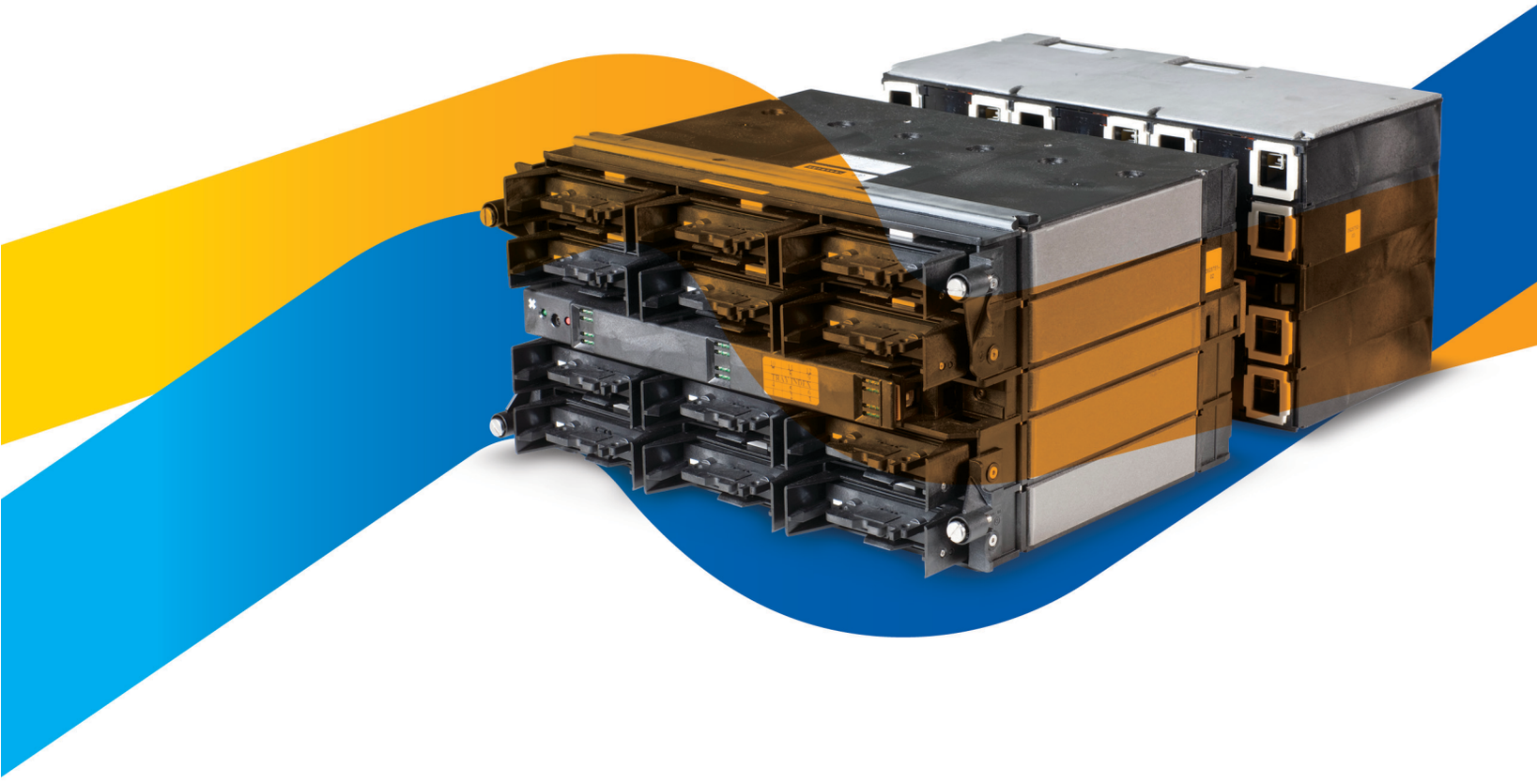
PROTECTION+ CONDUCTIVITY

LNP™ STAT-KON™ AND STAT-LOY™ COMPOUNDS

A guide to thermoplastics compounds for electrostatic discharge protection



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SABIC

Founded in 1976, SABIC is today the first public, global multinational enterprise headquartered in the Middle East. Our products range from bulk commodity chemicals to highly engineered plastics for demanding applications. We are a leading producer of polyethylene, polypropylene, glycols, methanol and fertilizers and the world's third largest polyolefin producer.

SABIC's offerings include Chemicals, Polymers, Specialties, Agri-Nutrients and Metals. In Saudi Arabia, the Netherlands, Spain, the USA, India, China and Japan, our dedicated Technology & Innovation centers research ways to meet our customers' needs with excellence.

INNOVATING FOR CUSTOMER SUCCESS

We believe that SABIC customers deserve the full benefit of every advantage our enterprise can offer. After all, our success is defined by our customers' success. And with more than 80 years of experience pioneering advanced engineering thermoplastics, SABIC is positioned to help create new opportunities for growth and breakthrough applications.

We offer expertise and experience to our customers in a variety of ways:

- Material solutions to help drive innovation and market leadership.
- Design, logistics and processing expertise to spark new ideas and better efficiencies.
- Unwavering commitment to build long-term relationships with ingenuity, trust and continuous improvement.

It's what we strive for and work to deliver… a mutual benefit.

Excellence and nothing less.

INTRODUCTION

Problems resulting from the build-up of electrostatic charges and electrostatic discharge had previously limited the acceptance of “insulating” plastics for many applications. LNP has formulated a complete line of thermoplastic compounds containing conductive additives which span the surface resistivity spectrum from antistatic, through conductive, to EMI shielding. These materials are the LNP STAT-KON and STAT-LOY compounds.

CONTENTS

LNP STAT-KON AND STAT-LOY COMPOUNDS

STAT-LOY compounds contain permanent antistatic additives which are non-humidity dependent and non-migratory. STAT-LOY compounds are themselves antistatic with resistivities in the 10^9 to 10^{12} ohms/sq. range.

STAT-KON compounds contain carbon fiber, carbon powder, or stainless steel fibers to produce conductive/statically dissipative compounds in the 10^2 to 10^9 ohms/sq. resistivity range.

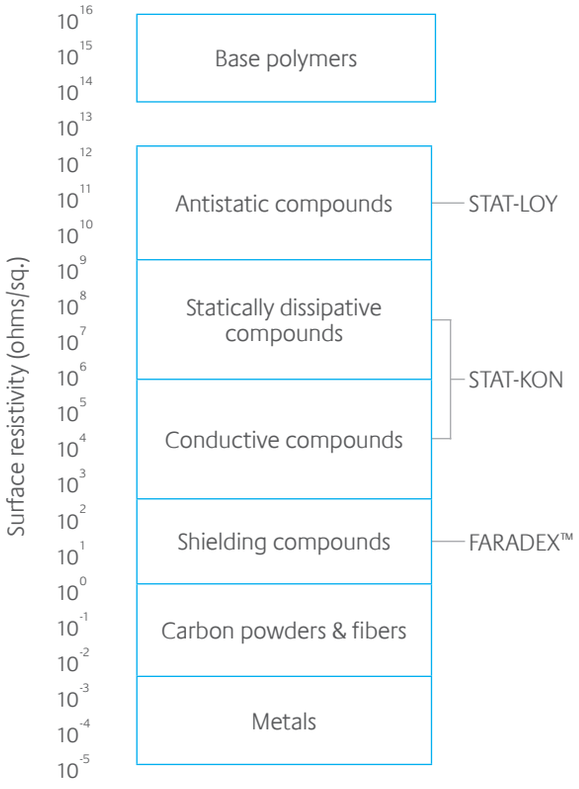
Thermoplastics are generally classified as electrically insulating materials having high surface resistivities in the range of 10^{14} to 10^{16} ohms/sq.

The electrically conductive plastics commercially available today are compound materials of electrically insulating base resins and electrically conductive fillers or reinforcing agents. This heterogeneous mixture of conductive additive and insulative thermoplastic base resin can be tailored to produce STAT-KON, and STAT-LOY compounds with surface resistivities across the resistivity spectrum from 10^2 to 10^{12} ohms/sq (see surface resistivity spectrum).

For these types of electrically conductive plastic compounds, the surface resistivity spectrum is divided into four different classifications of conductivity:

- Antistatic performance
- Dissipative performance
- Conductive performance
- Electromagnetic shielding performance

SURFACE RESISTIVITY SPECTRUM



CONDUCTIVE ADDITIVES

A variety of conductive additives are compounded into insulating polymers to achieve the different surface resistivity ranges.

These additives range from carbon and stainless steel fibers to carbon powder to antistatic ingredients (see Table 1).

Each additive can affect other properties besides resistivity, so certain additives are more appropriate for particular applications (see Table 2). This range of additives, coupled with our variety of base resins, technical background and experience can help solve most electrostatic charge and electrostatic discharge (ESD) problems.

TABLE 1

REINFORCEMENTS	FILLERS
Carbon fibers	Carbon powder
	Carbon fibrils
	Stainless steel fibers
	Permanent antistat

TABLE 2

CARBON FIBER	CARBON POWDER	STAINLESS STEEL FIBER	PERMANENT ANTISTAT
Increases strength/ stiffness	Isotropic shrinkage (Similar to unfilled)	Isotropic shrinkage (Similar to unfilled)	Isotropic shrinkage (Similar to unfilled)
Successfully used in clean room	Strength/stiffness (Similar to unfilled)	Strength/stiffness (Similar to unfilled)	Strength/stiffness (Similar to unfilled)
Anisotropic shrinkage (Tendency to warp)	Moderate elongation (4 – 20%)	Moderate elongation (4 – 6%)	Moderate elongation (10 – 30%)
Low elongation (2 – 3%)	More likely to slough (Particle generation)	Non-sloughing (No particle generation)	Non-sloughing (No particle generation)
		FDA capable	Colorable
		Colorable	

Tape drive bezels made from LNP STAT-KON DS compound

CONDUCTIVE ADDITIVES

STATIC ELECTRICITY — WHAT IS IT?

It's what the name implies — electricity at rest. This electrical charge is the result of a transfer of electrons that occurs due to the sliding, rubbing, or separating of a material which is a prime generator of electrostatic voltages e.g., plastics, fiber glass, rubber, textiles, etc. Under the right conditions, this induced charge can build to 30,000 or 40,000 volts.

When this happens to an insulating material, such as a plastic, the built-up charge tends to remain in the localized area of contact. This electrostatic voltage then can discharge via an arc or spark when the plastic material comes in contact with a body at a sufficiently different potential, such as a person or microcircuit.

If ESD occurs to a person, the result can range anywhere from a mild to painful shock. In extreme cases, ESD could even result in loss of life. Sparks are dangerous in an environment containing flammable liquids, solids or gases, such as in a hospital operating room or during the assembly of explosive devices.

Some micro-electronic parts can be destroyed or damaged by ESD as low as 20 volts. Since people are prime causes of ESD, they often cause damage to sensitive electronic parts, especially during manufacturing and assembly.

The consequences of discharge through an electrical component sensitive to ESD can range from erroneous readings to permanent damage resulting in excessive equipment downtime and costly repair or total part replacement.

STAT-LOY COMPOUNDS

Permanently antistatic compounds
(10^9 to 10^{12} ohms/sq.)

- Suppresses initial charges
- Minimizes tribocharging for movement
- Insulates against moderate to high leakage currents

STAT-KON COMPOUNDS

Dissipative compounds
(10^6 to 10^9 ohms/sq.)
(carbon powder/carbon fiber grades)

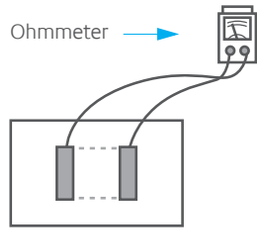
- No initial charge/low tribocharging
- Insulates against high leakage currents
- Prevents electrostatic discharge to/from human contact

Conductive compounds
(10^2 to 10^6 ohms/sq.)
(carbon powder/carbon fiber/stainless steel grades)

- No initial charge
- Dissipates tribo charges from high speed motion
- Provides grounding path for charge bleed-off

FIGURE 1

SURFACE RESISTIVITY MEASUREMENTS



$P_s = R_s \frac{P}{G}$ =ohms/sq.

R_s = Surface resistance
P = Perimeter of electrodes
G = Gap distance between electrodes

MEASURING ESD PROTECTION

Several methods exist for testing resistivity depending on filler type, resistivity range, and desired characteristics such as surface resistivity, volume resistivity, or static decay.

SURFACE RESISTIVITY

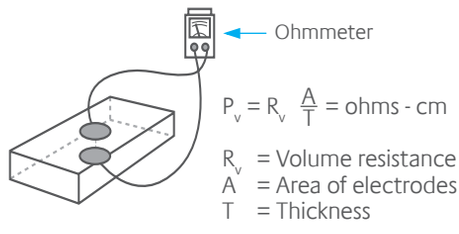
For thermoplastic materials intended to dissipate electrostatic charges, surface resistivity is the most common measurement of a material's ability to do so.

Widely accepted surface resistivity test methods are ASTM D257 and ASTM D4496. They consist of measuring the resistance (via an ohm meter) between two electrodes applied under load to the surface being tested. Electrodes are used rather than point probes because of the heterogeneous makeup of compounded thermoplastics.

Simply touching the surface with a point contact may not give readings consistent with the overall part (readings of this type are often insulative even when the part is actually conductive). It is also important to maintain good contact between the sample and electrodes, which can require considerable pressure. The resistance reading is then converted to resistivity to account for the dimensions of the electrodes which can vary depending on the size and shape of the test samples. [Surface resistivity is equal to resistance times the perimeter of the electrodes divided by the gap distance, yielding ohms/sq. (see Figure 1).]

FIGURE 2

VOLUME RESISTIVITY MEASUREMENTS



VOLUME RESISTIVITY

Volume resistivity is useful for evaluating the relative dispersion of a conductive additive throughout the polymer matrix.

Volume resistivity is tested in a similar fashion to surface resistivity. However, electrodes are placed on opposite faces of a sample (see Figure 2). ASTM D257 also refers to volume resistivity, and a conversion factor again based on electrode dimensions and part thickness is used to obtain the resistivity value from a resistance reading. [Volume resistivity is equal to resistance times the surface area (cm^2) divided by the thickness of the part (cm) yielding ohm-cm.]

STATIC DECAY

When a material transfers or eliminates a charge through a ground or to the atmosphere it is called static decay. A common method of testing is to apply a 5,000 volt charge to a part and then measure the time required to bleed-off the charge once grounded. One widely used specification for this method is MIL-B-81705B which requires the 5,000 volts to discharge to 0 volts in less than two seconds at 15% R.H. The National Fire Protection Association (NFPA) in code 56A calls for a decay to 500 volts (10%) in less than 0.5 seconds at 50% R.H.

Hand held field meters also can detect and quantify, to some degree, a static charge on a part. A quick check of antistatic properties can be done by rubbing a part with an insulating media. The hand held meter can then be used immediately to check the charge buildup and its ensuing decay.

CARBON SLOUGHING

One technique for achieving conductive plastic parts is to compound carbon powder into the base resin. In some situations, it is possible for the carbon powder to come out of the resin when the part comes in contact with other components. This effect is called 'sloughing.' In some applications carbon sloughing can be a source of contamination. While sloughing can be minimized through careful selection of components for particularly sensitive applications, it may be wise to consider alternative approaches such as carbon fiber.

LNP CLEAN COMPOUND SYSTEMS (CCS) CAPABILITIES

For components and handling devices in mass storage, disk drive, tape drive and optical/DVD applications, "clean" compounds are essential to maximize product performance and longevity. Out-gassing of organic volatiles and ionic contamination from nitrates, chlorides and sulfates can result in corrosion of both head and media with a corresponding loss of data. What's more, as disk drives and tape drives achieve faster speeds and lower flying head heights, the potential for damage from contamination only increases.

The solution? CCS materials from LNP specialty compounds. CCS materials feature very low levels (ppb range) of volatiles and ionic materials. A wide range of LNP STAT-LOY and STAT-KON compounds can be made using the CCS approach.

More than thirty five base polymers are available to fit your application's performance and cost requirements. The manufacture of CCS compounds begins with "clean" base resins, fillers, and additives.

During the compounding process, extreme care is taken to prevent the addition of ionic contaminants into the final material.

Initial internal testing can be conducted on developmental compounds to verify that they meet cleanliness criteria. Analytical capabilities include inductively coupled plasma (ICP) to test over a dozen different metal ions, ion chromatography (IC) to detect anions, and gas chromatography/mass spec (GC/MS) for volatiles. This testing will confirm the purity of CCS compounds to the ppb range. See brochure SABIC-PLA-8730 "LEAN + CLEAN / LNP STAT-KON COMPOUNDS Product Environmental Summary" for additional details.

Applications that can benefit from CCS compounds include wafer transporters, wafer mini environments, shipping combs, HGA and HSA trays, disk drive actuators, chassis and internal components, flex circuit clips, and more.

STAT-KON COMPOUNDS - AUTOMOTIVE INDUSTRY

The automotive industry's increasing demand for advanced electronic technology and continuing safety requirements has heightened awareness of the destructive effect of electrostatic discharge. STAT-KON compounds are excellent candidates for electrostatic discharge problems in such applications as instrument panel bezels and automotive fuel systems. Some examples include:

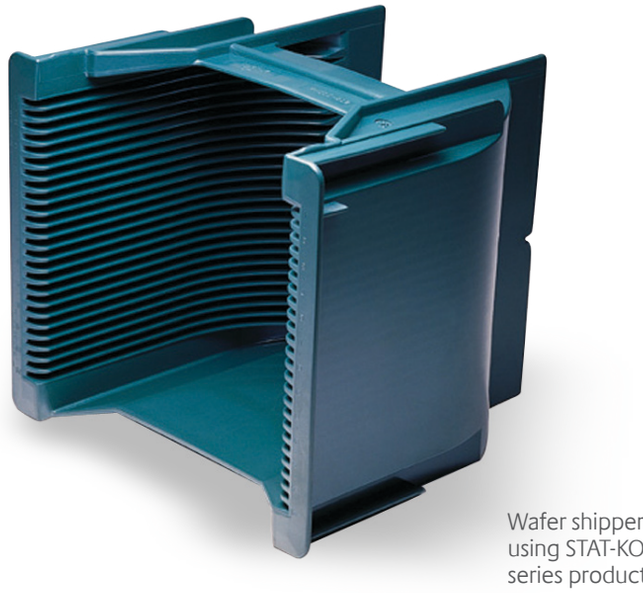
APPLICATIONS	MATERIALS
Electronic housings	LNP FARADEX DS compounds (multiple colors)
Fuel filter housings	LNP STAT-KON S, STAT-KON K compounds
Fuel line connectors	LNP STAT-KON O, STAT-KON S, STAT-KON SX, STAT-KON W compounds
Fuel line clips	LNP STAT-KON MD, STAT-KON SX, STAT-LOY P compounds
Fuel reservoir	LNP STAT-KON F compounds
Fuel filler pockets	LNP STAT-KON MD compounds

Inline fuel filter housing and fuel line made from LNP STAT-KON S series compounds

STAT-KON COMPOUNDS - BUSINESS MACHINES

STAT-KON compounds were originally developed at the request of customers who needed solutions for the problems of ESD in computers and other business machines. Since its origination, we have continued to develop and enhance our electrically active product line to meet industry challenges. Here are some examples:

APPLICATIONS	MATERIALS
Printed circuit board cassettes	LNP STAT-KON DD0009, STAT-KON DDF029 compounds
Grounding bushings	LNP STAT-KON KCL, STAT-KON OCL series compounds
Paper tractors	LNP STAT-KON DCL, STAT-KON QCL compounds
Font cartridges	LNP STAT-LOY A compounds
Plotter platen	LNP STAT-KON DCF compounds
Ink ribbon canisters	LNP STAT-KON JCL compounds
Mailing machine feed decks	LNP STAT-KON DC compounds



Wafer shipper molded using STAT-KON LC-CCS series product

STAT-KON COMPOUNDS - ELECTRONICS MARKET

LNP STAT-KON and STAT-LOY products have helped many customers in the semiconductor and microelectronics industries successfully reduce device failure and damage from ESD, particulant contamination, and out-gassing contamination. Areas of focus include molded packaging and handling equipment used in a range of automated electronics and semiconductor manufacturing operations.

APPLICATIONS	MATERIALS
IC chip trays and carriers	LNP STAT-KON J (180 °C), STAT-KON D (125 °C), STAT-KON Z (150 °C), STAT-KON A (65 °C), STAT-LOY A (65 °C), STAT-LOY AF (65 °C) compounds
IC shipping tubes	LNP STAT-KON D, STAT-LOY A compounds
Wafer boats and shippers	LNP STAT-KON L, STAT-KON M compounds
Carrier tape	LNP STAT-KON D, STAT-KON C compounds
Tote bins and trays	LNP STAT-KON M, STAT-KON MD, STAT-LOY A compounds

Digital copier paper path components made from STAT-KON UC series products

STAT-KON COMPOUNDS - PROPERTY DATA

TYPICAL PROPERTIES OF STAT-KON AND STAT-LOY COMPOUNDS — ASTM METHODS, ENGLISH UNITS

PROPERTY	TENSILE STRESS, BREAK	TENSILE STRAIN, BREAK	TENSILE MODULUS, 50 MM/MIN	FLEXURAL STRESS	FLEXURAL MODULUS	IZOD IMPACT, UNNOTCHED, 23 °C	IZOD IMPACT, NOTCHED, 23 °C	INSTRUMENTED IMPACT ENERGY @ PEAK, 23 °C
ASTM STANDARD	D638	D638	D638	D790	D790	D4812	D256	D3763
UNITS	psi	%	psi	psi	psi	ft.*lb./in.	ft.*lb./in.	in.-lb.
FAMILY/TRADENAME/PRODUCT								
STAT-KON CARBON FIBER REINFORCED COMPOUNDS								
STAT-KON DE0029EF	16530	2.30	1289050	26100	1109250	8.31	1.12	150.5
STAT-KON DEF42	17400	2.2	1762040	25810	1280060	9.01	1.59	79.7
STAT-KON EC002E	23345	1.6	1689250	34945	1566000	8.00	0.99	97.4
STAT-KON KE002	15225	2.4	—	23345	1078800	6.99	0.79	—
STAT-KON ME003S	5945	3	—	9425	739500	5.99	0.99	—
STAT-KON OE006A	30450	1.1	4749910	44225	3409965	8.00	0.90	26.6
STAT-KON WE002	19285	2.5	1470300	26245	1071550	8.18	0.69	62.0
STAT-KON CARBON POWDER FILLED GRADES								
STAT-KON DD000	8120	9.5	388600	14790	419050	22.79	1.20	70.8
STAT-KON DD0009	7685	5.6	408900	15660	408900	29.14	1.27	88.5
STAT-KON DDF029	11745	2.9	649600	19140	639450	8.30	0.99	62.0
STAT-KON FX98500	1885	43.2	155150	3770	126150	No Break	0.90	185.9
STAT-KON KD000	7685	6.2	517070	14645	474005	16.80	0.69	53.1
STAT-KON MD000	2320	47.6	18125	4205	169650	No Break	15.30	292.1
STAT-KON MD000ISC	2465	133.8	69600	3915	165000	29.08	15.60	212.4
STAT-KON RD000	9715	4.5	459650	13775	398750	20.00	1.99	79.7
STAT-KON AND STAT-LOY COMPOUNDS FOR EXTRUSION APPLICATIONS								
STAT-KON DX05499	8700	8.3	398750	14645	468350	44.08	1.80	221.3
STAT-LOY K3000Z	4640	59.5	230550	7105	208800	No Break	2.79	247.8
STAT-KON STAINLESS STEEL FILLED COMPOUNDS								
STAT-KON MS000IL	2175	76	182700	4495	184150	24.89	1.80	88.5
STAT-LOY COMPOUNDS								
STAT-LOY A3000	5220	6	298700	9425	303050	No Break	5.28	283.2
STAT-LOY M3000	2610	47	201550	5800	208800	No Break	1.29	62.0
STAT-LOY NX03583	7100	5	312000	12200	312000	—	12	336
STAT-LOY W3000XXJ	5900	4.3	280000	8847	274120	26.2	1.1	32
STAT-LOY A3000TXB	5500	31	241000	7107	216100	—	2.4	—

HDT, 1.84 MPa, 3.2 MM, UNANNEALED	CTE, -40 °C TO 40 °C, FLOW	CTE, -40 °C TO 40 °C, XFLOW	DENSITY	MOISTURE ABSORPTION, 50% RH,	MOLD SHRINKAGE, FLOW, 24 HRS	MOLD SHRINKAGE, XFLOW, 24 HRS	SURFACE RESISTIVITY	UL 94 FLAMMABILITY
D648	E 831	E 831	D792	D570	D955	D955	D 4496	UL SUBJECT 94
°F	X 10^{-5}1/°F	X 10^{-5}1/°F	g/cm^3	%	%	%	Ohm/sq	—
284	1.3	1.9	1.26	0.16	0.1 – 0.3	0.2 – 0.4	10^2 – 10^6	—
286	0.6	2.5	1.37	0.09	0.1 – 0.2	0.1 – 0.3	10^2 – 10^6	V-0 @ 2.4 mm
401	1.8	1.8	1.31	0.30	0.1 – 0.3	0.3 – 0.5	10^2 – 10^6	—
—	—	—	1.43	—	0.6	1.5	10^2 – 10^6	—
—	—	—	—	—	—	—	10^2 – 10^6	—
513	0.5	2.3	1.44	0.02	0.1	0.4	10^2 – 10^6	V-0 @ 1.0 mm
406	2.3	4.4	1.35	0.09	0.3 – 0.5	0.9 – 1.1	10^2 – 10^6	—
261	3.6	3.5	1.24	0.14	0.8	0.8	10^2 – 10^6	HB @ 1.5 mm
270	3.0	3.2	1.32	0.18	0.8	0.7	10^5 – 10^{10}	V-0 @ 1.7 mm
275	2.4	2.9	1.37	0.11	0.4	0.5	10^5 – 10^{10}	V-0 @ 1.8 mm
115	—	—	0.98	0.02	2.7 – 3.0	1.9 – 2.2	10^2 – 10^5	—
223	4.9	5.1	1.44	0.25	2.1 – 2.5	2.1 – 2.5	10^2 – 10^6	—
124	5.7	5.8	0.95	0.03	1.3 – 1.6	1.3 – 1.6	10^2 – 10^6	HB @ 1.5 mm
126	5.6	6.6	0.98	0.03	1.6 – 1.8	1.6 – 1.8	10^2 – 10^6	—
201	4.4	4.5	1.19	0.54	2.7	2.4	10^2 – 10^6	N/A
248	3.4	3.3	1.34	0.11	0.6	0.7	10^5 – 10^9	V-0 @ 0.5 mm
153	7.2	7.4	1.32	2.29	1.8	1.8	10^9 – 10^{11}	—
126	5.6	6.5	0.96	—	1.3	1.4	10^2 – 10^6	—
169	5.2	5.6	1.07	1.08	0.4	0.4	10^9 – 10^{11}	HB @ 1.5 mm
133	6.1	7.1	0.95	0.85	1.3	1.3	10^9 – 10^{11}	—
211	—	—	1.26	—	—	—	10^{10} – 10^{12}	V-0 @ 1.5 mm
131	6.38	7.11	1.27	0.37	2 - 4	2 – 4	10^{11} – 10^{13}	—
150	5.5	6,05	1.09	0.81	0.4 – 0.6	0.6 – 0.8	10^9 - 10^{11}	—

STAT-KON COMPOUNDS - PROPERTY DATA

TYPICAL PROPERTIES OF STAT-KON AND STAT-LOY COMPOUNDS — ASTM METHODS, SI UNITS

PROPERTY	TENSILE STRESS, BREAK	TENSILE STRAIN, BREAK	TENSILE MODULUS, 50 MM/MIN	FLEXURAL STRESS	FLEXURAL MODULUS	IZOD IMPACT, UNNOTCHED, 23 °C	IZOD IMPACT, NOTCHED, 23 °C	INSTRUMENTED IMPACT ENERGY @ PEAK, 23 °C
ASTM STANDARD	D638	D638	D638	D790	D790	D4812	D256	D3763
UNITS	MPa	%	MPa	MPa	MPa	J/m	J/m	J
FAMILY/TRADENAME/PRODUCT								
STAT-KON CARBON FIBER REINFORCED COMPOUNDS								
STAT-KON DE0029EF	114	2.30	8890	180	7650	444	60	17
STAT-KON DEF42	120	2.2	12152	178	8828	481	85	9
STAT-KON EC002E	161	1.6	11650	241	10800	427	53	11
STAT-KON KE002	105	2.4	—	161	7440	373	42	—
STAT-KON ME003S	41	3	—	65	5100	320	53	—
STAT-KON OE006A	210	1.1	32758	305	23517	427	48	3
STAT-KON WE002	133	2.5	10140	181	7390	437	37	7
STAT-KON CARBON POWDER FILLED GRADES								
STAT-KON DD000	56	9.5	2680	102	2890	1217	64	8
STAT-KON DD0009	53	5.6	2820	108	2820	1556	68	10
STAT-KON DDF029	81	2.9	4480	132	4410	443	53	7
STAT-KON FX98500	13	43.2	1070	26	870	No Break	48	21
STAT-KON KD000	53	6.2	3566	101	3269	897	37	6
STAT-KON MD000	16	47.6	125	29	1170	No Break	817	33
STAT-KON MD000ISC	17	133.8	480	27	1138	1553	833	24
STAT-KON RD000	67	4.5	3170	95	2750	1068	106	9
STAT-KON AND STAT-LOY COMPOUNDS FOR EXTRUSION APPLICATIONS								
STAT-KON DX05499	60	8.3	2750	101	3230	2354	96	25
STAT-LOY K3000Z	32	59.5	1590	49	1440	No Break	149	28
STAT-KON STAINLESS STEEL FILLED COMPOUNDS								
STAT-KON MS000IL	15	76	1260	31	1270	1329	96	10
STAT-LOY COMPOUNDS								
STAT-LOY A3000	36	6	2060	65	2090	No Break	282	32
STAT-LOY M3000	18	47	1390	40	1440	No Break	69	7
STAT-LOY NX03583	49	5	2150	84	2150	—	640	38
STAT-LOY W3000XXJ	41	4.3	1930	—	1940	1400	61	3
STAT-LOY A3000TXB	27	31	1660	54	1630	—	131	33

HDT, 1.84 MPa, 3.2 MM, UNANNEALED	CTE, -40 °C TO 40 °C, FLOW	CTE, -40 °C TO 40 °C, XFLOW	DENSITY	MOISTURE ABSORPTION, 50% RH,	MOLD SHRINKAGE, FLOW, 24 HRS	MOLD SHRINKAGE, XFLOW, 24 HRS	SURFACE RESISTIVITY	UL 94 FLAMMABILITY
D648	E 831	E 831	D792	D570	D955	D955	D 4496	UL SUBJECT 94
°C	X 10^{-5}1/°C	X 10^{-5}1/°C	g/cm³	%	%	%	Ohm/sq	—
140	2.4	3.5	1.26	0.16	0.1 – 0.3	0.2 – 0.4	10^2 – 10^6	—
141	1.1	4.5	1.37	0.09	0.1 – 0.2	0.1 – 0.3	10^2 – 10^6	V-0 @ 2.4 mm
205	3.3	3.3	1.31	0.30	0.1 – 0.3	0.3 – 0.5	10^2 – 10^6	—
—	—	—	1.43	—	0.6	1.5	10^2 – 10^6	—
—	—	—	—	—	—	—	10^2 – 10^6	—
267	0.9	4.1	1.44	0.02	0.1	0.4	10^2 – 10^6	V-0 @ 1.0 mm
208	4.2	7.9	1.35	0.09	0.3 – 0.5	0.9 – 1.1	10^2 – 10^6	—
127	6.4	6.3	1.24	0.14	0.8	0.8	10^2 – 10^6	HB @ 1.5 mm
132	5.4	5.7	1.32	0.18	0.8	0.7	10^5 – 10^{10}	V-0 @ 1.7 mm
135	4.4	5.2	1.37	0.11	0.4	0.5	10^5 – 10^{10}	V-0 @ 1.8 mm
46	–	–	0.98	0.02	2.7 – 3.0	1.9 – 2.2	10^2 – 10^5	—
106	8.8	9.2	1.44	0.25	2.1 – 2.5	2.1 – 2.5	10^2 – 10^6	—
51	10.2	10.5	0.95	0.03	1.3 – 1.6	1.3 – 1.6	10^2 – 10^6	HB @ 1.5 mm
52	10.1	11.9	0.98	0.03	1.6 – 1.8	1.6 – 1.8	10^2 – 10^6	—
94	8.0	8.1	1.19	0.54	2.7	2.4	10^2 – 10^6	N/A
120	6.2	6.0	1.34	0.11	0.6	0.7	10^5 – 10^9	V-0 @ 0.5 mm
67	13.0	13.3	1.32	2.29	1.8	1.8	10^9 – 10^{11}	—
52	10.1	11.7	0.96	—	1.3	1.4	10^2 – 10^6	—
76	9.3	10.1	1.07	1.08	0.4	0.4	10^9 – 10^{11}	HB @ 1.5 mm
56	11.0	12.8	0.95	0.85	1.3	1.3	10^9 – 10^{11}	—
99	—	—	1.26	—	—	—	10^{10} – 10^{12}	V-0 @ 1.5 mm
55	—	—	1.27	0.23	2.0 – 4.0	2.0 – 4.0	10^{11} – 10^{13}	—
66	5.5	6.05	1.09	0.54	0.4 – 0.6	0.6 – 0.8	10^9 – 10^{11}	—

STAT-KON COMPOUNDS - PROPERTY DATA

TYPICAL PROPERTIES OF STAT-KON AND STAT-LOY COMPOUNDS — ISO METHODS

PROPERTY	TENSILE STRESS, BREAK	TENSILE STRAIN, BREAK	TENSILE MODULUS, 50 MM/MIN	FLEXURAL STRESS	FLEXURAL MODULUS	IZOD IMPACT, UNNOTCHED 80*10*4 +23 °C	IZOD IMPACT, NOTCHED 80*10*4 +23 °C	HDT/AF, 1.8 MPA FLATW 80*10*4 SP=64MM
ASTM STANDARD	ISO 527	ISO 527	ISO 527	ISO 178	ISO 178	ISO 180/1U	ISO 180/1A	ISO 75/AF
UNITS	MPa	%	MPa	MPa	MPa	kJ/m²	kJ/m²	°C
FAMILY/TRADENAME/PRODUCT								
STAT-KON CARBON FIBER REINFORCED COMPOUNDS								
STAT-KON DE0029EF	117	2.4	8500	183	8800	29	6	139
STAT-KON DEF42	116	2	11630	192	10980	47	9	142
STAT-KON EC002E	137	1.2	12630	216	10310	—	5	207
STAT-KON KE002	104	2	8220	154	7050	—	4	161
STAT-KON ME003S	22‡	2.9‡	3140	23	1780	17	13	82
STAT-KON OE006A	204	1	25450	311	24720	—	5	268
STAT-KON WE002	125	2	10460	184	7760	—	4	201
STAT-KON CARBON POWDER FILLED GRADES								
STAT-KON DD000	53	8.8	2900	102	3100	98	6	127
STAT-KON DD0009	57	7.5	2810	102	2880	70	6	131
STAT-KON DDF029	81	2.8	4600	134	4800	—	6	135
STAT-KON FX98500	14	82.8	639000	931	26500	—	5	48
STAT-KON KD000	46	18.1	3190	83	3220	—	4	103
STAT-KON MD000	15	52	1220	24	1160	—	60	53
STAT-KON MD000ISC	17	—	1100	27	1200	—	65	56
STAT-KON RD000	64	7.6	3100	96	3000	—	7	77
STAT-KON AND STAT-LOY COMPOUNDS FOR EXTRUSION APPLICATIONS								
STAT-KON DX05499	53	12.6	2800	108	3100	—	9	122
STAT-LOY K3000Z	36	49.2	1500	40	1500	—	15	—
STAT-KON STAINLESS STEEL FILLED COMPOUNDS								
STAT-KON MS000IL	16	38.9	1170	24	1180	—	10	52
STAT-LOY COMPOUNDS								
STAT-LOY A3000	31	24.2	2010	59	1980	—	16	76
STAT-LOY M3000	7	98.2	1350	32	1360	—	9	59
STAT-LOY NX03583	—	—	—	—	—	—	—	—
STAT-LOY W3000XXJ	42	9.6	1880	61	1890	89	5	54
STAT-LOY A3000TXB	26	29	1550	49	1490	—	14	66

‡ at yield

CTE, -40 °C TO 40 °C, FLOW	CTE, -40 °C TO 40 °C, XFLOW	DENSITY	MOISTURE ABSORPTION (23 °C / 50% RH)	MOLD SHRINKAGE, FLOW, 24 HRS	MOLD SHRINKAGE, XFLOW, 24 HRS	SURFACE RESISTIVITY	UL 94 FLAMMABILITY
ISO 11359-2	ISO 11359-2	ISO 1183	ISO 62	ISO 294	ISO 294	ASTM D 4496	UL SUBJECT 94
X 10^{-5} 1/°C	X 10^{-5} 1/°C	g/cm^3	%	%	%	Ohm/sq	—
2.36	3.46	1.26	0.2	0.1 – 0.3	0.2 – 0.4	10^2 – 10^6	—
1.08	6.52	1.37	0.3	0.1 – 0.2	0.1 – 0.3	10^2 – 10^6	V-0 @ 2.4 mm
3.33	3.30	1.31	0.35	0.1 – 0.3	0.3 – 0.5	10^2 – 10^6	—
—	—	1.43	—	0.6	1.5	10^2 – 10^6	—
—	—	0.93	—	0.4 – 0.6	1.3 – 1.5	10^6 – 10^7	—
0.87	4.08	1.44	0.03	0.1	0.4	10^2 – 10^6	V-0 @ 1.0 mm
4.18	7.92	1.34	0.1	0.3 – 0.5	0.9 – 1.1	10^2 – 10^6	—
—	—	1.24	0.25	0.8	0.8	10^2 – 10^6	HB @ 1.5 mm
5.36	5.67	1.32	0.27	0.8	0.7	10^5 –10^{10}	V-0 @ 1.7 mm
4.43	5.19	1.37	0.2	0.4	0.4	10^5 –10^{10}	V-0 @ 1.8 mm
—	—	0.97	0.02	2.7 – 3.0	1.9 – 2.2	10^2 – 10^5	—
8.78	9.23	1.44	0.32	2.1 – 2.5	2.1 – 2.5	10^2 – 10^6	—
10.20	10.50	0.95	0.03	1.3 – 1.6	1.3 – 1.6	10^2 – 10^6	HB @ 1.5 mm
10.10	11.90	0.97		1.6 – 1.8	1.5 – 1.8	10^2 – 10^6	—
7.97	8.10	1.19	0.96	2.6	2.4	10^2 – 10^6	N/A
—	—	1.34	0.19	0.6	0.6	10^5 – 10^9	V-0 @ 0.5 mm
13.00	13.30	1.33	4.28	1.8	1.8	109 - 1011	—
10.10	11.70	0.96	—	1.2	1.3	10^2 – 10^6	—
9.34	10.10	1.06	—	0.4	0.4	10^9 – 10^{11}	HB @ 1.5 mm
11.00	12.80	0.95	—	1.3	1.3	10^9 – 10^{11}	—
—	—	—	—	—	—	10^{10} – 10^{12}	V-0 @ 1.5 mm
—	—	1.27	0.37	2.0 – 4.0	2.0 – 4.0	10^{11} – 10^{13}	—
5.5	6.05	1.09	0.81	0.4 – 0.6	0.6 – 0.8	10^9 – 10^{11}	—

PROCESSING TECHNIQUES

STAT-KON and STAT-LOY compounds are not limited to injection molding applications. Grades have been specifically developed to suit a variety of process techniques.

STRUCTURAL FOAM MOLDING

- LNP STAT-KON carbon fiber reinforced compounds

HOLLOW GAS

- Most LNP STAT-KON and STAT-LOY grade compounds

SHEET EXTRUSION

- LNP STAT-KON FD000Z compounds
- LNP STAT-KON DX10403, DX05499 compounds
- LNP STAT-LOY A compounds

SLAB EXTRUSION

- LNP STAT-KON DX10403, DX05499 compounds

TUBING

- LNP STAT-KON stainless steel nylon 12 compounds

THERMOFORMING

- LNP STAT-KON DX10403, DX05499 – sheet compounds

PROFILE

- LNP STAT-KON D compounds
- LNP STAT-KON J compounds

BLOW MOLDING

- LNP STAT-KON FD000Z compounds
- LNP STAT-KON M compounds
- LNP STAT-LOY A compounds

LNP PRODUCT LINE INFORMATION

LNP COLORCOMP™ COMPOUNDS

COLORCOMP pre-colored, unfilled engineering resins are excellent candidates for the OEM or molder with lot releases of 110 to 40,000 pounds, critical color accuracy requirements, and/or a need for short lead times. COLORCOMP resins can be manufactured from virtually any thermoplastic resin in the LNP product line, in addition to select trademark resins from other major suppliers. A full line of special effects resins is available. All COLORCOMP resins are manufactured to meet QS/ISO standards for lot traceability.

LNP KONDUIT™ COMPOUNDS

Compounds of thermally conductive fillers and engineering thermoplastics, KONDUIT compounds have 2 to 10 times more thermal conductivity than traditional unfilled resins, while remaining electrically insulative, plus CLTEs similar to many metals. KONDUIT compounds may reduce thermal rise and increase the efficiency of clutch coils, motors, transformers, and many other coil wound systems.

LNP LUBRICOMP™ COMPOUNDS

LUBRICOMP internally lubricated compounds offer inherent lubrication through the addition of PTFE, silicone, aramid fiber, and/or other materials to a wide variety of engineering thermoplastics. LUBRILOY™ compounds, a family of proprietary lubricated alloys, offers properties approaching PTFE-lubricated materials at reduced cost. These products may find use in demanding wear applications in the business machines, automotive, medical, appliance, and industrial markets.

LNP STAT-KON COMPOUNDS

STAT-KON electrically conductive compounds may provide economical and reliable solutions against electrostatic buildup. FARADEX compounds offer EMI/RFI shielding and ESD protection, eliminating the need for most special coatings or paints.

LNP STAT-LOY COMPOUNDS

STAT-LOY compounds contain permanent anti-static additives that are non-humidity dependent and non-migratory. Formulated for ease of processing, these compounds can be injection molded or extruded. Common applications include automotive fuel delivery systems, electronic and electrical equipment/instruments, business machines, and more.

LNP THERMOCOMP™ COMPOUNDS

THERMOCOMP glass and/or carbon fiber reinforced compounds offer enhanced mechanical and thermal properties, including exceptional resistance to high temperature, fatigue, creep, impact, and chemicals. THERMOTUF™ compounds have been impact modified for additional toughness. The THERMOCOMP line also includes high specific gravity (HSG) compounds, melt processable fluoropolymer compounds, and exceptional processing (EP) compounds for thin wall molding. Products from the THERMOCOMP line are typically used in automotive functional components, business machines, electrical/electronic components, consumer goods, appliances, and industrial applications.

LNP VERTON™ COMPOUNDS

VERTON compounds combine nylon, polypropylene, polyphthalamide and other engineering thermoplastics with long reinforcing fibers using SABIC pultrusion process, which may provide an outstanding balance of cost and performance in structural applications. Specifically, these remarkably lightweight materials offer exceptional mechanical properties, combining rigidity with outstanding strength and resistance to impact failures. VERTON compounds find use in demanding structural applications, primarily in the automotive, industrial, and recreational markets. They also frequently replace die-cast metal.

CONTACT US

Middle East and Africa

SABIC Global Headquarters
PO Box 5101
Riyadh 11422
Saudi Arabia
T +966 (0) 1 225 8000
F +966 (0) 1 225 9000
E info@sabic.com

Americas

2500 CityWest Boulevard
Suite 100
Houston, Texas 77042
USA
T +1 713 430 2301
E productinquiries@sabic.com

Technical Answer Center
T +1 800 845 0600

Europe

Plasticslaan 1
PO Box 117
4600 AC
Bergen op Zoom
The Netherlands
T +31 164 292911
F +31 164 292940

Technical Answer Center
T (0) 0 800 1 238 5060
T2 00 36 1 238 5060
E webinquiries@sabic.com

Asia Pacific

2550 Xiupu Road
Pudong
201319 Shanghai
China
T +86 21 2037 8188
F +86 21 2037 8288