

CHEMISTRY THAT MATTERS™

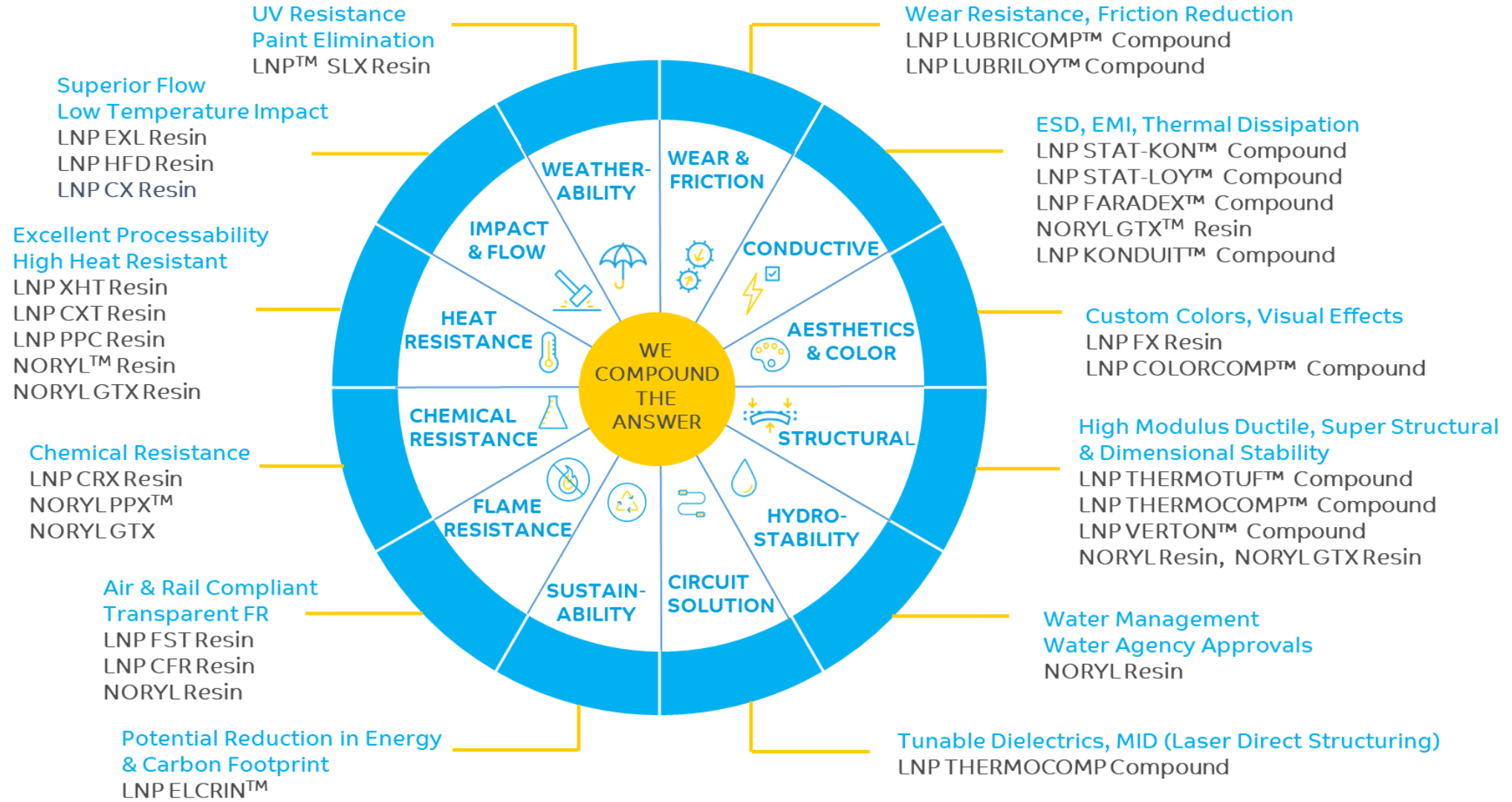


LNP™ ATEX - COMPLIANT PC-COPOLYMER BASED SOLUTIONS

March 2021



LNP™ COMPOUNDS, LNP COPOLYMERS AND NORYL™ RESINS – OVERVIEW



THE PREVENTION OF ELECTROSTATIC DISCHARGE

WHAT IS ELECTRICAL RESISTIVITY AND CONDUCTIVITY?

Electrical Resistivity, also referred to as resistivity, specific electrical resistance, or volume/surface resistivity, is an intrinsic material property that quantifies how strong a given material opposes the flow of electric current. Electrical conductivity or specific conductance is the reciprocal value of electrical resistivity, and is a measure of a material's ability to conduct an electric current.

- Electrical Conductivity does not come naturally with plastics, 99 % of plastics are poor conductors and are electrical insulators
- As opposed to plastics, metals are excellent electrical conductors

SURFACE RESISTIVITY



WHAT IS ELECTROSTATIC CHARGE AND DISCHARGE

Electrostatic charge is a localized build up of voltage caused by a transfer of electrons from e.g. friction.

Electrostatic Discharge (ESD) refers to the movement of an electrostatic charge or voltage via an arc or spark to a body of sufficiently different (lower) electrical potential.

Electrostatic discharges can:

- ground to humans causing a shock
- destroy IC chips or disk drives
- disrupt electrical component operation
- initiate combustion or explosions (ATEX)

Combustion & explosions



Damaged electronics



Electric shock

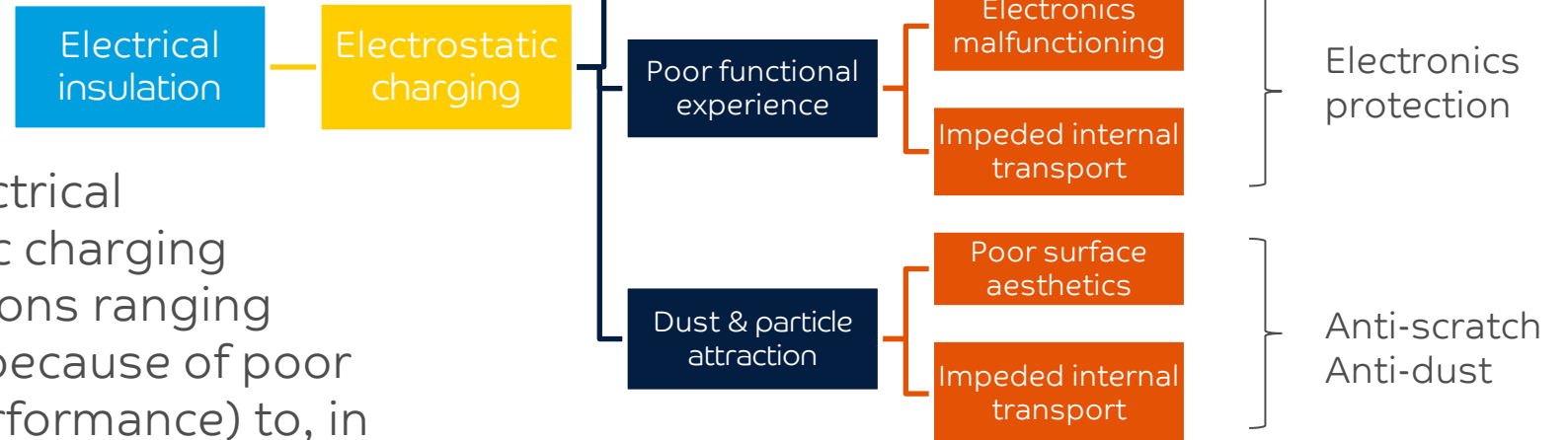


Malfunctioning applications



WHY EMPLOYING CONDUCTIVITY TO PLASTICS?

Electrostatic charging - the electric charge at rest on the surface of an insulated body, or - the quantity of unbalanced electricity in a body (either positive or negative) and construed as an excess or deficiency of electrons or – the localized build up of voltage caused by a transfer of electrons from relative motion.



Electrical insulation or lack of electrical conductivity leads to electrostatic charging effects, which can have ramifications ranging from, in the best case, nuisance because of poor quality (aesthetics, functional performance) to, in the worst case, catastrophic effects like fire and explosions. In all scenarios, significant costs are potentially involved.

ATEX – USING EQUIPMENT IN POTENTIALLY EXPLOSIVE ATMOSPHERES

ATEX is an abbreviation for "ATmosphere EXplosible".



Industry trends:

- The ATEX directive and its associated norms become more stringent, driven by increased safety requirements
- More applications and locations become subject to the ATEX directive

KEY REQUIREMENTS AND UNMET NEEDS FOR ATEX REGULATED APPLICATIONS

The material requirements for ATEX applications, specifically for the European market, include:

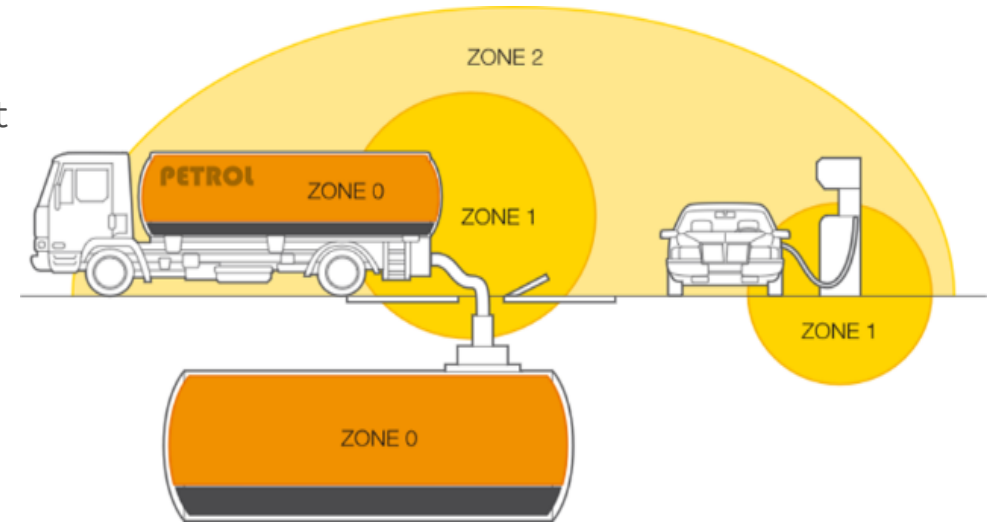
- Compliance with IEC 60079-0:2017 : “Explosive atmospheres–Part 0: Equipment–General requirements”
- Temperature Index as determined by IEC 60216-1:2013 “Electrical insulating materials – Thermal endurance properties–Part 1: Ageing procedures and evaluation”
- Colourable for creating Hazard recognition and branding



A main material challenge in meeting today’s and future ATEX regulations is having a balanced degree of electrical conductivity, combined with sufficient heat resistance and endurance, retention of impact strength under humid conditions and having colorability

CLASSIFICATION OF ATEX ZONES

Product	Category 1	Category 2	Category 3
User zone	Zone 0/20	Zone 1/21	Zone 3/22
Zone criteria	Where an explosive atmosphere is continuously present, or present for long periods of time (>1000 hour/year) Still safe with two faults.	Where an explosive atmosphere is likely to occur in normal operation (between 10>1000 hour/year) Increased safety under abnormal operating conditions.	Where an explosive atmosphere is not likely to occur in normal operation and if it does occur it will exist only for a short period of time. (between <10 hour/year) Equipment which is appropriate under normal conditions
Hazard	Certain	Likely	Not likely
Approved categories	1G 1D	1G / 2G 1D / 2D	1G / 2G / 3G 1D / 2D / 3D



Zone determines protection level requirements (IEC / EN60079-10-1/2)

ATEX RELATED POTENTIAL APPLICATION SPACES

INDUSTRIES

Lighting



Electrical



Industrial



SEGMENTS

Mining



Petrol stations



Transport





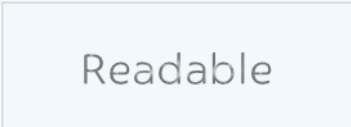


Storage



Petrochemical



POTENTIAL CONDUCTIVE LNP™ COPOLYMER RESIN BASED SOLUTIONS FOR ATEX REGULATED APPLICATIONS

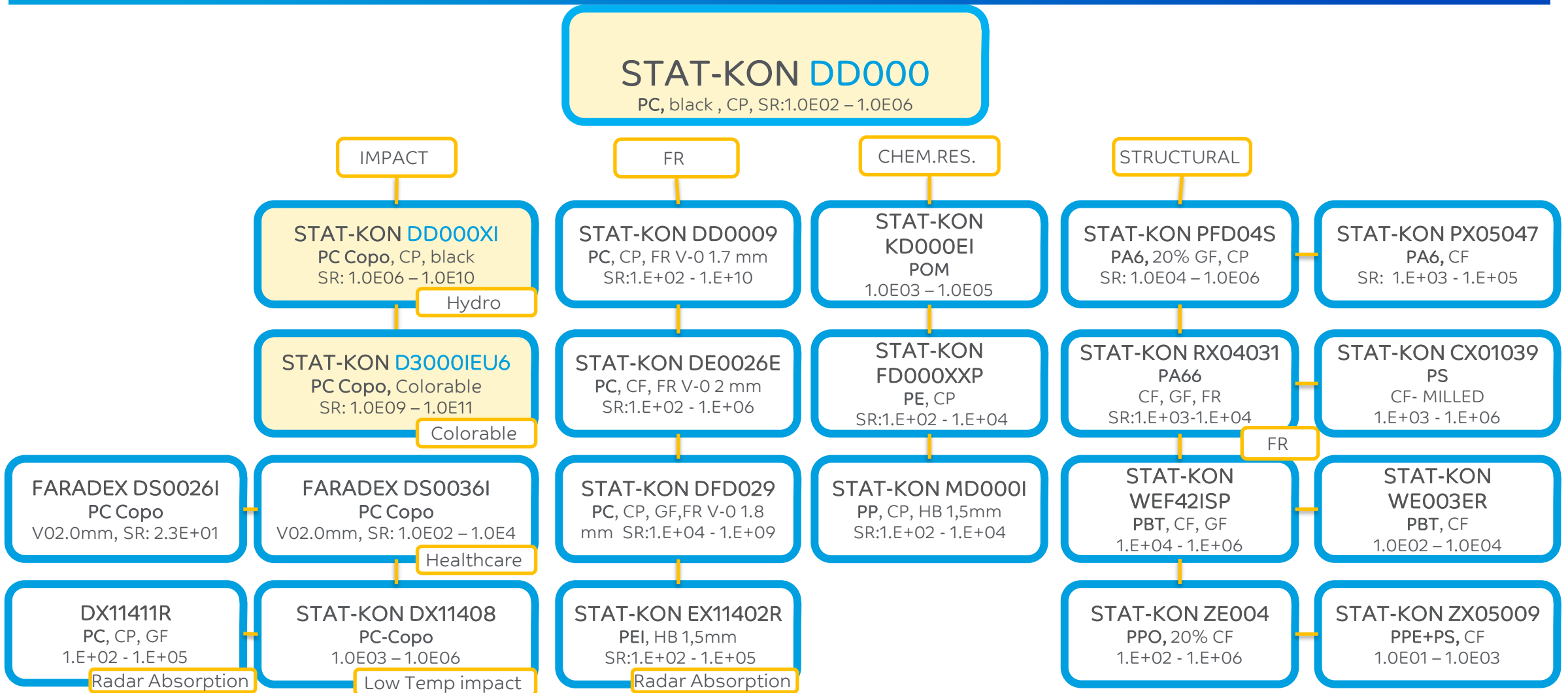
Non Flame Retardant			Flame Retardant (in development)	
Black	Colorable	Translucent	Black	Colorable
<ul style="list-style-type: none"> • Black only • Impact retention • Anti static (10⁶) • High heat • Excellent Hydro aging 	<ul style="list-style-type: none"> • Excellent colorable • Impact retention • Anti static (10⁹) • High heat • Excellent Hydro aging 	<ul style="list-style-type: none"> • Transmission > 80 % • Haze 10 – 100 % • Anti static (10¹¹) • Medium heat • Medium hydro aging • Weatherability 	<ul style="list-style-type: none"> • Black only • V-0 @1.0mm* • V-1 @0.8mm* • Anti static (10⁷) • High heat • High initial impact 	<ul style="list-style-type: none"> • Colorable • V-0 @2.0mm* • V-1 @1.6mm* • Anti static (10⁴) • High heat • Med. initial impact
DD000XI	D3000IEU6	63000ITU2	ER010963	ER010840
				



UNIQUENESS, DIFFICULTY AND TIME TO MARKET

*: Targeted UL94 V-rating based on limited number of measurements on lab samples in SABIC facilities

LNPT™ COMPOUND PORTFOLIO CURRENTLY POSITIONED FOR ATEX COMPLIANT APPLICATIONS



LNP™ NEW PRODUCT DEVELOPMENT INTENDED FOR ATEX REGULATED APPLICATIONS

THE MATERIAL CHALLENGE FOR THE REQUIREMENTS IN ATEX APPLICATIONS

CHALLENGE

Meeting today's and future ATEX regulations is the combination of:

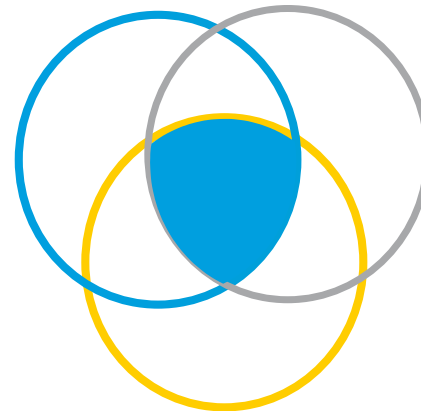
- Sufficient degree of **electrical conductivity**
- Application driven heat resistance & endurance
- Retention of impact under humid conditions
- Excellent **aesthetics** (color, transparency)
- Property and aesthetics retention after UV exposure

TARGETED SOLUTION

Our solution is **based on PC Copolymer technology** and provides a unique balance of:

- Good impact properties down to -30°C
- Good processing : potential for reduced cycle times and thin wall molding capability
- Retention of properties after prolonged exposure to humid conditions (hydro ageing)
- Heat performance
- Black and full colorable solutions available

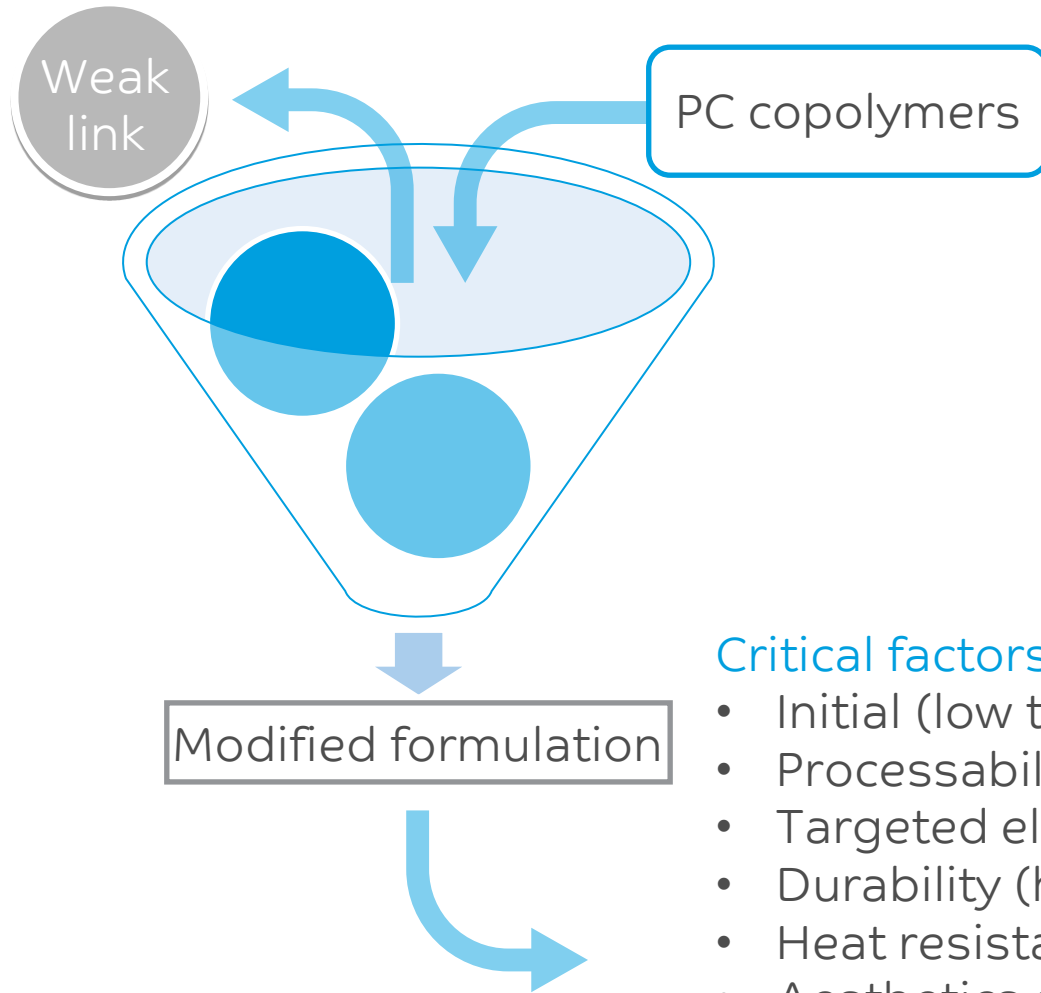
SURFACE
RESISTIVITY



IMPACT
RETENTION

AESTHETICS and UV stability

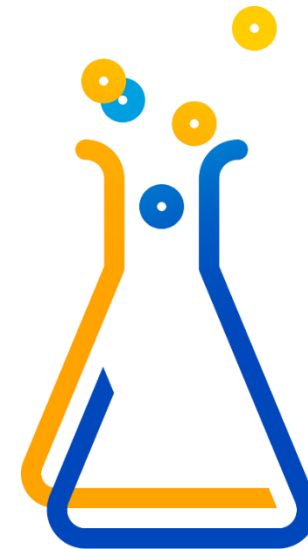
MATERIAL DEVELOPMENT STRATEGY: LEVERAGING PROPRIETARY PC COPOLYMER TECHNOLOGY



PC copolymers offer opportunities to improve the impact, processability and/or long-term properties of conductive PC compounds

Critical factors considered:

- Initial (low temperature) impact
- Processability of filled compounds
- Targeted electrical conductivity
- Durability (heat, hydro, UV)
- Heat resistance
- Aesthetics and colorability



OVERVIEW OF CONDUCTIVE FILLER TECHNOLOGIES

Different types of conductive fillers exist to improve and tailor electrical conductivity to desired levels required by ATEX regulations with their own advantages and disadvantages.

Conductive Carbon Black (CCB)



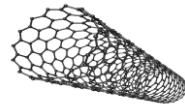
Potential Benefits:

- Cost efficient
- Isotropic filler
- Broad processing window

Disadvantages:

- Black colors only
- Can give sloughing
- High loadings needed
- Lowered impact strength

Carbon Nanotubes (CNT)



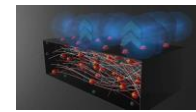
Potential Benefits:

- Isotropic filler
- Limited to no sloughing
- Low loadings needed
- Good property retention

Disadvantages:

- Black colors only
- Higher cost vs CCB
- Sensitive to processing

Inherent Dissipative Polymers (IDP)



Potential Benefits:

- Full color space
- Isotropic
- Excellent properties
- No sloughing

Disadvantages:

- High IDP cost
- Need to tailor compound to optimize stability

Stainless Steel Fiber



Potential Benefits:

- (Limited) color space
- No sloughing

Disadvantages:


- Anisotropic filler
- Highly conductive
- Lowered impact strength
- Higher cost vs CCB

LNP™ STAT-KON™ DD000XI
COMPOUND

LNPT™ STAT-KON™ DD000XI COMPOUND

LNPT STAT-KON DD000XI compound is based on Polycarbonate copolymer resin containing carbon powder. This compound is designed to offer an excellent balance of ESD performance, low temperature impact and impact retention after hydro ageing, coupled with excellent processability.

ATEX compliant

 Meeting ATEX directives on material level making grade potentially suitable for use in ATEX regulated environments.



GOOD IMPACT

Ductile practical impact, retained after hydro ageing.
High impact strength at -10°C.



PROCESSABILITY

High practical flow with broad processing window, potentially allowing thinner wall designs for cost and weight out opportunities.



DURABILITY

Long-term aesthetic and property retention under prolonged heat, humidity and UV exposure.



SURFACE RESISTIVITY

ATEX compliant surface resistivity of 10^6 — 10^{10} Ω /sq.

TYPICAL PRODUCT FEATURES FOR LNP™ STAT-KON™ DD000XI COMPOUND

A compound designed for ATEX applications

- Surface resistivity in range of $1E+06 - 1E+10 \Omega/Sq$
- High flow (spiral flows exceeding 20 cm at 2 mm thickness within processing window)
- High heat resistance (HDT, 140 °C @ 0.45 MPa)
- High practical impact energy at room and sub-ambient temperatures
- Impact retention after hydro ageing (672h.@95°C/90%R.H.)
- Excellent de-molding capability under relatively sharp draft angles
- F1 listing



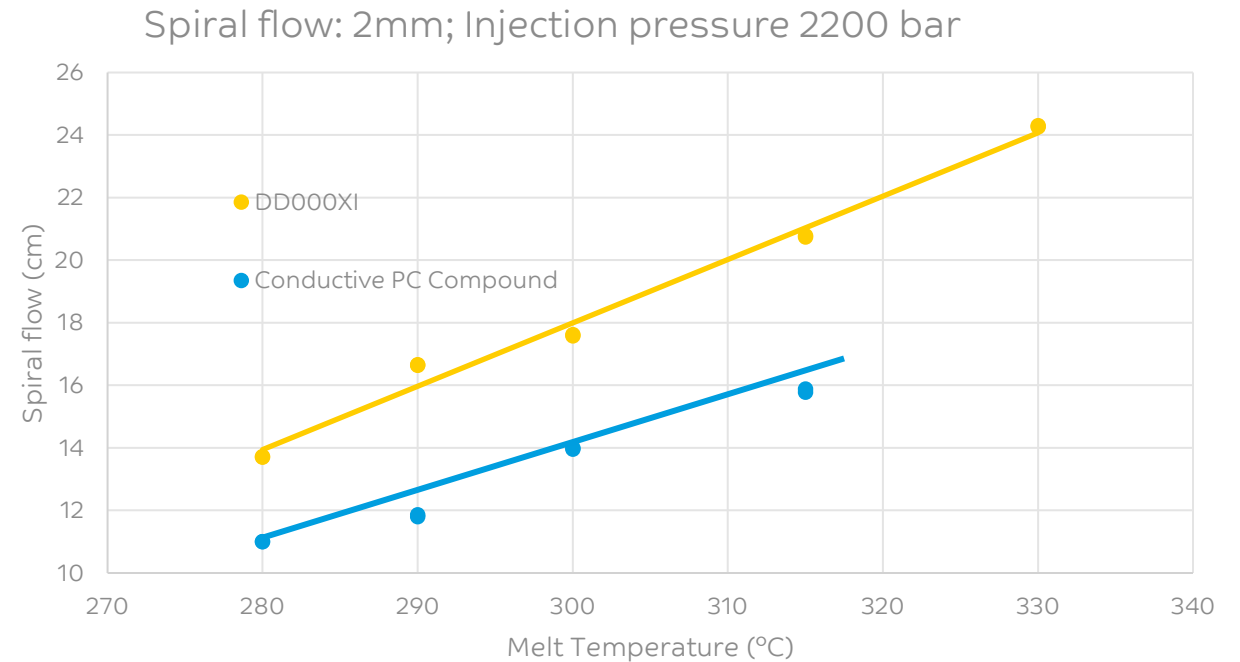
“Improving long-term property retention”

- Next best alternatives: [Conductive carbon black filled PC compounds](#)
- ATEX requires significantly improved practical impact and retention after long term hydro ageing

COMPARISON OF LNP™ STAT-KON™ DD000XI COMPOUND VS CONDUCTIVE PC-BASED COMPOUNDS

	CCB filled PC compound	STAT-KON DD000XI compound
Flow capability	●	●
Processing window	●	●
Impact	●	●
Heat aging	●	●
Hydro ageing	●	●
Heat resistance	●	●
UV stability	●	●

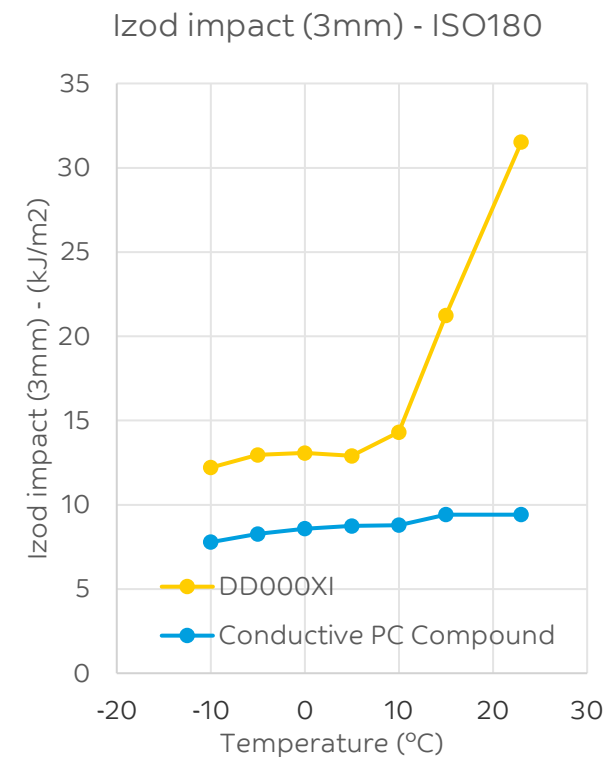
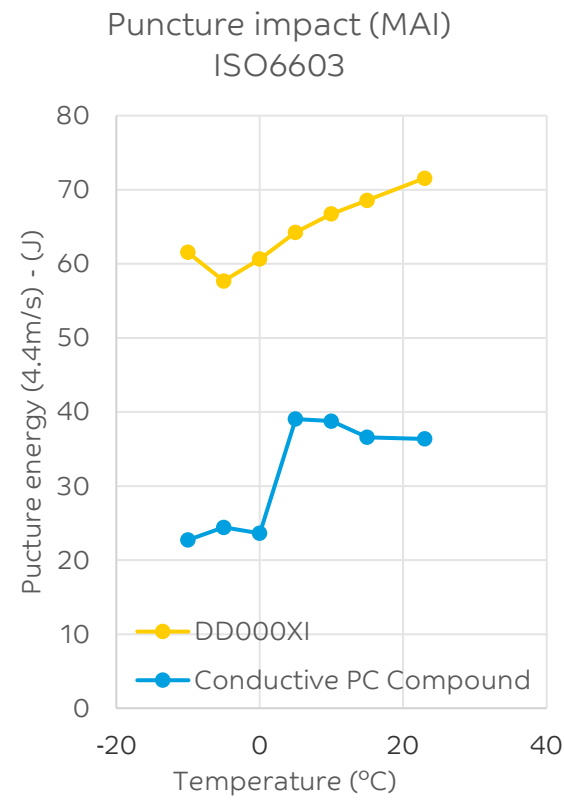
LNP STAT-KON DD000XI compound offers a **HIGHER PRACTICAL FLOW** and **BROADER PROCESSING WINDOW** when compared to alternative PC based resins of similar heat resistance, potentially offering benefits in productivity and design freedom in injection molding.



COMPARISON OF LNP™ STAT- KON™ DD000XI COMPOUND VS CONDUCTIVE PC-BASED COMPOUNDS

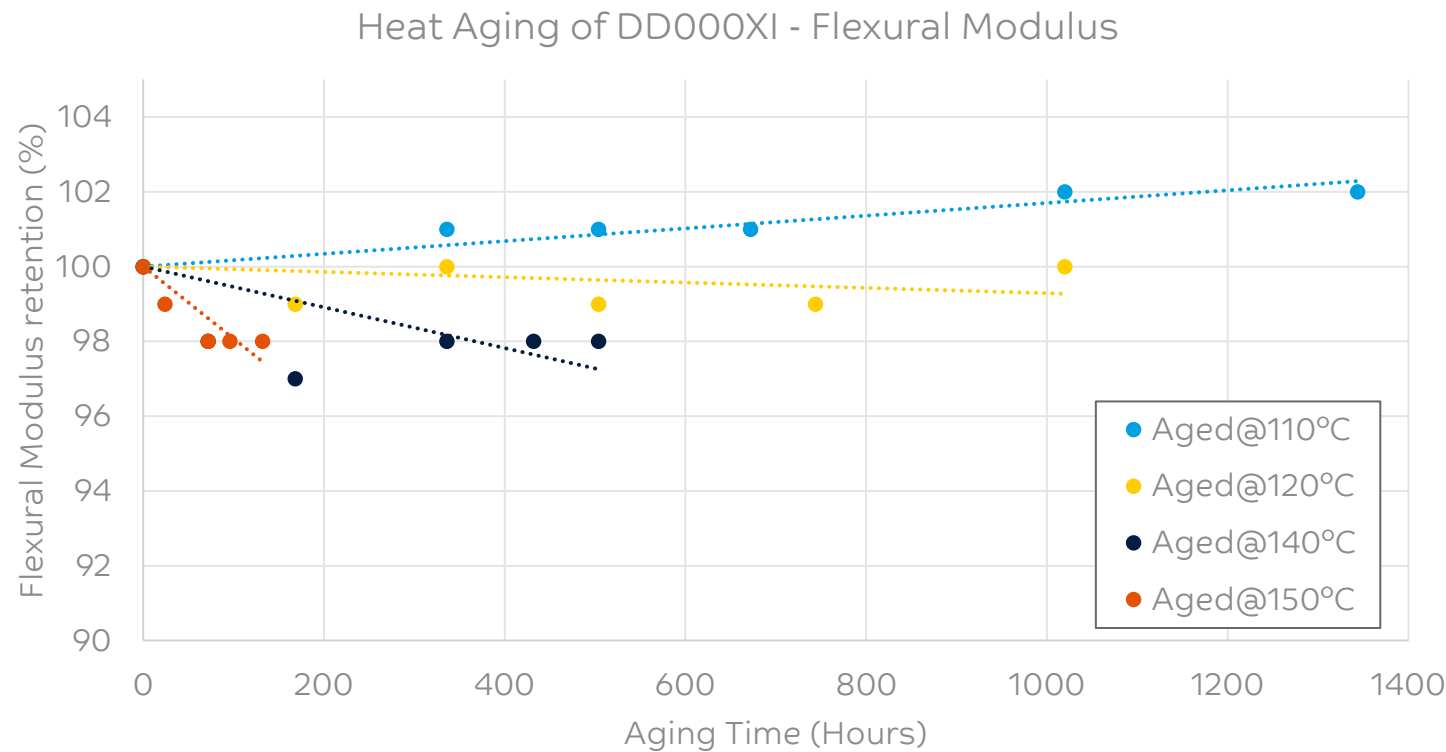
LNP STAT-KON DD000XI compound offers **HIGHER PRACTICAL IMPACT** when compared to CCB filled PC compounds of similar heat resistance, potentially offering benefits in high demanding assembly and use conditions

	CCB filled PC compound	STAT-KON DD000XI compound
Flow capability	Yellow circle	Green circle
Processing window	Yellow circle	Green circle
Impact	Orange circle	Green circle
Heat aging	Green circle	Green circle
Hydro ageing	Orange circle	Green circle
Heat resistance	Green circle	Green circle
UV stability	Green circle	Green circle



HEAT AGING OF LNP™ STAT-KON™ DD000XI COMPOUND

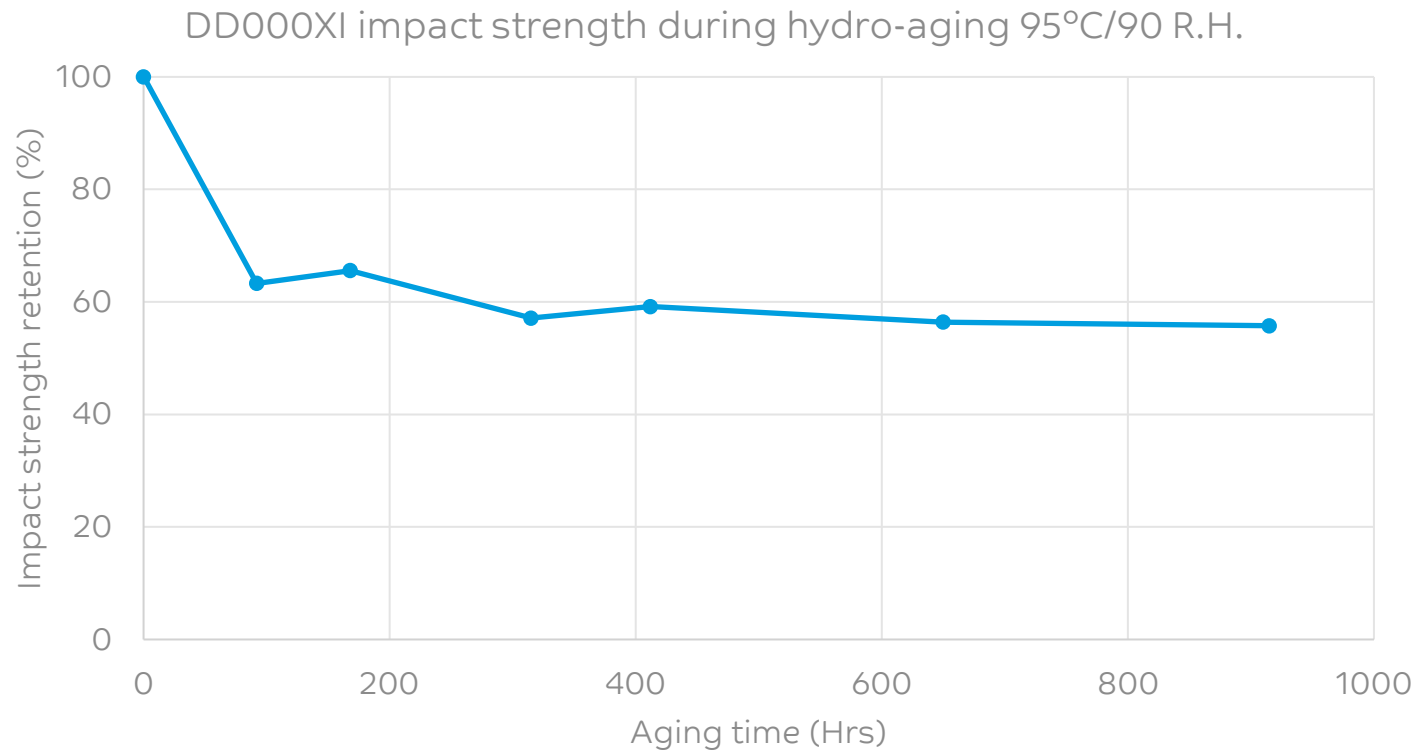
LNP STAT-KON DD000XI compound has excellent retention of physical properties after prolonged heat ageing as measured per IEC 60216-1:2013, with no significant loss in flexural modulus under the tested conditions. This indicates that DD000XI compound can handle exposure to higher temperatures for prolonged time.



Temperature Index (TI) based on flexural strength is 104°C or higher

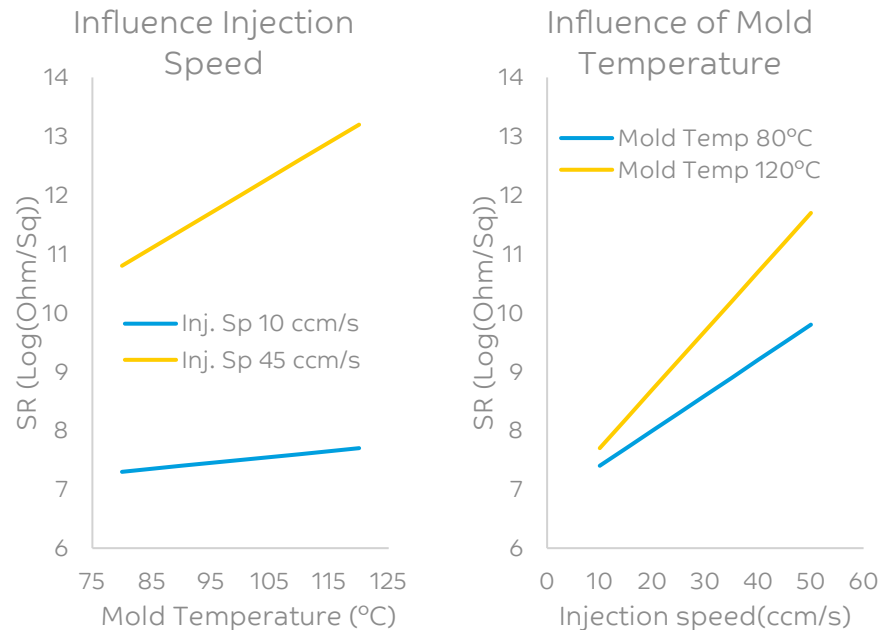
HYDRO AGING OF LNP™ STAT-KON™ DD000XI COMPOUND

LNP STAT-KON DD000XI compound has excellent retention of impact properties after prolonged exposure to heat/hydro conditions ageing, retaining over 50% of initial properties after 1000 hrs.



PROCESSING RECOMMENDATIONS FOR LNP™ STAT-KON™ DD000XI COMPOUND

In order to retain the desired balance of properties for STAT-KON DD000XI compound, it is critical to produce parts according to the recommended processing conditions, with especially the surface resistivity being affected by sub-optimal molding conditions



Low injection speed & “High” melt temperature are favorable for lower surface resistivity values.

PREPARATION

Proper drying (2-4 hours at 120°C) of STAT-KON DD000XI compound and machine cleaning is key to minimize aesthetic defects and yield losses.

MOLD TEMPERATURE

Mold temperature is not a significant factor at optimal injection speed and melt temperature, and is recommended to be set to 80-95°C. When conditions are not optimal, improved surface resistivity can be achieved with lowered mold temperatures.

INJECTION SPEED

Moderate injection speeds (10-20 ccm/s) are favorable to achieve low surface resistivity.

MELT TEMPERATURE

Recommended melt temperatures are between 300-320°C, with higher melt temperatures in this range preferred to optimize surface resistivity and reducing molded-in stresses.

It is highly recommended to measure surface resistivity on the molded parts

POTENTIAL FEATURES AND BENEFITS OF LNPT™ STAT-KON™ DD000XI COMPOUND

FEATURES

ATEX compliance



Durability



Processability

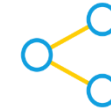
BENEFITS



Surface resistivity in range of 10⁻⁶ to 10⁻¹⁰Ω to meet ATEX regulations.



High impact to allow demanding assembly and/or use conditions.



High flow to offer enhanced design freedom such as low thickness and/or high long path length.



Part production without need for secondary operations like conductive painting.



Long part lifetime with excellent property retention under heat, moisture and/or UV light.



Cost & time efficient molding processes with potential to reduce cycle time and/or lower reject rates.



Meet stringent regulations for use in Industrial environments.



Appealing aesthetics after prolonged part use under aggressive conditions.



Good demolding performance allowing sharp draft angles with low reject.



Improved productivity and/or lower system cost while retaining quality

POTENTIAL APPLICATIONS FOR LNPT™ STAT-KON™ DD000XI COMPOUND



SENSOR HOUSINGS



CAMERA HOUSINGS



JUNCTION BOXES



DOCUMENT HANDLING



LIGHTING



ATM MACHINES



BELT CLIPS



SEMI CONDUCTORS

PROPERTY COMPARISON OF SELECTED LNP™ STAT-KON™ COMPOUNDS

PROPERTY	Standard	UNIT	LEXAN™ 161R resin	LNP DD000 COMPOUND	LNP DD000XI COMPOUND	LNP DX07323 COMPOUND	LNP DX11408 COMPOUND
Flexural Modulus	ISO 178	MPa	2300	2890	2300	2400	2480
Flexural Stress	ISO 178	MPa	90	102	90	88	88
Tensile Modulus	ISO 527	MPa	2350	2680	2500	2400	2630
Tensile Strength	ISO 527	MPa	70	62	55	55	55
Elongation to Break	ISO 527	%	6	10	10	9	16
Izod Notched, 4 mm	ISO 180/1A	kJ/m ²	70**	6	24	16	21
MVR, 300 °C, 2.16 kg	ISO1133	cm ³ /10'	9	-	5	50*	
HDT 0.45 MPa	ISO 75/Bf	°C	138	138	139	-	136
HDT 1.8 MPa	ISO 75/Af	°C	127	127	129	124	127
Vicat B120	ISO 306	°C	145	-	145	-	-
Shrinkage x-flow	ISO 294-4	%	-	0,8	0,6-1,0	0,5	-
CTE (-40 °C to +40 °C)	ISO 11359-2	10 ⁻⁴ /°C	7.E-05	-	6.E-05	5.E-05	-
UL-rating	UL94	mm	HB@1,1mm	HB@1,5mm	-	V1@2,5mm	HB@0,75mm

*MVR, 300 °C, 10,0 kg / ** measured at 3mm thickness

NEW DEVELOPMENT: STAT-KON™ ER011084 COMPOUND: A CARBON NANOTUBE BASED VERSION OF STAT-KON DD000XI COMPOUND

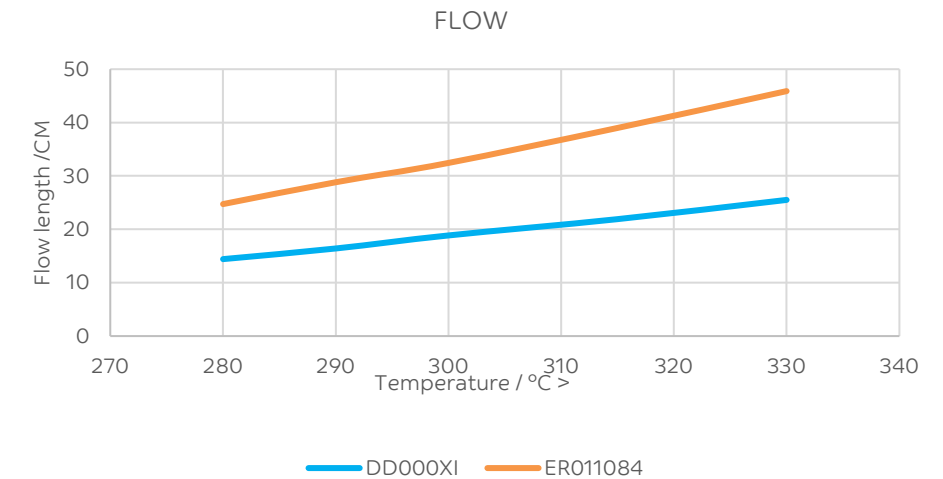
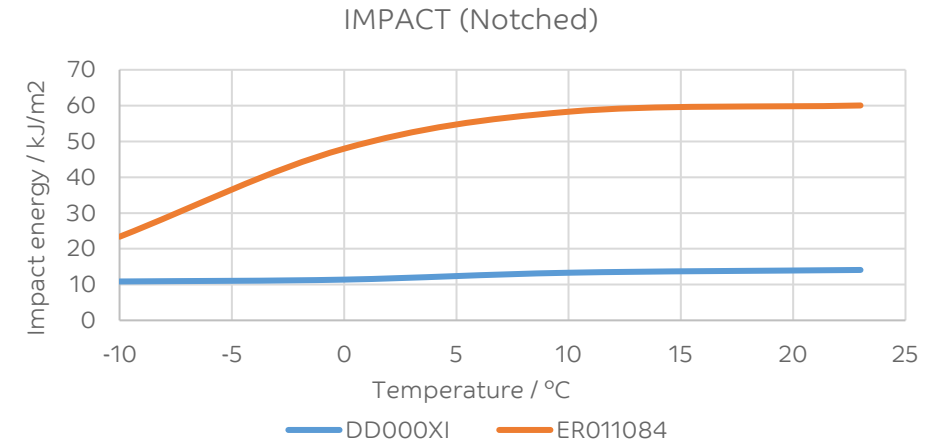
LNP STAT-KON ER011084 compound is a developmental conductive LNP compound and provides an even further optimized balance of impact and processability compared to conductive carbon black solutions, combining the benefits of CNT and PC copolymers.

KEY FEATURES:

- Similar ESD performance as CCB-based PC compounds and STAT-KON DD000XI compound
- Benefits in processing (with up to 50% higher spiral flow compared to CCB based PC compound molded at same conditions) and impact resistance with ductile IZOD notched impact at 0°C
- Improved cleanliness, purity and product consistency

POTENTIAL BENEFITS FOR CUSTOMERS:

- Improved productivity in injection molding
- Enhanced durability in aggressive assembly or use conditions
- Expand potential opportunities in ATEX applications where solutions like LNP STAT-KON DD000XI compound do not fit (e.g. due to cleanliness needs like preventing sloughing)



COLORABLE LNP™ STAT-LOY™
D3000IEU6 COMPOUND

LNP™ STAT-LOY™ D3000IEU6 COMPOUND

Colorable LNP STAT-LOY D3000IEU6 compound, based on PC copolymers, is designed to offer an optimized balance of ESD performance, colorability, low temperature impact, impact retention after hydro ageing and excellent processability



COLORABILITY

Potential opportunity to replace painted materials in applications for system cost reduction and/or design simplification.



ATEX COMPLIANCY

Meeting ATEX directives on material level, making grade potentially suitable for use in ATEX regulated environments.



GOOD IMPACT

High impact strength at $-30\text{ }^{\circ}\text{C}$ with retention of ductile impact after hydro ageing.



PROCESSABILITY

PC-Copolymer technology used to lower processing temperature and increased processing stability.



DURABILITY

Long-term aesthetics and property retention, UV resistant.



SURFACE RESISTIVITY

Surface resistivity of $10^9\text{--}10^{11}\text{ }\Omega/\text{sq.}$, with a low humidity dependency and low variability as function of processing conditions.



BROAD COLOR PALLETTE

The amber-white colored canvas can cover the full color space, product dedicated for color retention and UV stability.

EXAMPLE: LNP™ STAT-LOY™ D3000IEU6 COMPOUND FOR HANDHELD DEVICES

Optimized for ATEX compliant applications

- Surface resistivity of $1.0E+09 - 1.0E+11$ Ohm
- No/low level of yellowing after processing and aging
- Good weatherability (UL746C f1-rating or similar)
- Good hydrolytic stability (672 h. 95 °C/90 RH)
- Injection molding grade (low processing temperature)
- Sufficient heat (HDT > 100 °C at 1.8 MPa)
- Colorable in broad range of colors such as yellow/orange and other bright colors
- Impact IK10
- Low temperature impact strength (-30 °C)

Designed for:

Maximum service temperature of 75 °C

Minimum service temperature of -20 °C



“Improved colorability and color retention”

- Next best alternatives: Non conductive thermoplastics with ESD coating
- ATEX requires significantly improved practical impact strength, and impact retention after long term hydro ageing

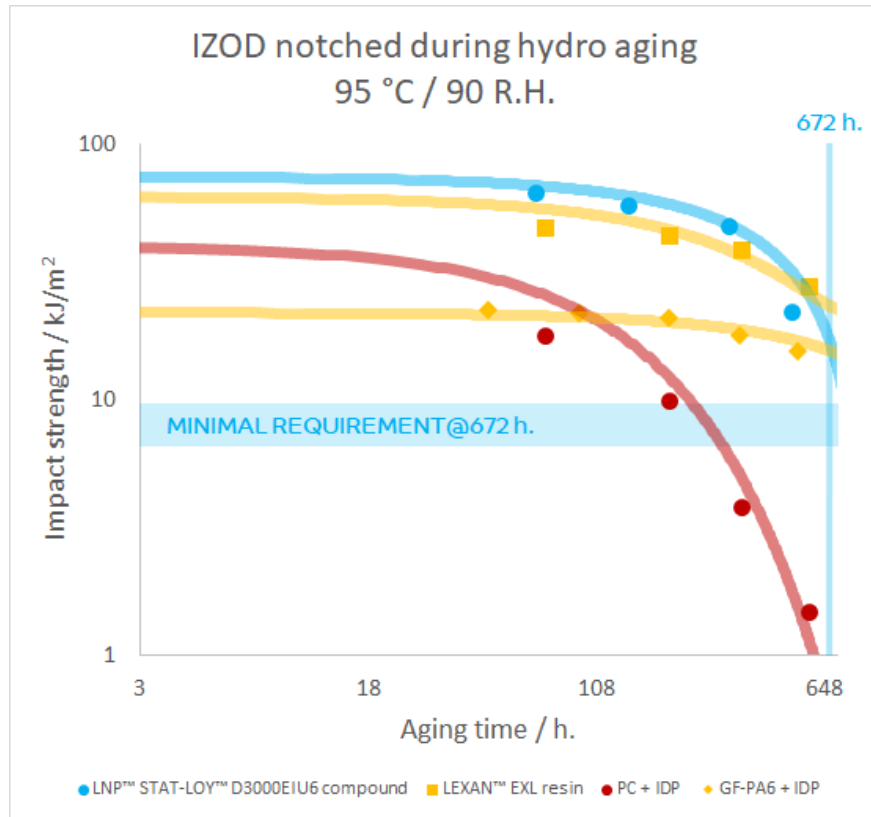
EXISTING ALTERNATIVES DO NOT DELIVER THE RIGHT BALANCE OF PROPERTIES

	LNP™ FARADEx™ COMPOUND	LNP STAT-KON™ COMPOUND	LNP STAT-LOY™ COMPOUND	LNP STAT-LOY D3000IEU6 COMPOUND
Filler Resin	Stainless steel fibre PC copolymer resin	Conductive carbon black PC copolymer resin	Anti-static polymer (IDP) Thermoplastic blend	Anti-static polymer (IDP) Thermoplastic blend
Challenges	<ul style="list-style-type: none"> • Highly conductive • Limited colourability • Medium impact strength 	<ul style="list-style-type: none"> • Not colourable • Medium impact strength 	<ul style="list-style-type: none"> • Low heat resistance • Limited thermal endurance • Limited weatherability 	<ul style="list-style-type: none"> • New to market
Positives	<ul style="list-style-type: none"> • Used for ATEX applications 	<ul style="list-style-type: none"> • Attractive pricing 	<ul style="list-style-type: none"> • Balanced conductivity 	<ul style="list-style-type: none"> • Optimized property profile for ATEX compliant applications

➤ New offering is potentially an excellent candidate for "ATEX" applications

	Conductive GF-PC compound	Conductive PC compound	Conductive ABS compound	Resin with Anti-static coating
Filler Resin	Anti-static polymer (IDP) Glass filled PA6 resin	Anti-static polymer (IDP) Standard PC resin	Anti-static polymer (IDP) Thermoplastic blend	PC, PC/ABS, PC Copolymer resins
Challenges	<ul style="list-style-type: none"> • Insufficient conductivity • Limited colourability • Medium impact strength 	<ul style="list-style-type: none"> • Insufficient conductivity • Limited thermal endurance • Low colour stability 	<ul style="list-style-type: none"> • Low heat resistance • Limited thermal endurance • Limited weatherability 	<ul style="list-style-type: none"> • Requires Secondary Operation • Difficult to paint complex parts • Drying time
Positives	<ul style="list-style-type: none"> • Good Hydro stability 		<ul style="list-style-type: none"> • Balanced conductivity 	

PROPERTY RETENTION AFTER HYDRO AGING COMPARED TO ALTERNATIVES



LNPT™ STAT-LOY™ D3000IEU6 COMPOUND

COMPARED TO LEXAN EXL1414 resin (non-conductive)

Similar performance on impact strength and impact retention as a best in class non-conductive material that is extensively used for demanding applications.

COMPARED TO CONDUCTIVE GF-PA6 COMPOUND

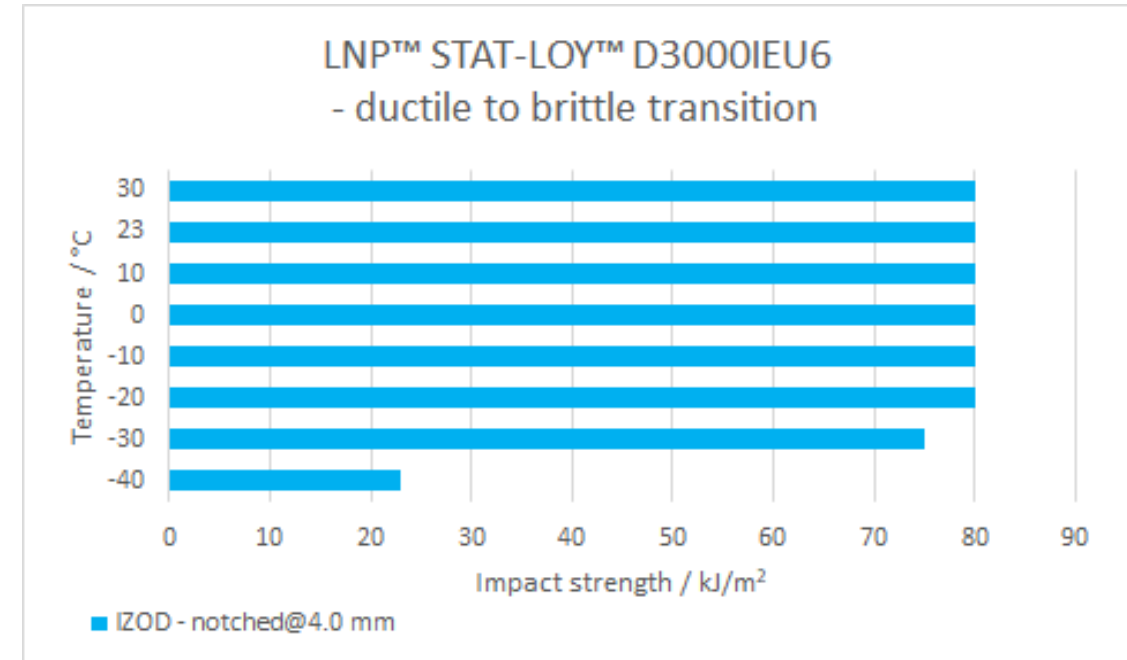
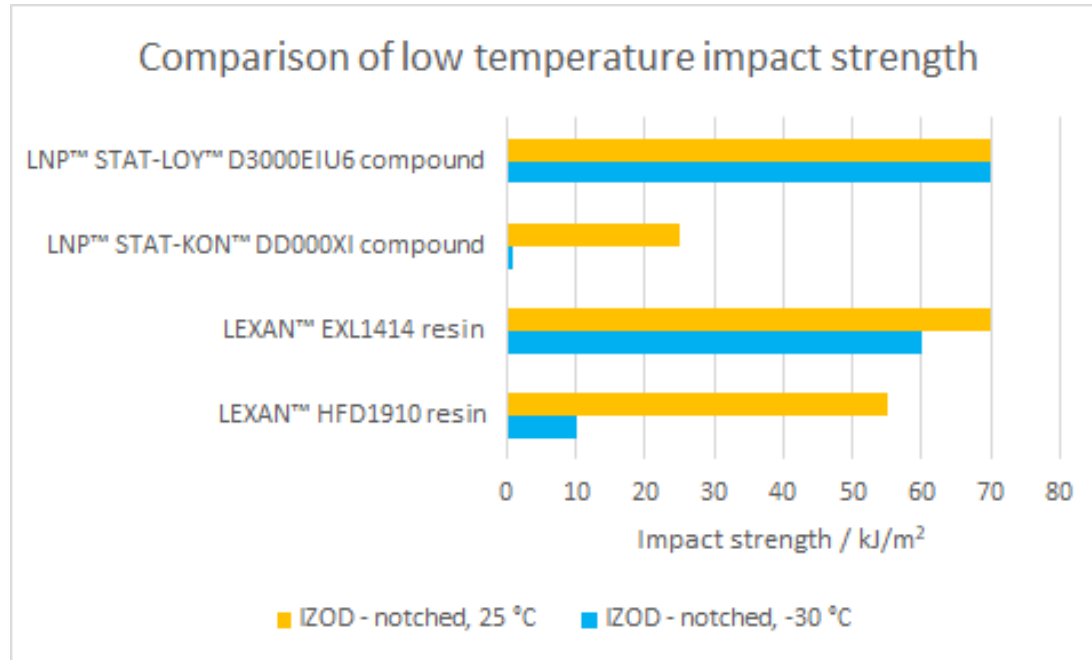
PA6 compounds have high water uptake resulting in good impact, but low dimensional stability. Color stability is typically poor during hydro aging.

COMPARED TO CONDUCTIVE PC COMPOUND

Conventional anti-static PC compounds quickly lose their impact strength and color when exposed to prolonged humid conditions.

Similar impact retention as compared to best in class non-conductive EXL1414 resin

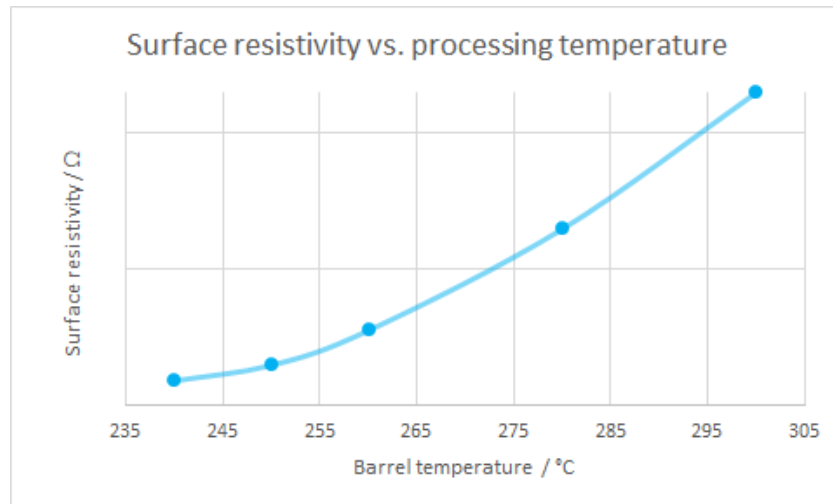
LNP™ STAT-LOY™ D3000IEU6 COMPOUND HAS EXCELLENT LOW TEMPERATURE IMPACT RESISTANCE COMPARABLE TO SABIC EXL RESINS



Conductive compound with excellent IZOD notched impact strength and Ductile-to-Brittle transition below -30 °C

RECOMMENDED PROCESSING CONDITIONS FOR LNP™ STAT-LOY™ D3000IEU6 COMPOUND

In order to achieve the desired balance of properties for LNP STAT-LOY D3000IEU6 compound, the recommended processing conditions should be carefully considered. Especially aesthetics and surface resistivity are potentially affected by processing.



High mold temperature and “low” melt temperature are favorable for retaining low surface resistivity values.

Sub-optimal settings can result in an undesired increase in surface resistivity (factor 100+ possible)

PREPARATION

Proper drying (2 – 4 hours at 80 – 95°C) of the resin and good machine cleaning is key to minimize aesthetic defects and yield losses in molding.

MOLD TEMPERATURE

Mold temperature is not a significant factor at optimal injection speed and melt temperature, and is recommended to be set in range of 90-110°C. When conditions are not optimal, surface appearance might be sub-optimal.

PROCESSING CONDITIONS

High shear rates should be avoided in order to obtain the best possible visual appearance. Injection speed and pressure, as well as tool and sprue/hot runner design should be designed accordingly. Exceeding the recommended maximum melt temperature will negatively affect surface resistivity of the parts.

MELT TEMPERATURE

Recommended melt temperature is between 240 – 260 °C, with lower melt temperatures in this range preferred to optimize surface resistivity and reducing discoloration.

It is highly recommended to measure surface resistivity on the molded parts

FEATURES AND BENEFITS OF LNPT™ STAT-LOY™ D3000IEU6 COMPOUND

FEATURES

ATEX compliance


+

Durability

+

Processability


BENEFITS




✓ Surface resistivity in 10^9 to $10^{11} \Omega$ range to meet ATEX regulations.




High impact to allow demanding assembly and/or use conditions.




High flow to offer enhanced design freedom such as low thickness and/or high long path length.



Design freedom without need for secondary operations like conductive paint.



Long part lifetime with excellent property retention after heat, moisture and/or UV light exposure.




Cost & time efficient molding processes with potential to reduce cycle time and/or lower reject rates.



Meet stringent regulations for use in Industrial environments.



Pleasing aesthetics after prolonged part use under aggressive conditions.

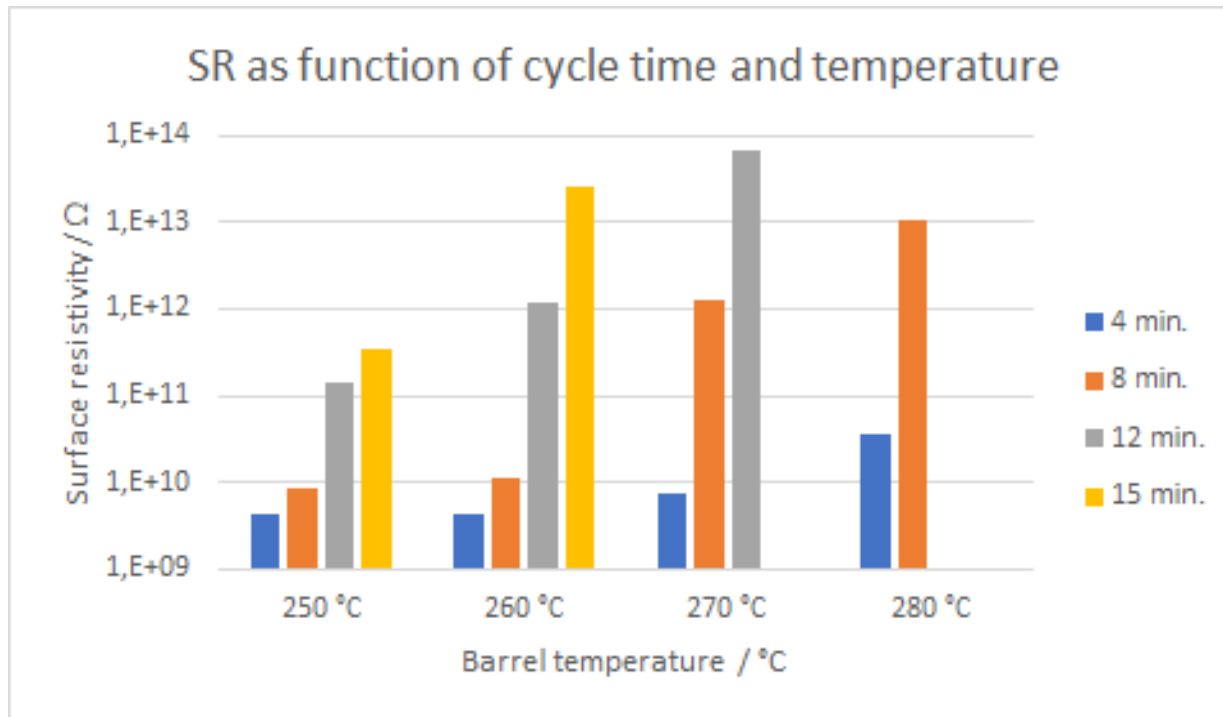


Good demolding performance allowing sharp draft angles with low reject.



Improved productivity and/or lower system cost while retaining quality

LNPT™ STAT-KON™ D3000IEU6 COMPOUND IS FULLY COLORABLE



New offering has full colorability and stable SR performance

COMPARISON OF PHYSICAL PROPERTIES OF SELECTED SABIC GRADES

Property	Standard	Unit	STAT -LOY™ D3000IEU6 compound	Typical conductive GF-PA6 compound	Typical conductive PC compound	STAT- KON™ DD000XI compound	STAT-LOY™ A3000 compound	FARADEx™ DS0036I compound	EXL1414 resin
Flexural Modulus	ISO 178	MPa	1825	-	2050	2300	1980	2600	2250
Flexural Strength	ISO 178	MPa	70	-	79	90	59	80	85
Tensile Modulus	ISO 527	MPa	1750	7700	1725	2500	2010	2800	2150
Tensile Strength	ISO 527	MPa	45	105	50	45	59	55	60
Elongation to Break	ISO 527	%	>60	6	> 10	10	24	-	-
IZOD–notch.@23 °C	ISO180/1A	kJ/m ²	60	14	70	24	20	14	70
IZOD–notch.@-30 °C	ISO 179	kJ/m ²	60	-	-	10	-	-	60
HDT 0.45 MPa	ISO 75	°C	123	217	128	139	88	136	140
HDT 1.8 MPa	ISO 75	°C	105	196	113	129	75	125	128
Density	ISO 1183	g/cm ³	1.16	1.38	1.18	1.21	1.07	1.29	1,19
Moisture absorption	ISO 62	%	0.15-0.3	~2	-	0.06-0.12	1	0.13	0.15
Shrinkage x-flow	ISO 294-4	%	0.6 - 0.8	0.4 - 0.8	0.6 - 0.9	0.6-1.0	0.49	0.4-0.6	0.4 - 0.8
Surface resistivity	ASTM 257D	Ω	1.0E+09	1.0E+11	1.0E+11	1.E+6- 1.E+10	1.E+09- 1.E+11	1.0E+03	1.0E+15

POTENTIAL APPLICATIONS FOR COLORABLE CONDUCTIVE COMPOUNDS



ANTI-DUST APPLICATIONS



LIGHTING FIXTURES



HAND HELD DEVICES



INDUSTRIAL ENCLOSURES



SAFETY HELMETS



BEZELS



CAMERA HOUSINGS



DIAGNOSTIC EQUIPMENT

DEVELOPMENTAL LNP™ STAT-KON™ ER010684 COMPOUND – A CONDUCTIVE COMPOUND WITH HIGH TRANSLUCENCY AND 100% HAZINESS

The developmental LNP STAT-LOY ER010684 compound is a light transmissive version having an excellent balance of properties; including processing, surface resistivity, mechanical strength, surface aesthetics and thermal endurance at favorable cost versus incumbent solutions based on coating solutions. First samples for testing are readily available.

KEY FEATURES:

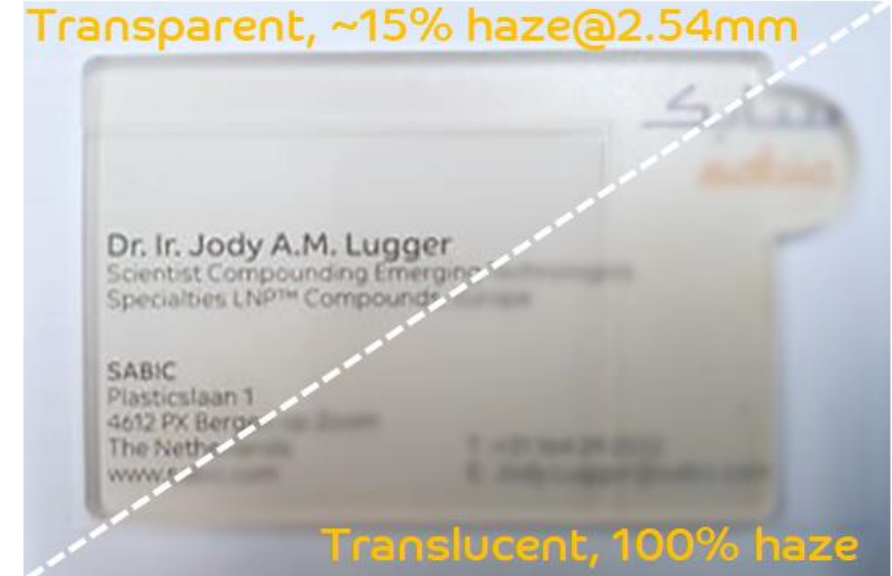
- Optimized grade for ATEX compliant applications
- Highly translucent for lighting, in-line with neat PC solutions
- Haze levels which are suitable for the lighting industry

POTENTIAL BENEFITS FOR CUSTOMERS:

- Improved productivity in conversion processes (injection molding and extrusion)
- Expand potential opportunities in multiple market segments where existing solutions do not fit
- Overall system cost reduction

Designed for:

- Maximum service temperature of 60 °C
- Minimum service temperature of -20 °C



CONCLUSIONS

VALUE PROPOSITION OF LNPT™ STAT-KON™ AND STAT-LOY™ SOLUTIONS

PRODUCT DIFFERENTIATION



- Possibility to **use** products **in harsh environments** that are subject to stringent ATEX requirements
- **Design freedom** driven by excellent balance of processability and impact resistance

COMPLIANCE WITH REGULATIONS*



- Possibility to provide electrically conductive solutions based on **PC-copolymer technology** to meet the growing trend of **more strict ATEX regulations** applicable to more application areas



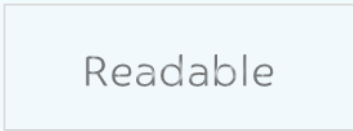


REDUCE TOTAL SYSTEM COST



- Improved **durability** in harsh application environments via **excellent property retention under hydro conditions**
- **Potentially reduced risk** of product failure driven by **excellent impact performance**
- Potential for **improved productivity** via **reduced cycle times in molding and enhanced flow**

* https://ec.europa.eu/commission/presscorner/detail/en/QANDA_20_419

POTENTIAL CONDUCTIVE LNP™ COPOLYMER RESIN BASED SOLUTIONS FOR ATEX REGULATED APPLICATIONS

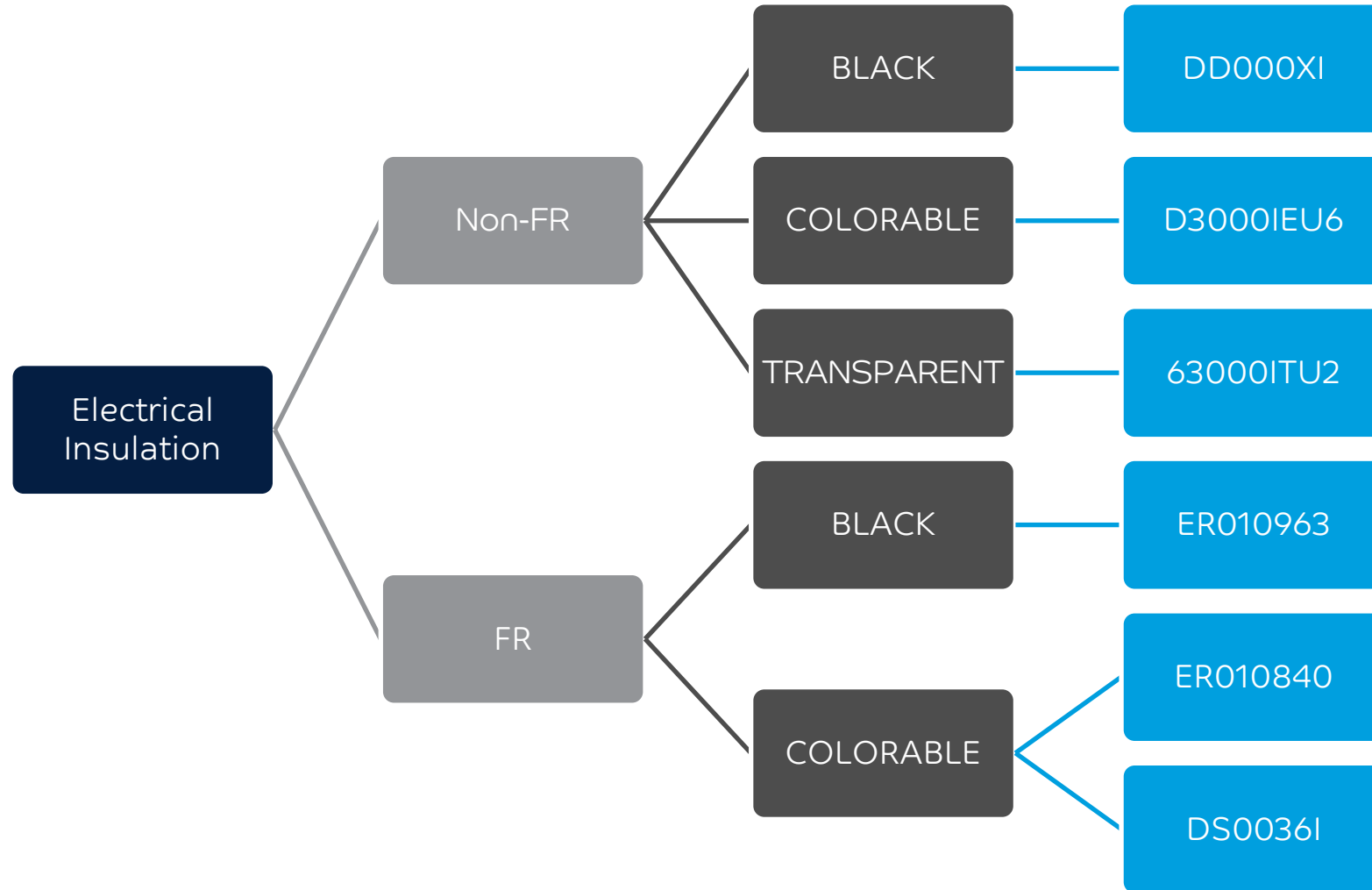
Non Flame Retardant			Flame Retardant (in development)	
Black	Colorable	Translucent	Black	Colorable
<ul style="list-style-type: none"> • Black only • Impact retention • Anti static (10⁶) • High heat • Excellent Hydro aging 	<ul style="list-style-type: none"> • Excellent colorable • Impact retention • Anti static (10⁹) • High heat • Excellent Hydro aging 	<ul style="list-style-type: none"> • Transmission > 80 % • Haze 10 – 100 % • Anti static (10¹¹) • Medium heat • Medium hydro aging • Weatherability 	<ul style="list-style-type: none"> • Black only • V-0 @1.0mm* • V-1 @0.8mm* • Anti static (10⁷) • High heat • High initial impact 	<ul style="list-style-type: none"> • Colorable • V-0 @2.0mm* • V-1 @1.6mm* • Anti static (10⁴) • High heat • Med. initial impact
DD000XI	D3000IEU6	63000ITU2	ER010963	ER010840
				



UNIQUENESS, DIFFICULTY AND TIME TO MARKET

*: Targeted UL94 V-rating based on limited lab samples measured in SABIC facilities

POTENTIAL CONDUCTIVE LNPT™ PC-COPOLYMER BASED SOLUTIONS FOR ATEX-REGULATED APPLICATIONS



POTENTIAL LNP™ PORTFOLIO FOR ATEX-REGULATED APPLICATIONS

Resin	Grade	Description	Attribute
PC	STAT-KON DD000	PC containing carbon powder, electrically conductive, black color only.	SR: 1.0E02 – 1.0E06, 94HB 1.5mm
PC COPOLYMER	STAT-KON DD000XI	PC COPOLYMER containing carbon powder, electrically conductive, improved impact properties, hydrolytic stability and complying with latest ATEX regulations. Black color only.	SR: 1.0E06 – 1.0E10, NFR
PC COPOLYMER	STAT-KON D3000IEU6	PC COPOLYMER, electrically conductive, improved impact properties, hydrolytic stability and complying with latest ATEX regulations. Excellent Colorable.	SR: 1.0E09 – 1.0E11, NFR
PC COPOLYMER	FARADEX DS0036I	PC COPOLYMER, containing 15% Stainless Steel, Electrically Conductive, EMI/RFI Shielding, High Impact, Non-Brominated & Non-Chlorinated FR. Healthcare. Equivalent or better shielding performance to copper overspray .	SR: 1.0E02 – 1.0E04, V-0 2.0 mm, F1, SE 55dB.
PC COPOLYMER	FARADEX DS0026I	PC COPOLYMER, containing Stainless Steel Fiber. Static decay, High Impact, Non-Brominated & Non-Chlorinated FR, EMI/RFI Shielding.	SR: 2.3E+01, V-0 2.0 mm
PC COPOLYMER	STAT-KON DX11408	PC COPOLYMER, containing carbon powder, electrically conductive, Improved Ductility	SR E3-E6, UL-HB 0,75mm (f1)
POLYCARBONATE	STAT-KON DX11411R	Polycarbonate resin containing Proprietary Filler(s), electrically conductive	S.R: 1.E+02 - 1.E+05 , HB-1,5mm
POLYCARBONATE	STAT-KON DD0009	Polycarbonate resin containing Carbon Powder. Electrically Conductive, Flame Retardant	SR: 1.0E02 – 1.0E10, V-0 1.7 mm
POLYCARBONATE	STAT-KON DE0026E	Polycarbonate resin containing carbon fiber. Electrically Conductive, Flame Retardant.	SR: 1.E+02 - 1.E+06, V-0 2.0 mm
POLYCARBONATE	STAT-KON DFD029	Polycarbonate resin containing carbon powder. Electrically Conductive, Flame Retardant.	SR: 1.E+04 - 1.E+09, V-0 1.8 mm
POLYETHERIMIDE	STAT-KON EX11402R	Polyetherimide resin containing Proprietary Filler(s). electrically conductive	SR: 1.E+02-1.E+05
POM	STAT-KON KD000EI	POM resin containing Carbon Powder, electrically Conductive, Impact Modified.	S.R: 1.E+03 - 1.E+05 , HB-0,75mm
PE	STAT-KON FD000XXP	Polyethylene based. Electrically Conductive.	S.R: 1E02-1E04
PP	STAT-KON MD000I	Polypropylene resin containing Carbon Powder. Electrically Conductive, High Impact.	S.R: 1.E+02-1.E+04, HB-1,5mm
PA6	STAT-KON PFD04S	PA 6 resin containing Glass Fiber, Carbon Powder. Electrically Conductive, Heat Stabilized.	SR: 1.E+03-1.E+04, HB-1,0mm
PA66	STAT-KON PX05047	PA 6 resin containing Carbon Fiber, Proprietary Filler (s). Added features include: Electrically Conductive, High Impact.	S.R: 1.E+03 - 1.E+05
PA66	STAT-KON RX04031	PA66 resin containing Carbon Fiber, Glass Fiber, Non-Brominated & Non-Chlorinated Flame Retard. Electrically Conductive, Easy Molding.	S.R: 1.E+03-1.E+04, V-0 0.8mm
PS	STAT-KON CX01039	Polystyrene resin containing Proprietary Filler(s). Electrically Conductive	S.R: 1.E+03-1.E+06
PBT	STAT-KON WEF42ISP	PBT resin containing Glass Fiber and Carbon Fiber. High Impact, Heat Stabilized and Electrically Conductive.	S.R: 1.E+04-1.E+06
PBT	STAT-KON WE003ER	PBT resin containing Carbon Fiber. Easy Molding, Easy Release, Electrically Conductive.	SR: 1.E+02-1.E+04
PPO	STAT-KON ZE004	PPO resin containing 20% Carbon Fiber Electrically Conductive.	S.R: 1.E+02 - 1.E+06 , HB-1,5mm
PPE+PS	STAT-KON ZX05009	PPE+PS Blend resin containing Carbon Fiber. Electrically Conductive.	S.R: 1.E+01 - 1.E+03

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