TIPPLEN
TATREN

PRODUCT CATALOGUE

POLYPROPYLENE

MOL GROUP
THINK. CREATE. MOVE.

TVK

Slovnaft

INTRODUCTION

TIPPLEN
TATREN

Along with petrochemical units of SLOVNAFT, a.s. in Bratislava, **TVK Plc.** is composing the Petrochemical business in the MOL Downstream Division, which holds leading position in Central Europe's petrochemical sector and is one of the ten largest polymer producers in Europe.

We can highly lean on the refinery integration benefits in the MOL Downstream Division: the secured feedstock supply, the robust financial background and strong position in the regional markets, together with the high quality products of the optimized production capacities. We keep operational reliability up by regular maintenance programs, carried out at our production units.

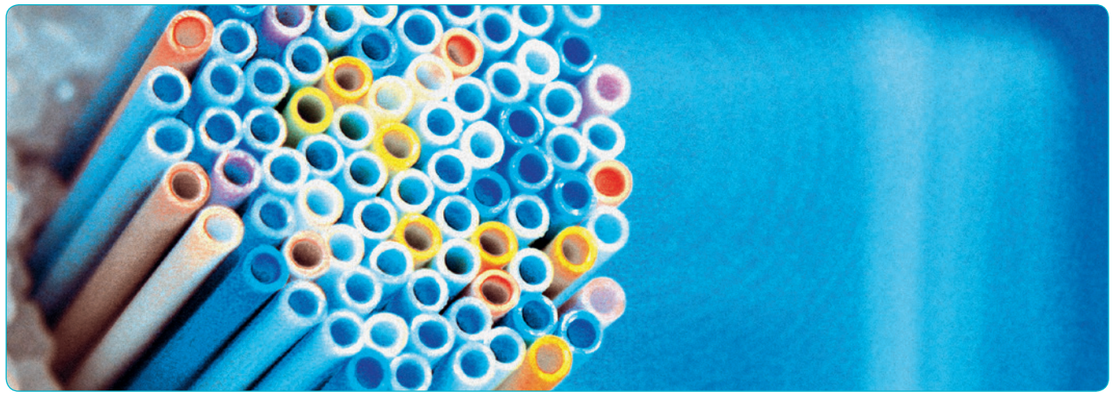
Our prime objective is maintaining our petrochemical leadership in the Central and Eastern European polymer markets where the demand growth perspectives exceeds Western European figures.

Our advantageous location in the Central European markets and our competitive portfolio of high quality polyolefin products - optimized in line with customer requirements - provide a firm basis for exploiting the opportunities arising from the surge of demand for polymers in Central and Eastern Europe.

Corporate History

1999 MOL acquired minority stake in TVK Plc.
2001 MOL became majority owner in TVK with a stake over 33.34%
2004 MOL acquired majority stake in TVK (44.31%) and in SLOVNAFT (98.4%)
MOL Petrochemicals Division established: the product range has been streamlined and the sales channels integrated in order to provide competitive edge to our customers on their markets
2011 Petrochemical business integrated into the Downstream Division of MOL Group

TIPPLEN is the registered trademark of TVK Plc. and **TATREN** is the registered trademark of SLOVNAFT, a.s. Our product portfolio includes isotactic homopolymers, impact copolymers and random copolymers.



POLYPROPYLENE

general information

Polypropylene is a colourless and odourless thermoplastic polymer, translucent in the natural state and can be pigmented in a number of colours and shades.

All types of TIPPLEN and TATREN grades are first of all characterized by high polymer purity and consistent quality. This is due to the highly sophisticated production process in which Ziegler-Natta catalysts are used.

The most important properties of the polypropylene grades are the following:

- Low density
- High hardness, abrasion resistance and rigidity
- Good heat resistance (up to 100 °C if not subjected to mechanical stresses)
- Versatile, easy processability
- Outstanding resistance to several chemicals
- Good impact strength
- Low water absorption and water-vapour permeability

These properties, which vary according to certain parameters (melt flow rate, etc.), differ between homopolymers and copolymers. The essential difference between copolymers and homopolymers is that copolymers have good impact strength even at low temperatures.

Polypropylene has very good mechanical properties which result from regular structure and molecular weight distribution.

Polypropylene is a good insulator with very low dielectric constant and low dissipation factor. Dielectric strength depends on the temperature and the wall thickness of an item. Dielectric strength of thin wall items is very high.

Chemical resistance of polypropylene is excellent. Diluted and concentrated mineral acids and bases, polar solvents, high-molecular aliphatic compounds and inorganic salts and their solutions practically have no effect on polypropylene. This property is preserved even at high temperatures. However, it is swollen by low-molecular aliphatic, aromatic and chlorinated hydrocarbons. Strong oxidizing agents attack it at room temperature.

UV radiation and higher temperatures of the environment negatively affect physical and mechanical properties of polypropylene. Therefore it is necessary to protect PP products against these effects, mainly in outdoor applications.

APPLICATION

The wide range of grades and the consequent variation of their characteristics allow TVK Plc. and SLOVNAFT, a.s. polypropylene to be used in highly different fields of application, which are briefly described as follows:

- PIPES (RIGID AND FLEXIBLE, PRESSURE PIPES, CORRUGATED, ETC.) AND THEIR RELATIVE FITTINGS
- EXTRUDED AND CAST SHEETS, CORRUGATED SHEETS, PROFILES
- EXTRUDED SHEETS FOR THE THERMOFORMING OF CONTAINERS
- RIGID AND FLEXIBLE STRAPS
- MONOFILAMENTS, FIBRES, STAPLE FIBRE, ETC., SLIT AND SPLIT FILM YARN, ROPES AND TWINES
- NON-WOVEN FABRICS (SPUN BONDED)
- HOUSEHOLD ARTICLES, TOYS
- PARTS FOR HOUSEHOLD APPLIANCES, BATTERY CASES
- ARTICLES AND PARTS FOR THE ELECTRICAL, AUTOMOTIVE, ELECTRONICS AND TEXTILE INDUSTRIES
- INJECTION OR BLOW MOULDED CONTAINERS FOR FOODSTUFFS, COSMETICS, TOILETRIES, DETERGENTS AND PHARMACEUTICALS
- HIGH SPEED INJECTION MOULDED FOOD-GRADE CONTAINERS
- TRANSPARENT CAST AND BLOWN FILM, BIORIENTED FILM
- FURNISHING (CHAIRS AND CHAIR BACKS, TABLE TOPS, ETC.)

CODING SYSTEM - TATREN

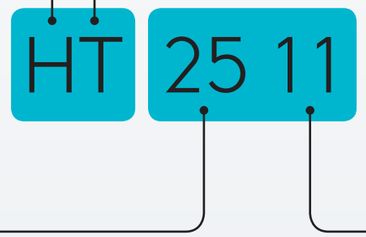
TATREN COMMERCIAL GRADES ARE CODED BY TWO LETTERS AND TWO GROUPS OF DIGITS.

The first letter represents the structure of the material

H = Homopolymer
I = Impact copolymer
TPO = Thermoplastic Olefin
R = Random copolymer

The second letter represents typical application

G = General purpose
M = Moulding
T = Textile



The first group of numbers represents the MFR.

The second group of numbers represents internal code.

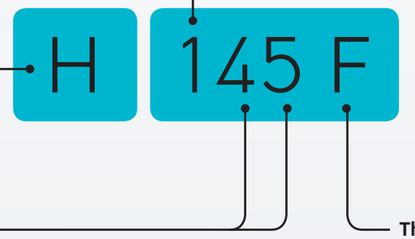
CODING SYSTEM - TIPPLEN

TIPPLEN STANDARD GRADES ARE CODED USING A SYSTEM OF A LETTER, THREE OR FOUR DIGITS AND ONE/TWO LETTERS.

The first letter denotes the chemical nature of the polymer:

H = Homopolymer
K = Impact copolymer
R = Random copolymer

The melt flow index range of the polymer is indicated by **the first digit** in three-digit numbers **and by the first two-digits** in four-digit numbers.



Internal code

The last letters indicate the specific properties of the polymer.

POSSIBLE SPECIFIC PROPERTIES
A = antistatic
F, FH = film or fibre grade

HOMOPOLYMERS

Grade/Parameter	Melt Mass-Flow Rate (MFR) 230 °C/2.16 kg	Flexural Modulus *	Modulus of Elasticity in Tension *	Tensile Stress at Yield *	Tensile Strain at Yield *	Notched Izod Impact at 23 °C *	HDT 0.45 MPa *	Hardness Rockwell *	Special features	Special additives	Application
Units	g/10 min	MPa	MPa	MPa	%	kJ/m²	°C	R scale	-	-	-
Test methods	ISO 1133-1	ISO 178	ISO 527-1,2	ISO 527-1,2	ISO 527-1,2	ISO 180/A	ISO 75-1,2	ISO 2039/2	-	-	-
H 880	0.30	1950	1650	40	10.5	8.5	113	93	good mechanical properties, excellent long-term heat stability	SA	extrusion, pipes, thick sheets
H 781 F	0.70	1750	1450	37	10.5	12	104	93	excellent processability, balanced mechanical properties	SA	extrusion, blow moulding, sheets
H 681 F	1.7	1650	1550	36	10	6.5	98	96	good mechanical properties, excellent processability	SA	extrusion, sheets for thermoforming, blown bottles
H 659 F	1.7	1900	1800	40	8	6	120	102	excellent optical properties, outstanding stiffness	NA	extrusion, sheets for thermoforming, blown bottles
H 649 FH	2.5	1700	1600	38	9.5	6.5	108	99	bimodal, for high-speed production, metallizable grade, excellent optical properties	-	biaxially oriented film
H 650 F	3	1700	1600	38	9.5	5.5	105	100	bimodal, for high-speed production, metallizable grade, excellent optical properties	-	biaxially oriented film
H 543 F	4	1700	1600	38	9	5	105	101	low water carry-over	-	extrusion, weaving tapes, split film yarns
H 583 F	4.2	1700	**1500**	37.5	9.3	4.6	100	99	low water carry-over, improved tensile strength	SA	monofilaments, split film yarn, geotextile
H 483 F	6.5	1700	1550	37.5	9	4	94	98	good mechanical properties	SA	monofilaments, split film yarns
H 388 F	9	1500	1400	36	10	3.5	95	98	controlled rheology, high transparency and gloss	AB, SA	cast and blown film
H 145 F	28	1900	1750	39	8	2.5	109	104	high gas-fading resistance	SA, AGF	low denier staple fibre, BCF and CF multifilaments
H 949 A	45	1900	1800	39.5	9	2	118	104	controlled rheology, outstanding processability for shorter cycle times	NA, AS	thin wall injection moulding, DVD shells, household and camping articles

Additives:
SA slip agent
AB antiblocking agent
NA nucleating agent
AS antistatic agent
AGF anti gas fading

Notes: * Values have been measured on standard injected moulded specimens prepared in accordance with ISO 1873-2.

HOMOPOLYMERS

Grade/Parameter	Melt Mass-Flow Rate (MFR) 230 °C/2.16 kg	Flexural Modulus *	Modulus of Elasticity in Tension *	Tensile Stress at Yield *	Tensile Strain at Yield *	Notched Izod Impact at 23 °C *	HDT 0.45 MPa *	Hardness Rockwell *	Special features	Special additives	Application
Units	g/10 min	MPa	MPa	MPa	%	kJ/m²	°C	R scale	-	-	-
Test methods	ISO 1133-1	ISO 178	ISO 527-1,2	ISO 527-1,2	ISO 527-1,2	ISO 180/A	ISO 75-1,2	ISO 2039/2	-	-	-
HT 3 06	3	1850	1900	36	8.5	6	102	102	low water carry-over	-	high tenacity raffia, monofilaments, marine ropes, excellent for carpet backing, extrusion, injection moulding
HG 10 07	10	1900	1950	36	7.5	4	98	102	good colour stability, superior spinning characteristics, good optics	AGF	staple fibres, cast film, core layer at co-extrusion, injection moulding of sanitary equipments, caps, closures, small technical items
HT 25 11	25	1450	1550	32	10	3.5	78	98	controlled rheology, low smoke	AGF	spun bond, extrusion coating of PP fabrics, injection moulding
HM 50 46	50	1800	1900	36	8	3	95	101	controlled rheology, enhanced stiffness and good dimensional stability	NA, AS	thin wall containers, household articles, buckets, caps and closures, lids and trays, garden furniture, boxes for food packaging

Additives: NA nucleating agent
AS antistatic agent
AGF anti gas fading

Notes: * Values have been measured on standard injected moulded specimens prepared in accordance with ISO 1873-2.

RANDOM COPOLYMERS

Grade/Parameter	Melt Mass-Flow Rate (MFR) 230 °C/2.16 kg	Flexural Modulus *	Modulus of Elasticity in Tension *	Tensile Stress at Yield *	Tensile Strain at Yield *	Notched Izod Impact at 23 °C *	HDT 0.45 MPa *	Hardness Rockwell *	Haze **	Special features	Special additives	Application
Units	g/10 min	MPa	MPa	MPa	%	kJ/m²	°C	R scale	%	-	-	-
Test methods	ISO 1133-1	ISO 178	ISO 527-1,2	ISO 527-1,2	ISO 527-1,2	ISO 180/A	ISO 75-1,2	ISO 2039/2	ISO 14782	-	-	-
R 780	0.50	1050	900	30	12	21	82	75		excellent processability, good heat stability, expandable	-	automotive components, foamed sheets
R 660	2	1000	900	28	12	25	78	75	11	excellent clarity and gloss	CA	extrusion, blow moulded bottles, injection stretch blow moulding
R 351 F	8.5	900	850	27	12	5	74	77		excellent transparency, gloss and very good heat weldability	SA, AB	cast and blown film for foodstuffs, stationery, clothes packaging
R 359	12	1100	1050	29	13	5	80	81	11	very good transparency and excellent gloss	CA	injection moulding for packaging cosmetics, herbs, household articles
R 959 A	45	1050	1000	30	12	3.5	84	80	8.5	reactor grade, excellent organoleptic properties, very good transparency and excellent gloss	AS, CA, OW	thin wall injection moulding for packaging cosmetics, sweets, household articles
R 1059 A	85	1100	1000	29	12	3	89	80	10	controlled rheology, excellent optical properties, good resistance to warping	AS, CA, OW	thin wall injection moulding for packaging cosmetics, sweets, household articles
RM 60 57	60	1300	1350	30	12	4	78	85	12	controlled rheology, excellent processing stability, good transparency, high gloss	CA, AS	thin wall injection moulding, food packaging, media boxes, household articles
RM 45 55 CLEAR	45	1250	1300	30	12	4	74	85	9.5	reactor grade, excellent organoleptic properties, excellent transparency, high gloss, very good processing stability	CA, AS	thin wall injection moulding especially food packages, household articles, cups, closures, media boxes
RM 85 82 CLEAR	85	1300	1300	30	12	3.5	72	85	10	reactor grade, excellent organoleptic properties, excellent transparency, high gloss, very good processing stability	CA, AS	thin wall injection moulding especially food packages, household articles, cups, closures, media boxes

CLEAR:
C - Clarified by last generation clarifying agent
L - Low odor and C-emissions
E - Economical processing conditions
A - Attractive appearance, fresh look of packed products
R - Reactor grade

Additives:
SA slip agent
CA clarifying agent
AB antiblocking agent
AS antistatic agent
NA nucleating agent
OW optical whitener

Notes: * Values have been measured on standard injected moulded specimens prepared in accordance with ISO 1873-2.

** Values has been measured on specimens with 1 mm wall thickness

IMPACT COPOLYMERS

Grade/Parameter	Melt Mass-Flow Rate (MFR) 230 °C/2.16 kg	Flexural Modulus *	Modulus of Elasticity in Tension *	Tensile Stress at Yield *	Tensile Strain at Yield *	Notched Izod Impact at 23 °C *	Notched Izod Impact at -20 °C *	HDT 0.45 MPa *	Hardness Rockwell *	Special features	Special additives	Application
Units	g/10 min	MPa	MPa	MPa	%	kJ/m²	kJ/m²	°C	R scale	-	-	-
Test methods	ISO 1133-1	ISO 178	ISO 527-1,2	ISO 527-1,2	ISO 527-1,2	ISO 180/A	ISO 180/A	ISO 75-1,2	ISO 2039/2	-	-	-
K 850	0.23	2000	1800	36	8	42	5	116	85	excellent heat and detergent resistance, very high stiffness and good weldability	SA, NA	extrusion, corrugated sewage pipes, gigapipes, sheets
K 880	0.35	1500	1300	30	11	53	7.5	97	76	excellent heat and detergent resistance, very high impact strength	SA	extrusion, pipes, sheets, blow moulding
K 793	0.70	1450	1300	30	10	55	6	88	76	very high impact strength	SA	corrugated cardboards, corrugated pipes, extrusion, sheets, blow moulding
K 691	1.3	1600	1450	30	7	56	6	100	82	high impact strength and stiffness	SA, NA	corrugated cardboards
K 693	2	1450	1250	29	8	25	6	88	79	high impact strength and stiffness	SA	corrugated cardboards, corrugated pipes, extrusion, sheets, blow moulding, injection moulding
K 695	2	1400	1300	30	9	30	4.5	88	79	good mechanical properties, low gel content	SA	cast film, corrugated cardboards, sheet for thermoforming
K 597	4	1150	1100	24	7	48	7	77	70	outstanding high impact strength	SA	injection moulding, automotive components, battery cases
K 499	6.5	1300	1200	28	6	14	5	94	83	excellent resistance to heat and chemicals	SA	injection moulding, automotive components, battery cases, crates, boxes, dowels
K 395 A	12	1400	1300	27	5	9	4	106	90	high stiffness	NA, AS	injection moulding, household articles, pails, boxes, garden furniture
K 295 A	20	1600	1550	29	4	6	4	115	92	high stiffness	NA, AS	thin wall injection moulding, household articles
K 199	30	1400	1350	26	5	5.5	3.5	105	87	reactor grade, low C-emmisions and odour, good flow	NA	thin wall injection moulding, automotive components
K 948	45	1350	1350	27	5	5	3	97	88	reactor grade, excellent organoleptic properties, low C-emmisions	NA	high-speed injection moulding, thin-walled packaging containers, pails, covers, garden furniture, automotive components
TPO 12 76	12	900	1000	18	11.5	45**	32**	68	-	controlled rheology, extra high impact strength, good impact/stiffness balance	NA	compounding, automotive applications and bumpers, injection moulding
TPO 20 77	20	950	1000	18.5	10	42**	30**	70	-	controlled rheology, extra high impact strength, good impact/stiffness balance	NA	compounding, automotive applications and bumpers, injection moulding
IM 6 56	6	1500	1550	28	6	10	4.5	96	86	excellent long-term heat stability, high stiffness and good impact resistance	AS	injection moulding of parts for household appliances, auto battery cases and technical items where long term heat resistance is required
IM 12 59	12	1450	1450	24.5	5	10	5	88	80	high stiffness, good impact resistance	NA	injection moulding of rigid packaging, storage and transport boxes, household articles and technical items
IM 22 63	22	1350	1350	24	5.5	10	4.5	82	77	controlled rheology, high stiffness, good impact resistance	NA, AS	injection moulding of rigid packaging, household articles, garden furniture and technical items
IM 25 75	25	1150	1200	21	5.5	40**	6**	80	55	controlled rheology, excellent impact resistance and good stiffness	NA, AS	heavy duty injection moulded products, medical and transport containers, crates, boxes, technical items, compounding
IM 55 80	55	1450	1450	23	4	7	4	88	82	reactor grade, excellent organoleptic properties, high stiffness, good impact resistance, good flow	NA, AS	high-speed thin wall injection moulding of rigid packaging, household articles, garden articles and technical items
IM 75 81	75	1450	1450	23	4	6	3.5	88	82	reactor grade, excellent organoleptic properties, high stiffness, good impact resistance, good flow	NA, AS	high-speed thin wall injection moulding of rigid packaging, household articles, garden articles and technical items
IM 100 85	100	1500	1500	24	4	4	3	92	82	reactor grade, excellent organoleptic properties, high stiffness, good impact resistance, very good flow and good dimensional stability	NA, AS	high-speed thin wall injection moulding of rigid packaging, products of complicated shapes, household articles, garden articles and technical items

Additives:
SA slip agent
NA nucleating agent
AS antistatic agent

Notes: * Values have been measured on standard injected moulded specimens prepared in accordance with ISO 1873-2
** Values have been measured on standard injected moulded specimens prepared in accordance with internal method

PRODUCT SELECTION CRITERIA BASED ON THE TYPE OF POLYPROPYLENE

Selection criteria		Homopolymer	Random copolymer	Impact copolymer and TPO
Stiffness		first choice	not recommended	second choice
Toughness	>0 °C	second choice	second choice	first choice
	<0 °C	not recommended	second choice	first choice
Transparency		second choice	first choice	not recommended

EFFECT OF NUCLEATION ON TECHNICAL PROPERTIES

Technical properties	Trend
Stiffness	+
Impact resistance	=
Transparency*	+
Cycle time	+
Shrinkage (total)	-
Processability	+

+ improvement = no change - decline

* Nucleating agent slightly improves transparency of homopolymers and random copolymers. Much better optical properties using special type of nucleator – clarifying agent – are achieved. Nucleated impact copolymers are never transparent, they are opaque.

SUPPLEMENTARY INFORMATION MISCELLANEOUS PROPERTIES OF POLYPROPYLENE RESINS*

Physical	Density (ISO 1183-1)	0.9 g/cm^3
	Bulk Density (ISO 60)	0.46-0.58 g/cm^3
	Melting point (ISO 11 357-3)	
	Homopolymer	156-165 °C
	Impact copolymer	158-165 °C
	Random copolymer	130-150 °C
	Water absorption (ASTM D570)	<0.03%
	Mould Shrinkage (ISO 294-4)	1.1-2.5%
Thermal	Thermal Conductivity (ASTM C518)	
	solid	0.23 W/(m·K)
	melt	0.16 W/(m·K)
	Coefficient of Linear Expansion	
	at 20 °C	1.1 ·10^{-4} K^{-1}
	at 80 °C	1.7 ·10^{-4} K^{-1}
	Specific heat (ASTM D2766)	
	at 23 °C	1.68 J/(g·K)
	at 100 °C	2.10 J/(g·K)
Electrical	Dielectric Constant (DIN 53 483)	2.27 (at 50 Hz)
	Dielectric Strength (DIN 53 481)	500 kV/cm
	Volume Resistivity (DIN 53 482)	>10^{17} Ω·cm
	Surface Resistivity (DIN 53 482)	10^{14} Ω
	Dissipation Factor (DIN 53 483)	<4·10^{-4} (at 50 Hz)

*Properties of individual product shipments may vary slightly from published properties. This information is provided upon the condition that users should make their own test to determine the safety and suitability of each product for their own purposes.

STORAGE AND HANDLING

Pellets are packed in 25 kg PE-LD bags and transported on shrink-wrapped or stretch-wrapped pallets at eligible load of polymer 1375 kg. We use adhesive between the bags in order to avoid their slipping. Pay attention to this fact during the removing of the bags from the pallets. The prefered method is to lift the bag at first without rotation. Heat treated pallets are available as well. Transportation in a road silo or rail silo is also available. For more detailed information please contact SLOVNAFT and TVK sales representative.

Since polypropylene is a combustible substance, the fire safety rules applicable for combustible materials in warehouses and store rooms should be observed.

If polymer is stored in conditions of high humidity and fluctuating temperatures, then atmospheric moisture can condense inside the packing. If it happened, it is recommended the pellets to be dried before use. During the storage polypropylene should not be exposed to UV radiation and temperatures above 40 °C. Producer does not take responsibility for any damages caused by adverse storage.

REACH STATEMENT

Polymers are exempt of REACH registration. However, their raw materials which mean monomers and relevant additives have been registered. SLOVNAFT, a.s./TVK Plc. is committed to fully respect this legislation and will only use REACH compliant raw materials. At this point in time PP TATREN/TIPPLEN does not contain any substances specifically identified as SVHC at levels greater than 0.1%.

APPLICATION FOR FOODS

Most TIPPLEN and TATREN grades satisfy the regulations applied by the European countries (EEC). Because several European countries apply restrictive regulations for the allowed migration values of additives in packaging material in contact with food, it is recommended that customers contact TVK and SLOVNAFT for some special information or product licenses for food industry.

SAFETY

Under normal circumstances, polypropylene is not regarded as hazardous material when in contact with the skin or when inhaled. However, any contact with the molten polymer or the inhalation of the released gases should be avoided in processing. It is recommended to install exhaust units over processing machines and to secure good ventilation of the place. For further information see Material Safety Data Sheet.

RECYCLING

Polypropylene resins are suitable for recycling using modern recycling methods. In-house production waste should be kept clean to facilitate direct recycling.

DISCLAIMER

The information provided in this publication has been compiled to the best of our present knowledge. However, in view of the various applications of polypropylene resins and the equipment used, the processing conditions may differ.

The recommendations and data herein are to be construed as informatory only and do not relieve users from carrying out their own tests and experiments prior to processing in order to check suitability for a specific use. It is the responsibility of those to whom we supply our products to ensure that any proprietary rights and existing laws and legislation are observed. Our products are under continuous development, therefore we reserve the right to change the information presented in this brochure at our own discretion.

The REACH statement herein does not constitute legal advice. The REACH statement is provided for informational purpose only.

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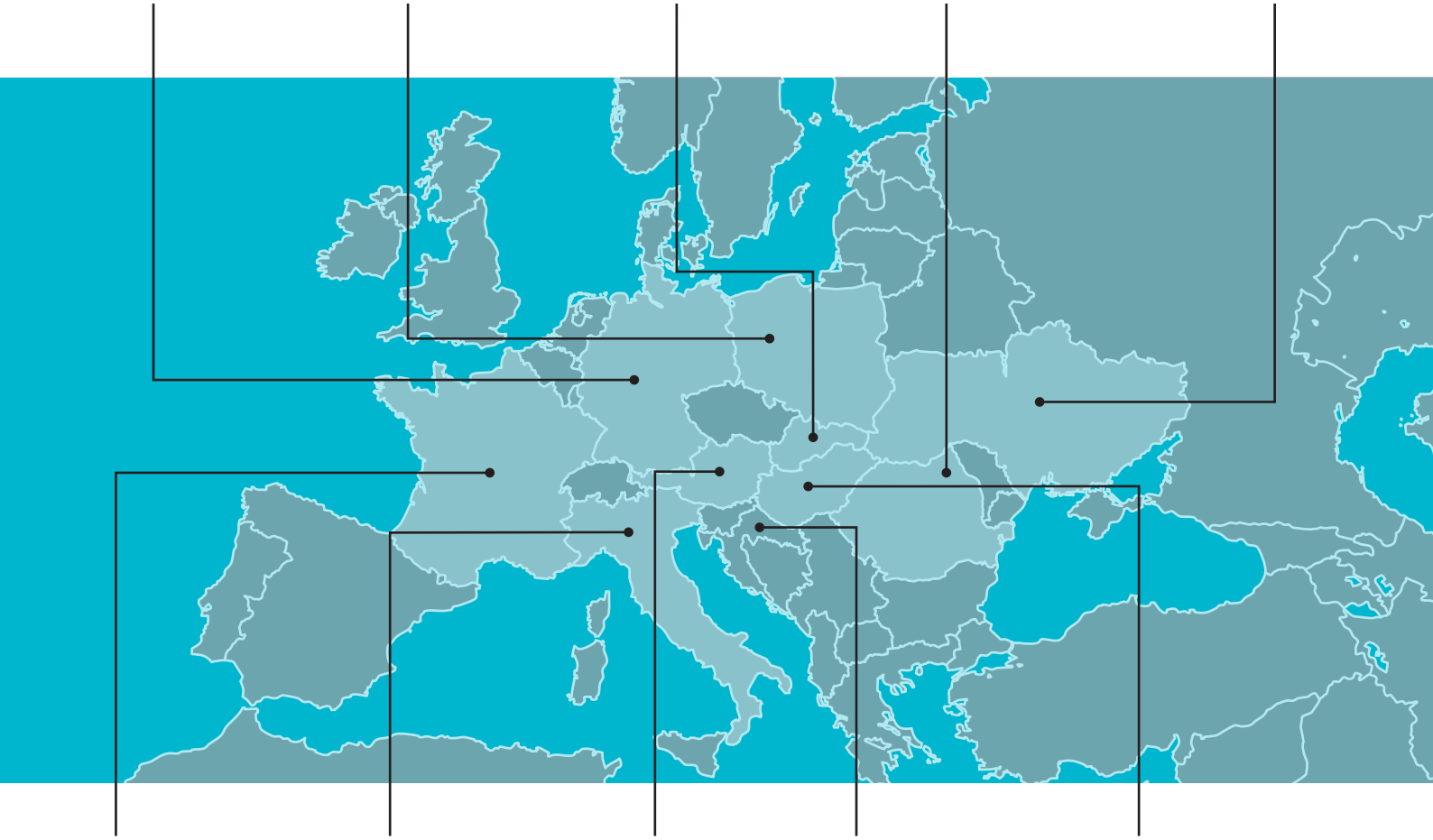

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CERTIFICATES

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Published in March 2015

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