD112	Wax	2 hydroxyl	112	1,000	0.47 (70)	Polycarbonate
Oxymer™ HD56	Wax	2 hydroxyl	56	2,000	2.40 (70)	Polycarbonate





## 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 130 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. This is how we enable you to meet market demands for safer, lighter, more durable and environmentally sound end-products – for the aerospace, marine, coatings, chemicals, plastics, engineering, and construction industries, as well as 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. Consistent high quality, capacity and delivery security are ensured through strategic production plants in Asia, Europe and North 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 smarter and safer products and sustainable processes that reduce environmental impact and create real value in new chemical applications. This principle of proactive 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](http://www.perstorp.com)