

PANOX[®]

The Thermally Stabilized
Textile Fiber

Oxidized Fiber



Broad Base. Best Solutions.



C

Carbon is Future.

SGL Group – The Carbon Company.

Carbon has unique properties. It is indispensable in the production of steel, aluminum and solar energy systems. Carbon increases the performance of wind turbines and reduces the weight of airplanes, cars and sports equipment.



Carbon substitutes other materials and contributes to a reduction in CO₂ emissions.



SGL Group is one of the leading manufacturers of carbon-based products and has the broadest product and technology portfolio, a global sales network and state-of-the-art production sites in Europe, North America and Asia.

Carbon Fibers & Composites

The Business Area Carbon Fibers & Composites (BA CFC) encompasses the complete value chain of carbon fiber products – from precursor via carbon fibers, fabrics and prepregs to finished CFRP composite parts.

We are the only European-based carbon fiber producer and have secured our own precursor supply. BA CFC has established a full range of downstream production technologies to provide its customers with a broad range of carbon products. Our materials portfolio is completed by glass fiber-based non-crimp fabrics and special technological developments like automated braiding in our joint venture SGL Kumpers.

Our subsidiary Hitco Carbon Composites has been supplying composite parts to the aerospace industry for many years now. To support the growth of the wind energy industry, our joint venture SGL Rotec is producing rotor blades for on- and offshore wind turbines. The automotive industry is supplied through our joint ventures Benteler SGL and Brembo SGL Carbon Ceramic Brakes.

We strive to be the leading carbon supplier to strategic growth industries with customized solutions from our broad product portfolio.

The Thermally Stabilized Textile Fiber

PANOX is the industry standard when it comes to fire-retardant textile fibers. PANOX is our trademark for an oxidized, thermally stabilized polyacrylonitrile (PAN) fiber that does not burn, melt, soften or drip. PANOX is ideal for processing into yarns, woven fabrics, nonwovens and felts.

Key benefits of fiber

- High LOI value (Limiting Oxygen Index)
- Excellent flammability classification
- High thermal stability
- High electrical resistivity
- Physiologically safe

Key benefits of process

- Superior blending and handling characteristics
- Ideal for textile processing
- Advantageous optical surface effects in composites

Ideal for textile processing

PANOX can be processed on standard textile machinery into needled or spun-laced nonwovens in a wide range of weights.

PANOX can easily be blended with other fibers, e.g. polyester, and is supplied with a special types of finish for excellent handling properties in textile processes.

Nonwovens containing PANOX show good finishing and coating behavior to achieve, for example, oil and water repellence on one hand and adhesive characteristics on the other.

Due to their high LOI value (Limiting Oxygen Index) PANOX fibers are non-flammable and provide end products with excellent fire resistance, high thermal stability and good thermal insulation.



Close-proximity suit containing PANOX®



PANOX® based carbon/carbon aircraft brake disk being tested



Insulation material of truck engines using nonwovens made of PANOX®

A Wide Range of Applications

Protective apparel



■ Close-proximity fire-fighting suit

The main features of PANOX include its exceptional thermal stability and moisture absorbency – characteristics that are essential requirements for heat- and flame-resistant protective apparel. Typical applications are glove and thermal liners in protective clothing for e.g. fire fighters, armed forces and police personnel, racing drivers and steelworkers. Using PANOX in protective clothing on its own or in blends reduces stress for the wearer in terms of fire protection and heat blocking, minimizing the suit weight and increasing manoeuvrability.

Furniture



■ Waiting area in a public building

The high-performance properties of PANOX fibers including their fire resistance and moisture absorbency help our customers produce advanced woven and nonwoven fabrics for furniture used in buildings such as theaters, nursing homes, hotels, cinemas and other public buildings. In case of a fire, PANOX helps to delay ignition or melting of upholstery foams and the release of toxic gases, winning time for people to escape from a building. PANOX can be used on its own or blended with other fibers to increase its wear and tear resistance.

Aircraft seats



■ Fire-blocking fabrics for aircraft seats

The heat- and fire-blocking quality of fabrics used for aircraft seats can be life-saving. Thanks to its high LOI value, PANOX is ideally suited to improve the heat- and fire-blocking performance of the fabric that covers the polyurethane foam used in aircraft seats. In case of a fire on board, PANOX helps to delay melting of the covering fabric and the foam behind it, slowing the release of toxic gases and allowing passengers more time to escape.

Aircraft brakes



■ C/C aircraft brake from a Boeing 767 manufactured with PANOX

One of the largest applications of PANOX is its use as a precursor material in the production of carbon/carbon aircraft brake disks. They are manufactured with a non-woven process producing a preform, which is then carbonized to form the solid carbon/carbon material. This is machined to shape to complete the brake disk. All leading brake manufacturers use PANOX for its textile processing properties that can provide brake disks withstand landing temperatures of sometimes over 1000 °C.

A Wide Range of Applications

Automotive



- Bonnet insulation covered with PANOX containing nonwoven material

Automotive manufacturers, with their stringent safety and environmental standards, require high-performance thermal and acoustic insulation in cars and trucks. PANOX is the industry standard when it comes to fire-retardant textile fibers employed for nonwoven and felt production. In conjunction with flax, wool, rock wool and foams, PANOX achieves excellent thermal and acoustic insulation values in a variety of automotive components. Blended with e.g. polyester, the material can be formed into almost any shape. In its milled form PANOX can be used as a substitute for asbestos in friction linings and brake pads, capitalizing on its superior heat resistance and flexibility as well as friction and wear properties.

Industrial



- Fabric-based bellows manufactured with PANOX or in a blend of PANOX and aramid fiber

Beyond the major industrial applications in the automotive and aircraft sector there are a multitude of further industrial uses for PANOX. These include welding blankets, bellows and industrial packings and gaskets. PANOX is also a popular means of achieving certain visual effects in molded thermoplastics across a variety of industries.

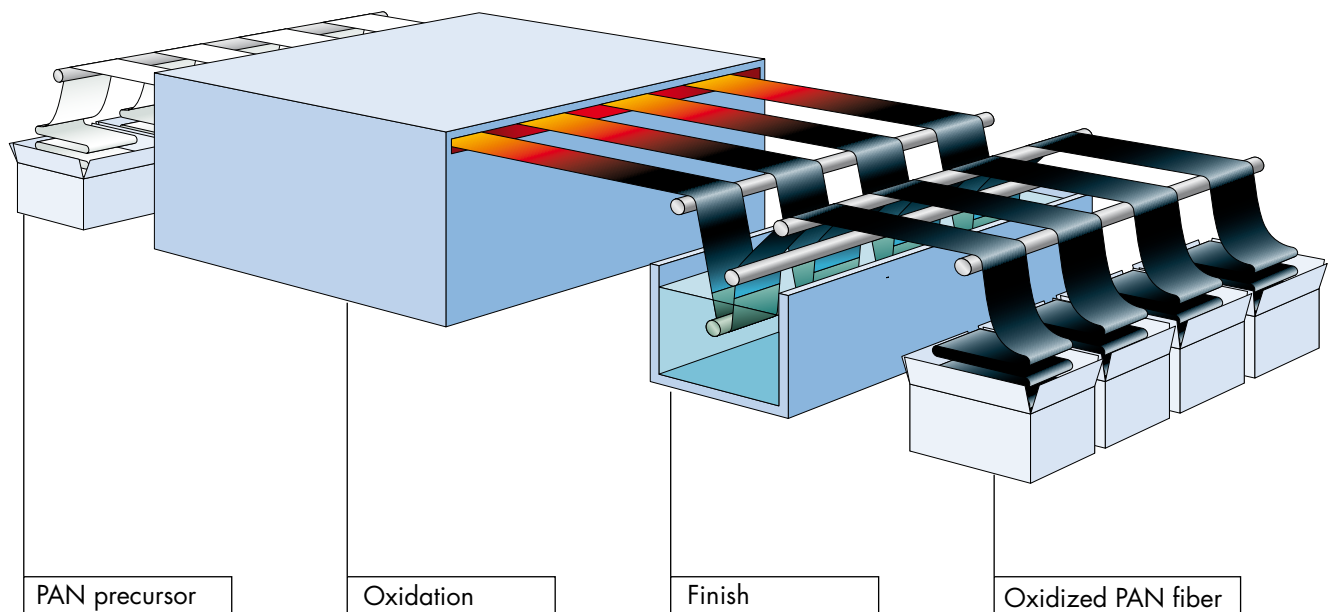
PANOX®

Optimized Manufacturing Process

PANOX is produced by a thermal stabilization reaction of polyacrylonitrile (PAN) with atmospheric oxygen at 300 °C. The result is an oxidized textile fiber with a nominal carbon content of 62 %.



Multifilament PANOX® tows on the production line



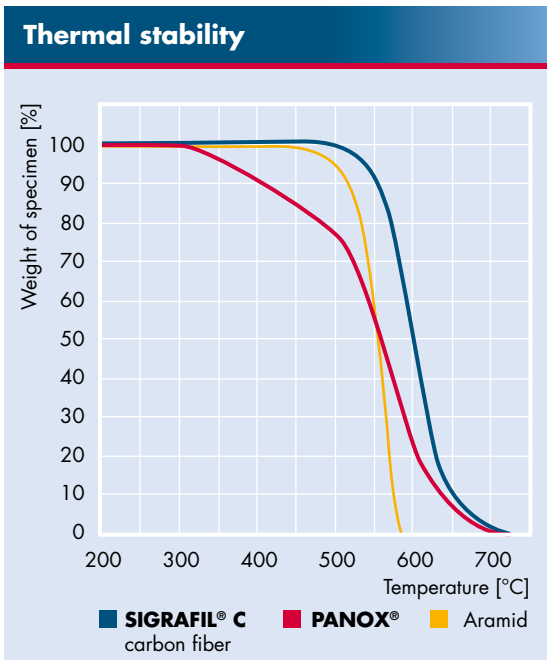
Matching Your Needs

Benefits of PANOX

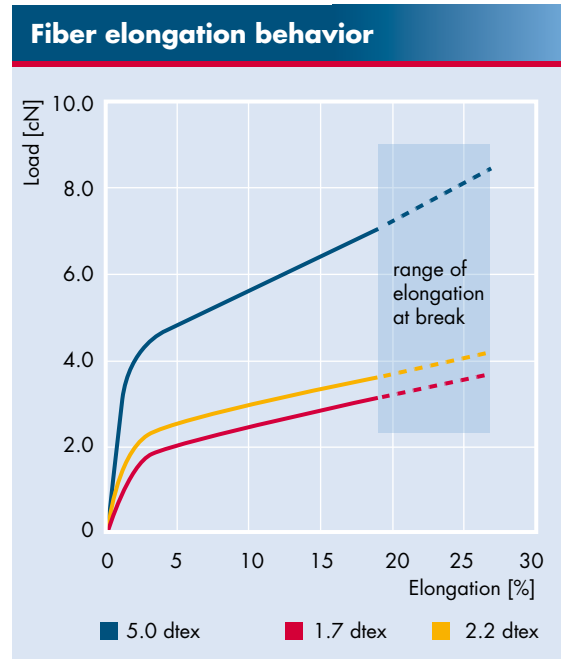
- High LOI value (Limiting Oxygen Index)
- Excellent flammability classification S-a (EN 532/533)
- Good fire behavior (DIN 4102)
- Low thermal conductivity of 0.4 W/mK
- High electrical resistivity $>10^8 \Omega\text{m}$
- High mechanical strength

- High moisture absorbency
- Physiologically safe
- Chemical composition: (% by weight)

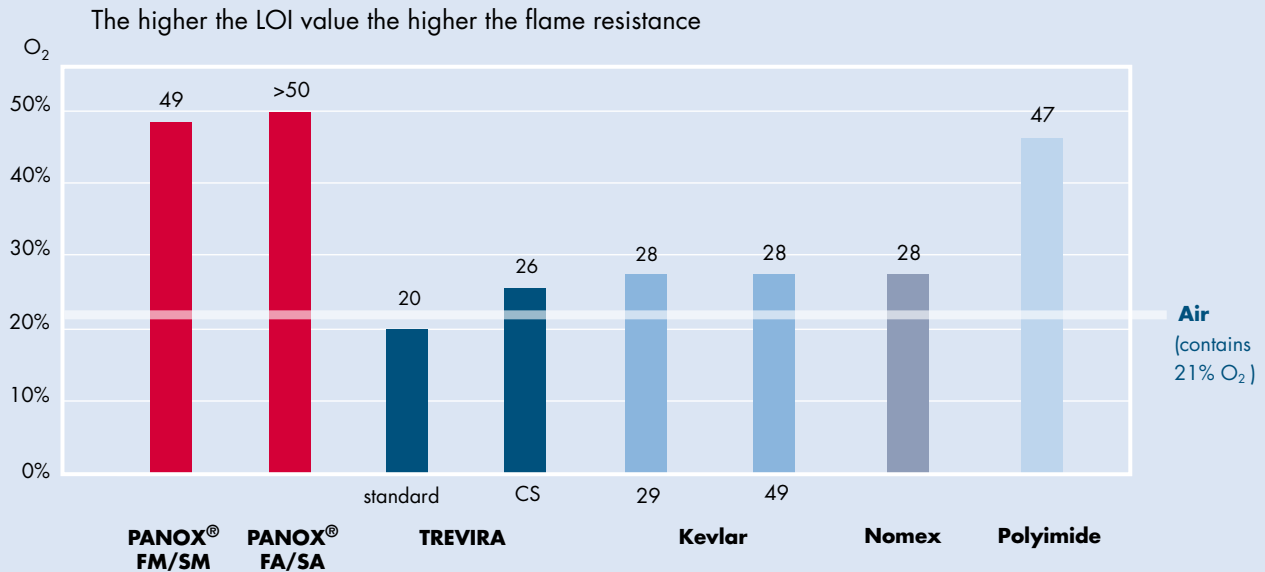
C	60 - 65
N	20 - 22
O	12 - 16
H	2 - 5



Heating rate 10°C/min
 Weight of specimen 30 mg
 Air flow 120 l/min



LOI values of non-burning fibers



Example: 49 % oxygen in air is needed to make PANOX burn, which is more than twice the normal oxygen content

Packaging units

PANOX type	Packaging	Items/ carton	Net weight/ PE bag	Net weight / carton
Continuous tow	Cartons on non-returnable pallets	1		180 kg/ 396 lb (average)
Crimped staple fiber	Compressed bales in polyethylene film (non-returnable pallets available on request)			235 kg/ 520 lb (average)
Staple fiber	PE plastic film bags in cartons on non-returnable pallets	4	10 kg/ 22 lb	40 kg/ 88 lb
Milled fiber	Cartons lined with PE bags on non-returnable pallets			25 kg/ 55 lb

Choosing the Right Fiber

To meet your specific requirements, PANOX fibers can be varied in:

- Fiber type
- Length
- Single filament count
- Fiber density
- Finish

The table below illustrates how our product codes are constructed. Choose the combination that meets your requirements from the various diameters, densities, lengths and finishes.

Product codes for PANOX			Example:	PANOX	SM	T320	EEA
Single filament count		Code					
1.7 dtex		F					
2.2 dtex		S					
Fiber density		Code					
1.37 g/cm ³		B					
1.38 g/cm ³		M					
Fiber type	Length	Code					
Continuous tow ¹⁾	N/A	T320					
Crimped staple fiber*	63 mm	C063					
	76 mm	C076					
Staple fiber*	4 mm	S004					
Milled fiber	400 µm	M400					
Finish type		Code					
For carbon/carbon and spinning		EEA					
For felts and nonwovens		SSC					

¹⁾ 320k filaments

*Other lengths on request

Example: You require PANOX fibers at 2.2 dtex single filament count (**S**) and 1.38 g/cm³ fiber density (**M**) as continuous tow with 320k filaments (**T320**) in a finish for spinning (**EEA**). This particular fiber is represented by the following product code **PANOX SM T320 EEA**.

Product specification

PANOX type	Filaments per tow in [000s]	Linear density		Mean filament diameter [µm]	Fiber density [g/cm ³]	Mean moisture absorption [%]	Typical elongation at break [%]	Mean tensile strength [MPa]	Mean fiber tenacity [cN/tex]	Typical finish content [%]	Mean fiber length ²⁾ [mm]	Crimps per cm
		[dtex]	[den]									
Continuous tow for yarns												
FM T320 EEA	320	1.7	1.5	13	1.39	6.5	16 - 28	210	> 16	0.6	-	-
SMT320 EEA	320	2.2	2.0	15	1.38	8.5	16 - 28	210	> 16	0.6	-	-
Continuous tow for carbon/carbon applications												
FB T320 EEA	320	1.7	1.5	13	1.37	6.5	20 - 32	210	> 16	0.6	-	-
Crimped staple fiber for felts and nonwovens												
FM C063 SSC	-	1.7	1.5	13	1.39	10	18 - 28	210	> 16	0.9	63	6.0
SMC063 SSC	-	2.2	2.0	15	1.38	10	18 - 28	210	> 16	0.9	63	6.0
SMC076 SSC	-	2.2	2.0	15	1.38	10	18 - 28	210	> 16	0.9	76	6.0
Crimped staple fiber for yarns												
FM C063 EEA	-	1.7	1.5	13	1.39	6.5	16 - 28	210	> 16	0.6	63	6.0
SMC063 EEA	-	2.2	2.0	15	1.38	8.5	16 - 28	210	> 16	0.6	63	6.0
Milled fiber for friction linings												
FB M400EEA	-	-	-	13	1.37	6.5	20 - 32	210	> 16	0.6	0.3	-

¹⁾ further single filament counts on request

²⁾ further lengths available on request

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Carbon Fibers & Composite Materials

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