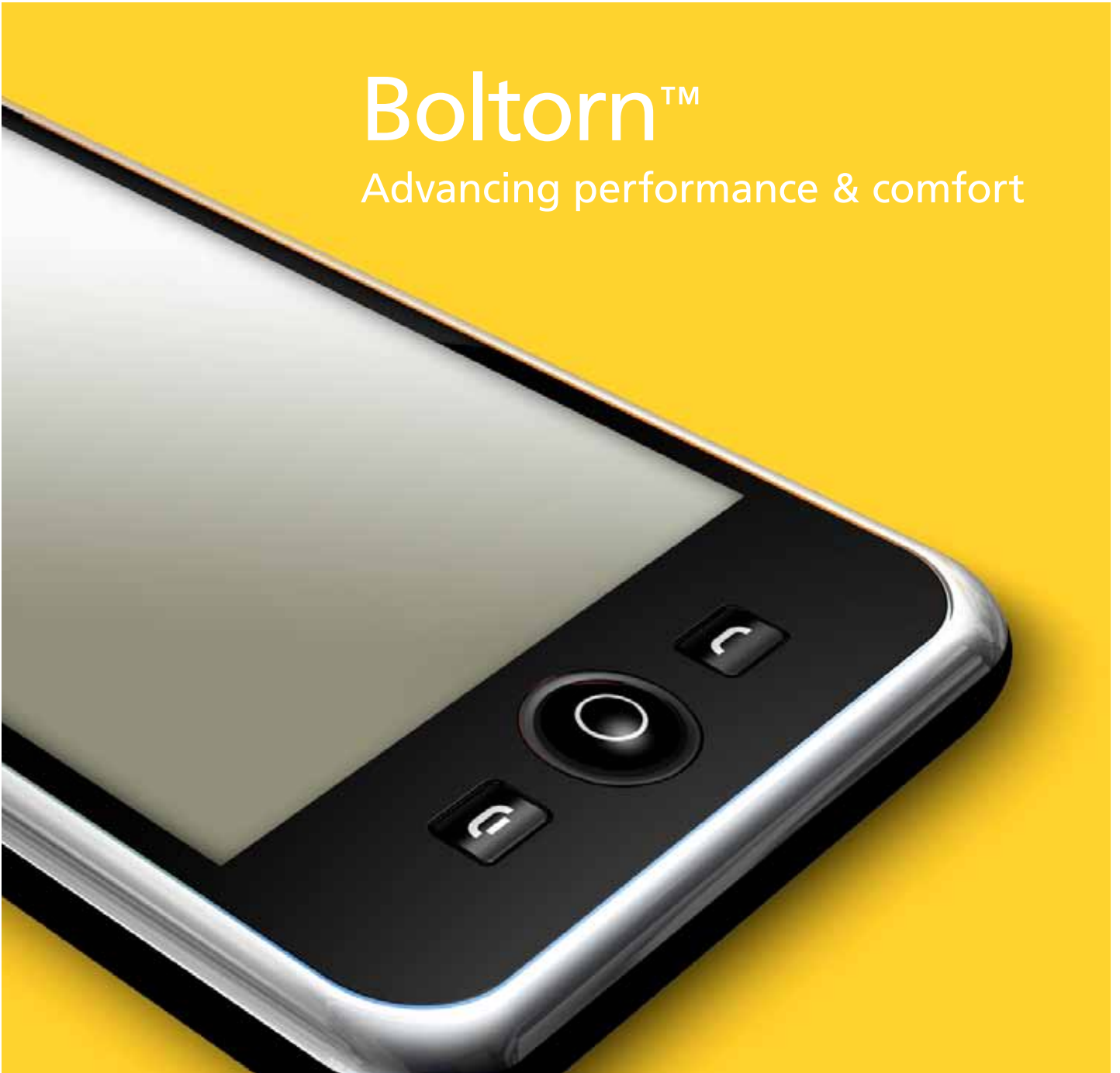


Boltorn™

Advancing performance & comfort



Our dendritic polymers

- Secure exceptional firmness and comfort in flexible polyurethane foam
- Improve the Tg/flexibility ratio of cast polyurethane elastomer products
- Ensure rapid curing, excellent durability and high performance in UV curing applications
- Provide reduced VOC and improved performance in architectural coatings

Advancing performance & comfort

Sharpen your competitive edge by partnering with the global leader in bringing cost-effective dendritic polymers to the market. Dendritic polymers are characterized by a densely branched backbone and a large number of reactive groups. Their globular structures have excellent flow and processing properties at high molecular weight. The exceptional concentration of reactive groups facilitates customization of properties for a wide range of end uses.

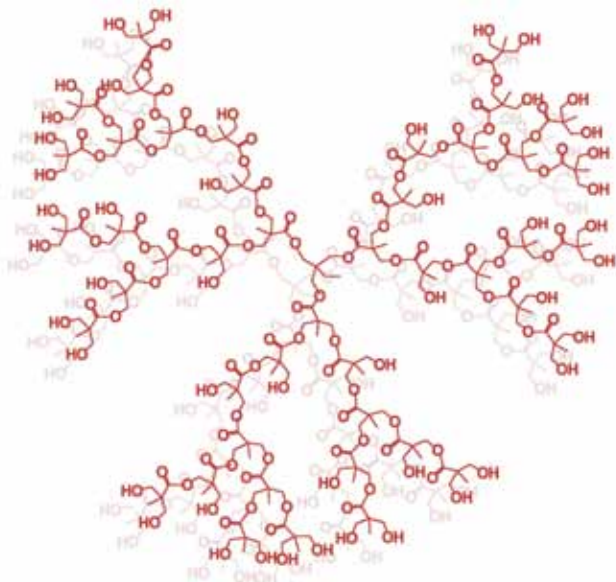
The main applications of Boltorn™ dendritic polymers:

- Performance additives for flexible polyurethane foam, such as in automotive seating applications
- Oligomer precursors for UV-curing applications for excellent scratch resistance, adhesion and flexibility
- Water-dispersing additives for partial replacement of solvents with water in solvent-borne paints
- Reactive diluents for VOC control with maintained drying properties in high-solid alkyd paints

Boltorn™ technology

- Large number of primary hydroxyl groups
- Densely branched polymer backbone
- Extensive formulation possibilities

Boltorn™ dendritic polymer



The cutting edge of technology

Our Boltorn™ products are produced using polyalcohol cores, hydroxy acids and technology based on captive materials. The dendritic structures are formed by polymerization of the particular core and 2,2-dimethylol propionic acid (Bis-MPA). The base products obtained are hydroxyl-functional dendritic polyesters. Fully aliphatic and consisting only of tertiary ester bonds, they provide excellent thermal and chemical resistance. Extensive branching also improves reactivity, lowers viscosity and results in balanced mechanical properties.

Our dendritic polymer range:

Boltorn™ H2004

6 terminal hydroxyl groups,
nominal molecular weight of 3,100 g/mol

Boltorn™ H311

23 terminal hydroxyl groups,
nominal molecular weight of 5,300 g/mol

Boltorn™ P500

Formulated bimodal product with terminal hydroxyl groups,
nominal molecular weight 1,800 g/mol

Boltorn™ P501

Formulated bimodal product with terminal hydroxyl groups,
nominal molecular weight 1,700 g/mol

Boltorn™ P1000

Formulated bimodal product with terminal hydroxyl groups,
nominal molecular weight 1,500 g/mol

Boltorn™ U3000

Modified with unsaturated fatty acid,
nominal molecular weight 6,500 g/mol

Boltorn™ W3000

Modified with non-ionic groups and unsaturated fatty acid,
nominal molecular weight 10,000 g/mol

By using our unique technology it is possible to tailor make Boltorn™ products. For further information please visit www.perstorp.com or contact one of our specialists to discuss your requirements in more detail.

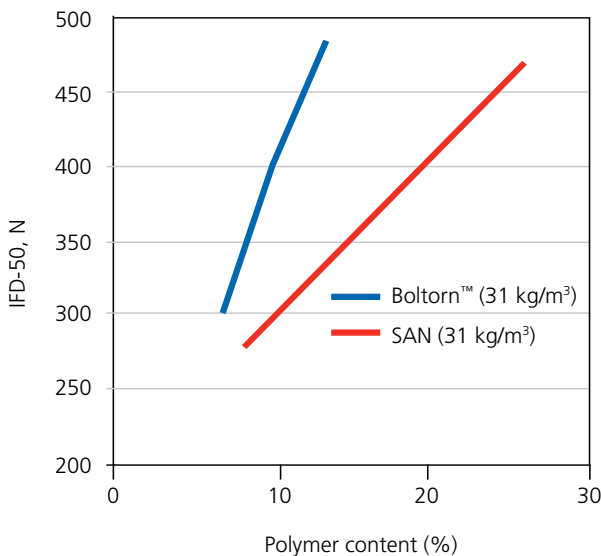
Boltorn™ for polyurethanes

Millions of car owners already enjoy superior seating comfort with the help of Boltorn™ technology. In partnership with a leading automotive foam supplier, we have developed a unique technology that improves the firmness of high-resilience foam articles with dendritic polymer polyols.

Boltorn™ H311 – for exceptional firmness & stability

This liquid polymer polyol provides exceptional compressive load-building characteristics in flexible foam at very low addition levels. It is used as an additive, partially replacing conventional cross-linkers or graft co-polymer polyols of SAN-type. Compared to conventional technology, Boltorn™ H311 offers considerable benefits:

- Two to three times the efficiency in providing compressive loads (IFD or CFD) at a given addition solids level, which allows lower average solids levels to be used
- Exceptional firmness, extending beyond current state-of-the-art technology
- Improved foam stability due to the cross-linking mechanism and reduced surface voids of finished parts



Compressive load as function of polymer content for Boltorn™ H311 vs. co-polymer polyols

Boltorn™ P500 – for high firmness at low compression set

Our dendritic polymer polyol for molded foam is a product that yields exceptionally low compression set at high firmness when used with graft co-polymer polyols. The low compression set allows you to operate at reduced foam density and still meet the comfort specifications of end users.

Formulation	60-15	50-11-4
SAN, %	15	11
Boltorn™ P500, %	0	4
Density, kg/m³	60	50
IFD-25, N	239	192
IFD-65, N	633	558
Dry set, %	4	2.9

Standard high resilience molded formulation. Density reduction at reduced compression set when using Boltorn™ P500.



Innovative Performance

Boltorn™ for radiation curing

Oligomer precursors for superior performance

Boltorn™ products enhance radiation curing applications by providing oligomer precursors that significantly increase the average molecular weight of UV formulations at high acrylate concentration. Acrylates based on Boltorn™ technology are typically used to partially or fully replace urethane acrylates, other top-end oligomers or acrylates of high functionality.

Acrylate oligomers based on Boltorn™ dendritic polyols offer significant benefits:

- Excellent reactivity
- Improved scratch resistance and film hardness
- Low shrinkage and good adhesion
- Exceptional flow properties and good pigment wetting
- Improved labeling with low extractables
- Unique molecular weight/viscosity ratio

For coatings, the balance between flow and properties like reactivity, and chemical and scratch resistance, is crucial for meeting end-user demands. Environmental compliance is also a key competitive factor. Radiation curing systems, typically UV, have gained market share in the past decades since very rapid curing and excellent film properties are obtained with low or no VOC emissions.



Boltorn™ P500 & P501 – designed for hardness

Boltorn™ P500 and Boltorn™ P501 has been specifically tailored to offer a good balance between hardness and flexibility. The acrylate of Boltorn™ P500 achieves an ideal balance between hardness, flexibility and reactivity together with a low viscosity. Boltorn™ P501 has been custom designed to further boost scratch resistance and hardness of UV cured coatings while maintaining all the other excellent properties of Boltorn™ P500.

Boltorn™ P1000 – for monomer free formulation

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

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.

	DPHA	Boltorn™ P500 acrylate	Boltorn™ P501 acrylate
Viscosity, 100% solids (mPas, 23°C)	12,800	500	600
Pencil hardness on PC	5H/6H	H/2H	3H/4H
Adhesion crosscut on PC	Fail (GT-5)	OK (GT-0)	OK (GT-0)
Steel wool rubs (50 rubs) on PC, gloss 20°, %	98.5	95.7	98.2

All coating formulations contain 4% Irgacure 250, are applied 6 µm thick on Polycarbonate and cured by using 250 mJ/cm²



Designed to enhance

Boltorn™ for architectural coatings

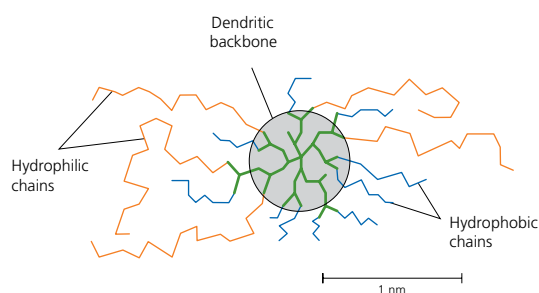
Our Boltorn™ performance additives for solvent-borne and water-borne architectural coatings help coating formulators comply with environmental demands without compromising coating performance. A number of patented technologies have been developed in which Boltorn™ additives improve the performance of architectural coatings. Achieve excellent properties including reduced VOC and improved drying in wood stain and reduced cost at lower VOC in water-extended solvent-borne paints.

Boltorn™ U3000 – unique flow properties

For high-solid alkyds, the branched structure of Boltorn™ U3000 provides unique flow properties, which allows wood-stains and alkyd paints for outdoor applications to comply with recent VOC demands while still securing rapid drying and durability.

Boltorn™ W3000 – add 1% and gain 10%

The unique properties of dendritic polymers offer extensive design possibilities. With Boltorn™ W3000, we have developed a water-dispersing additive that contains non-ionic as well as unsaturated fatty acid chains. This highly efficient product allows paint formulators to partially exchange solvent for water. By adding approx. 1% of Boltorn™ W3000 to a solvent-borne paint, 15% of the solvent can be replaced with water. The resulting paint will have a similar paint performance at a lower cost per liter and with reduced air emissions.



Schematic structure of Boltorn™ W3000

Formulation	Conventional woodstain	+40wt% Boltorn™ U3000
Type	oil/alkyd	oil/alkyd/dendritic alkyd
VOC, g/l	595	238
Viscosity, 23°C, mPas	28	72

Drying properties (45µm dry film)		
Film hardness-1 day, Ks	5	45
Film hardness-10 days, Ks	27	35
Film hardness-17 days, Ks	27	33
Film hardness-31 days, Ks	26	33

Effect on VOC and drying properties when adding Boltorn™ U3000 to a conventional woodstain available in Scandinavia

High-gloss paint for brush application	Water-extended paint with Boltorn™ W3000	Solvent-borne alkyd paint reference
Boltorn™ W3000, wt% in paint	1.34	-
Alkyd (OL65), wt% in paint	27.8	33.1
Water content, wt% in paint	15.1	-
PVC, wt%	18.7	18.7
VOC, g/l	340	420
Gloss, 60°, %	94	92
Drying*		
Dust dry, h	0.5	0.5
Tack-free, h	2.5	2.5
Through-dry, h	3.0	3.0
Hard, h	3.5	7.0

* Beck-Koller, glass panels at 23°C, 50% humidity, 25 µm DFT

The physical properties of a water-extended solvent-borne alkyd paint containing Boltorn™ W3000 compared to a solvent-borne counterpart



Product data summary

Product	Soluble in	Appearance	Water cont. wt%	OH-value mg KOH/g	Mw (GPC) g/mol	Tg (DMA) °C	Viscosity, Pas (°C)
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Molded flexible foam

Boltorn™ H311	Polyether/ polyester polyols	Yellow liquid	9.5 – 10.5	230 – 260	5,700	-5	40 (23)
Boltorn™ P500	Polyether polyols	Clear liquid	<0.5	560 – 630	1,800		15 (23)

Product	Soluble in	Appearance	Functionality	OH-value mg KOH/g	Mw (GPC) g/mol	Tg (DMA) °C	Viscosity, Pas (°C)
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Radiation curing

Boltorn™ P500	Acrylic acid + toluene	Clear liquid	Mixed hydroxyl	560 – 630	1,800 (bimodal)	–	12 (23)
Boltorn™ P501	Acrylic acid + toluene	Clear liquid	Mixed hydroxyl	690 – 750	1,700 (bimodal)	–	23 (23)
Boltorn™ P1000	Acrylic acid + toluene	Clear liquid	Mixed hydroxyl	430 – 490	1,500 (bimodal)	–	5 (23)
Boltorn™ H2004	EtOH, Toluene, Xylene	Yellow liquid	6	105 – 125	3,200	-35	15 (23)

Product	Soluble in	Appearance	Functionality	Oil length % triglyc.	Mw (GPC) g/mol	Solids, %	Viscosity, Pas (°C)
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Architectural, waterborne coatings

Boltorn™ U3000	Oils, coalescents, EtOH, Xylene	Yellow liquid	Air-drying	75	6,500	99	1 (23)
Boltorn™ W3000	Emulsifying, soluble in alkyds, co-solvents, xylene	Yellow wax	Amphiphilic Air-drying	45 (fully aliphatic)	9,000	99	2 (35)



Precisely tailored
end-product properties





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