ZOLTEK OX

TECHNICAL FIBER PRODUCTS

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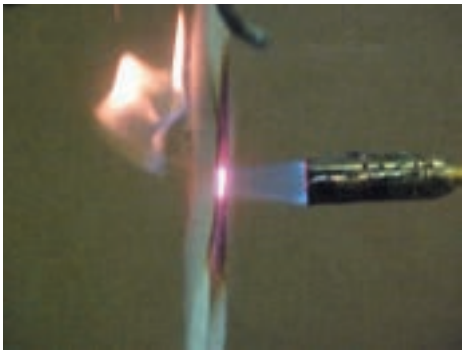
ZOLTEK OX

ZOLTEK OX is a tradename for oxidized polyacrylonitrile (PAN) fibers produced by ZOLTEK. PAN fiber is processed through a high temperature oven to oxidize and stabilize its molecular structure. ZOLTEK has produced oxidized ZOLTEK OX technical fibers for over 20 years, allowing us to fine tune our process and become the largest oxidized PAN fiber supplier in the world.

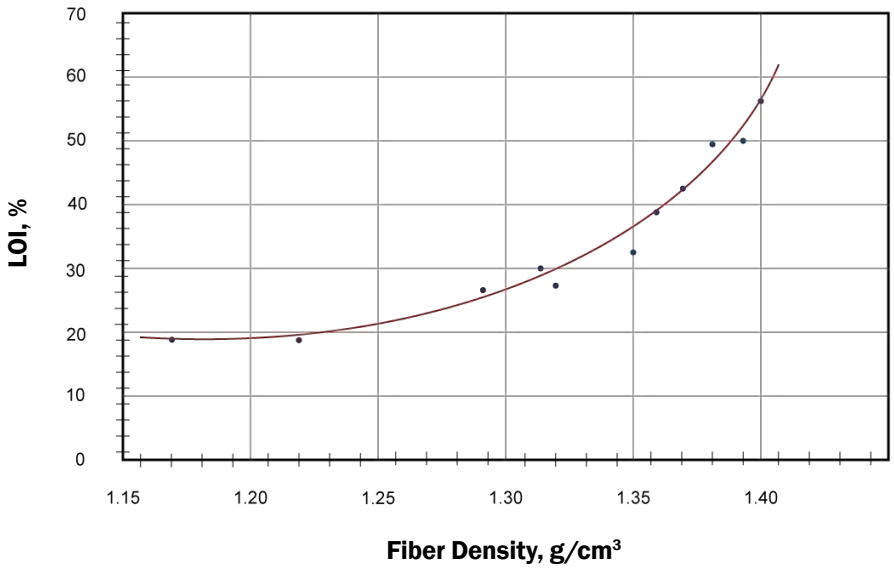
ZOLTEK OX is inherently flame resistant, making it an effective heat-blocking and fire barrier material.

SIDE BY SIDE COMPARISON

In a comparison test, after 30 seconds in a 1250°C flame, the ZOLTEK OX product retains its appearance, dimensional stability, soft hand and continues to perform as a barrier material.



ZOLTEK OX does not burn in ambient air conditions. It does not melt or drip, chars without shrinking, self-extinguishes and remains supple after flame exposure.



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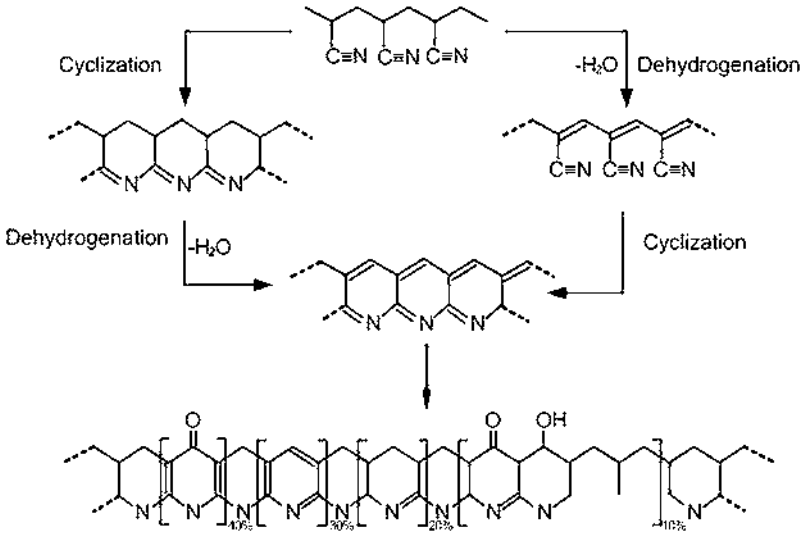
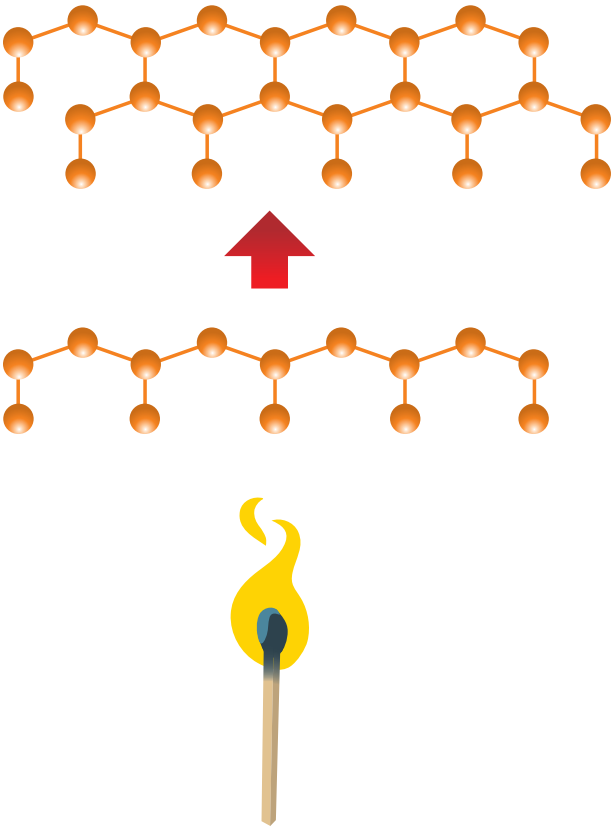
CHEMICAL STRUCTURE

The manufacturing process begins with PAN precursor fiber. The PAN precursor fiber is solution spun and then processed through a high temperature oven, in air, to stabilize its molecular structure.

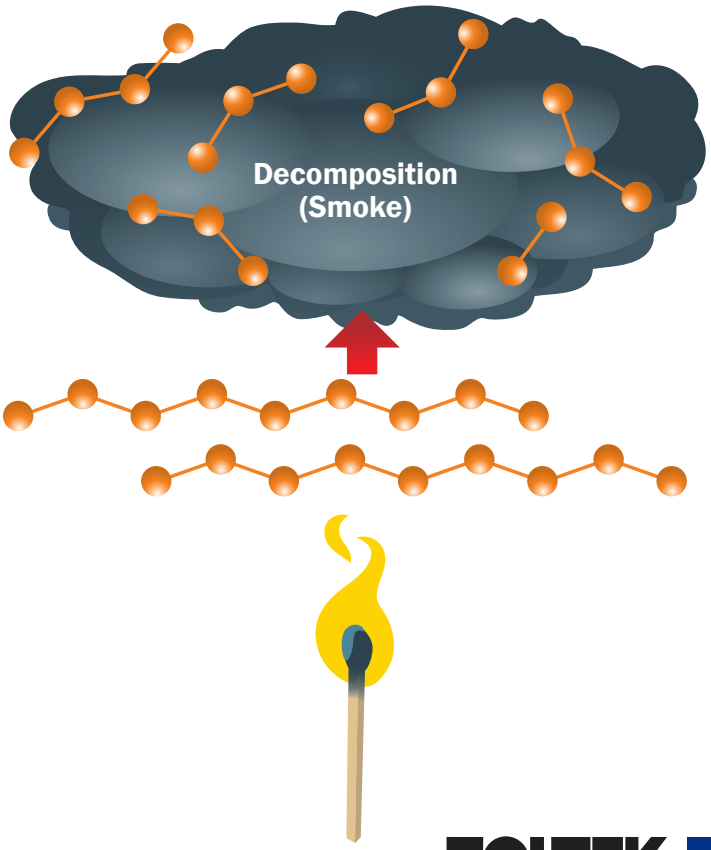


**from Science Direct article "A Review of Heat Treatment on Polyacrylonitrile Fiber"*

Molecules of ZOLTEK OX fibers form stable char structures



Molecules of most fibers decompose when the heat limit is exceeded



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APPLICATIONS

One of the greatest benefits of ZOLTEK OX products are their broad application of end use. ZOLTEK OX fiber can be processed via all conventional textile methods: needle punching, stitch bonding, hydroentangling, thermal bonding, chemical bonding, air lay, wetlay, ring spinning, stretch breaking, weaving, knitting and braiding. End uses include aircraft brake preforms, transportation heat and flame blocking layers, thermal, acoustical and vibration insulation liners, flame resistant apparel.

Aircraft Brakes

ZOLTEK OX fiber is the key component in the production of carbon aircraft brakes. ZOLTEK OX fiber is processed into a textile preform and then converted into carbon brakes through a series of manufacturing operations.In comparison to steel brakes, ZOLTEK OX based carbon brakes offer twice as many landings per overhaul, similar life-cycle costs, significant weight savings, higher energy absorption capability and the ability to handle up to 2000°F during landings.

Fireblocking Layer Fabric

ZOLTEK OX fiber is the key component in woven and nonwoven fireblocking layer (FBL) fabrics for aircraft, rail and marine seating applications. ZOLTEK OX is blended with para-aramid and other FR fibers to provide the optimal FBL solution. ZOLTEK OX is the most cost-effective fiber for this FBL end use and it contains no halogens, has outstanding flame- resistance, and generate very low toxic gas when exposed to flame.

Automotive Noise, Heat and Vibration Liners

ZOLTEK OX fiber is blended with polyester fiber to create felts for use in noise, heat and vibration liners for automotive applications. These applications require excellent heat and thermal aging resistance in the high temperature compartments of an automobile and have the preferred black color for this end use.

Welding Drapes and Heat Insulating Blankets

ZOLTEK OX fiber is used in welding drapes, welding aprons, welding curtains and in thermal insulation blankets. It provides excellent resistance against sparks and flame because it does not shrink when exposed to high temperatures.

Flame and Electric Arc Resistant Apparel

ZOLTEK OX fiber blends can be dyed to produce soft and comfortable knit and woven FR apparel having excellent electric arc performance. ZOLTEK OX based FR apparel has been UL certified to NFPA 2112 and ASTM F1506 Hazard Risk Category 2.

Acoustical, Heat and Flame Resistant Insulation

ZOLTEK OX fiber can be thermally bonded into highloft nonwoven batts and needle punched to form protective nonwoven felt.

Heat and Thermal Protective Apparel

ZOLTEK OX fiber blends are converted to woven and non-woven fabrics for high performance heat and thermal apparel for molten metal and radiant heat protection. ZOLTEK OX based heat and thermal fabrics have been tested to ASTM F955.

Runaway Thermal Barriers for Electric Vehicle Batteries

Silica aerogel impregnated ZOLTEK OX felt are used to slow the spread of fire between cells within the lithium battery compartment of an electric vehicle.

Carbonized Yarns, Fabrics and Felts

ZOLTEK OX fiber can be carbonized into many product forms. Carbonized Zoltek OX products are used as high temperature furnace insulation, intumescent carbon mesh, redox flow battery electrodes, braided sleeves, mechanical packings, carbon composite materials. A whole variety of Zoltek OX carbonized needle punched and spunlace felts is available.

OXIDIZED FIBER APPLICATIONS


Seating Fire Blocking Layers

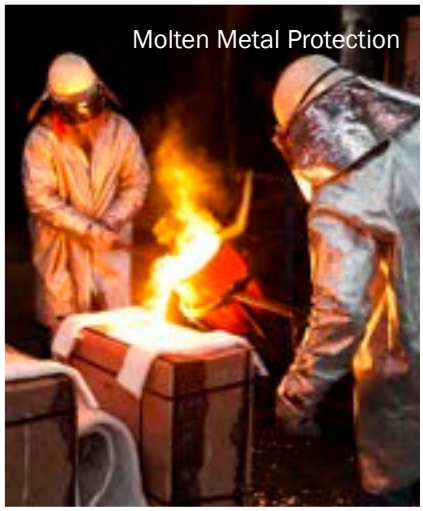

Fire Resistant Apparel


Aircraft Brakes


Radiant Heat Protection Apparel


Noise Harshness
Vibration Liners


Welding Blankets


Molten Metal Protection


Runaway Thermal
Barrier For EV's

Zoltek products for a variety of applications.

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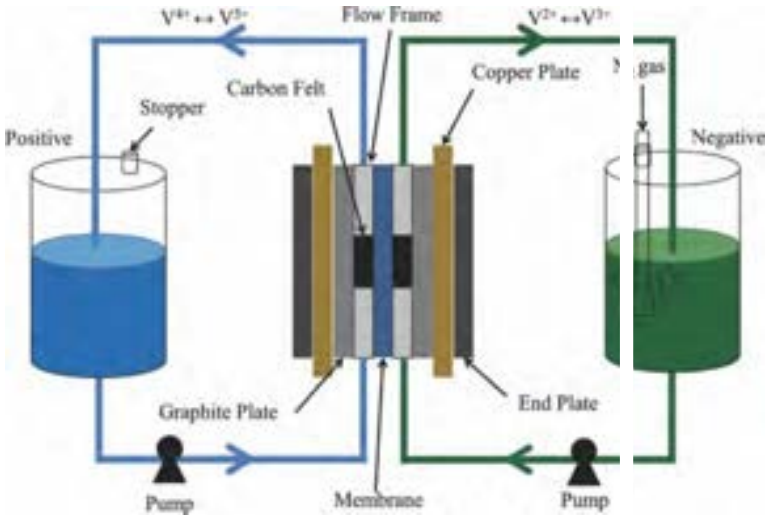
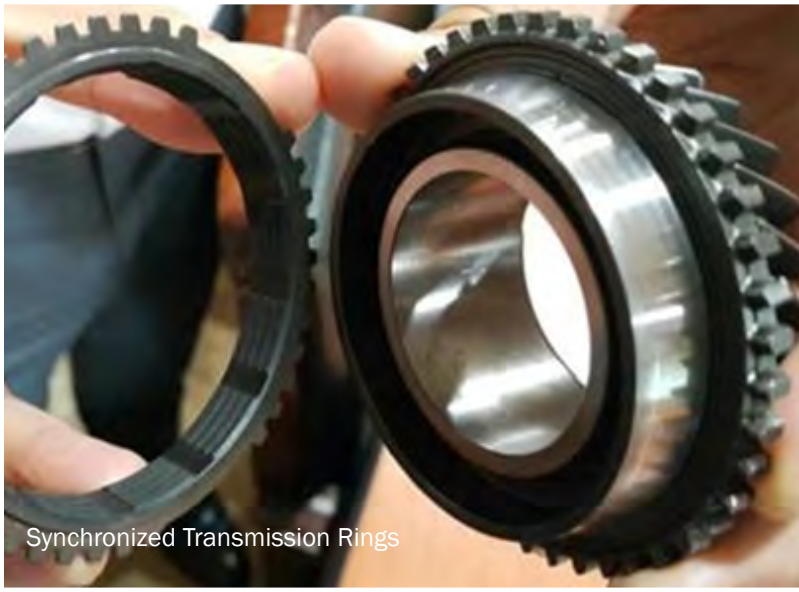
CARBONIZED OX APPLICATIONS



Redox Flow Battery Electrodes



Synchronized Transmission Rings

Furnace Insulation Linings

Energy Storage

Turbojet Exit Vanes

Carbonized Spunlace Felt

Zoltek products for a variety of applications.

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CONTINUOUS TOW

ZOLTEK OX continuous tow is a 300,000 filament bundle of oxidized/stabilized PAN (OPAN) filaments which exhibit excellent resistance to heat and flame and chemicals and solvents. ZOLTEK OX is also electrically nonconductive. ZOLTEK OX continuous tow is suitable for cutting into flock, crimping & cutting into staple fibers.

IDEALLY SUITED FOR:

- **Stretch Broken Yarns**
- **Aircraft Brake Preforms**

MATERIAL OVERVIEW	STANDARD DENSITY			HIGH DENSITY	
Density	1.37 g/cm³ (0.0495 lb/in³)			1.40 g/cm³ (0.0506 lbs/in³)	
LOI	~45%			~55%	
Fineness	1.7 dTex	2.2 dTex	5.0 dTex	1.7 dTex	2.2 dTex
Tensile Strength	18.5-23 cN/tex (2.1 - 2.6 gpd) 240 -300 MPa (34,800 psi)				
Fiber Diameter	12.5 µ	14 µ	22 µ	12.5 µ	14 µ
Filament Count	300K		160K	300K	
Elongation to Break	22% - 28%				
Format	Uncrimped				

The properties listed herein do not constitute any warranty or guarantee of values. This information should only be used for the purposes of material selection. Please contact us for more details.

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STAPLE FIBER

ZOLTEK OX staple fibers are crimped, oxidized/ stabilized PAN fibers (OPAN) available in three denier sizes and several cut lengths. ZOLTEK OX staple fibers produce the highest quality nonwoven felts and the finest spun yarns in the market today. ZOLTEK OX staple is often blended with other strengthening flame resistance fibers, such as para-aramids, to obtain optimal end use properties.

IDEALLY SUITED FOR:

- **Nonwovens (Needle Felt & Spunlace**
- **Thermal Bonding**
- **Yarn Spinning**

MATERIAL PROPERTY	STANDARD DENSITY					HIGH DENSITY		
Density	1.37 g/cm³ (0.0495 lb/in³)					1.40 g/cm³ (0.0506 lbs/in³)		
LOI	~45%					~55%		
Fineness	1.7 dTex 1.5 denier		2.2 dTex 2.0 denier		5.0 dTex 4.5 denier	1.7 dTex 1.5 denier		2.2 dTex 2.0 denier
Length	50 mm 2.0 in	60 mm 2.4 in	74 mm 2.9 in	80 mm 3.1 in	100 mm 3.9 in	50 mm 2.0 in	60 mm 2.4 in	74 mm 2.9 in
Staple Crimp Level	>7.6 per inch (>3.0 per cm)							
Moisture Content	13 +/-3%							
Elongation to Break	22% - 28%							

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STRETCH-BROKEN YARNS

ZOLTEK OX stretch-broken yarns are composed of oxidized/stabilized PAN (OPAN) fibers. Stretch-broken yarns produced with ZOLTEK OX can be knit or woven into fabrics that are used in high-performance industrial or race wear apparel, industrial fire blocking blankets or high-temperature belting applications.

IDEALLY SUITED FOR:

- **FR and Thermal Protective Apparel**
- **Friction Applications**

MATERIAL OVERVIEW	STANDARD DENSITY	HIGH DENSITY
Density	1.37 g/cm^3 (0.0495 lb/in^3)	1.40 g/cm^3 (0.0506 lb/in^3)
Diameter	12.5 microns	
LOI	40%+	50%+
Color	Black	
Resistivity	8 x 10^8 Ω cm	

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PLAIN WEAVE FABRIC

ZOLTEK OX plain weave fabrics are produced from 100% 2-ply ZOLTEK OX yarn. These fabrics have high LOI%, good strength properties, an ability to be laminated and have excellent cut and sew properties.

IDEALLY SUITED FOR:

- **Protective Clothing**
- **Welding Blankets**
- **Feed Fabrics for Carbonization**

MATERIAL OVERVIEW	PW03		PW06	
	SI	US	SI	US
Areal Weight	190 g/m^2	5.6 oz/yd^2	359 g/m^2	10.6 oz/yd^2
Warp and Fill	142 x 142/10 cm	36 x 36/in	94.5 x 94.5/10 cm	24 x 24/in
Width	99 cm	39 in	129.5 cm	51 in
Roll Length	90 m	98 yds	45 m	50 yds
Thickness	0.43 mm	0.017 in	0.73 mm	0.029 in
Yarn Input	2/27 Worsted Count		2/10 Worsted Count	
Construction	Plain Weave			

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SATIN & KNIT WEAVE FABRIC

ZOLTEK OX satin weaves and circular knits are produced from 100% ZOLTEK OX yarn. These fabrics are characterized by high LOI%, excellent stretch, no melt-no drip and a soft hand for apparel applications.

IDEALLY SUITED FOR:

- **Protective Clothing**
- **Welding Blankets**
- **Feed Fabrics for Carbonization**
- **Friction Applications**

MATERIAL OVERVIEW	SATIN WEAVE - SW08		KNIT FABRIC - KF07	
	SI	US	SI	US
Areal Weight	471 g/m^2	13.9 oz/yd^2	424 g/m^2	12.5 oz/yd^2
Warp and Fill	126 x 126/10 cm	32 x 32/in	N/A	N/A
Width	129 cm	51 in	66 cm unslit	26 in
Roll Length	45 m	50 yds	35 m	39 yds
Thickness	1.2 mm	0.047 in	1.4 mm	0.055 in
Yarn Input	2/10 Worsted Count		2/10 Worsted Count	
Construction	8 Harness Satin		Single Knit Tubular	

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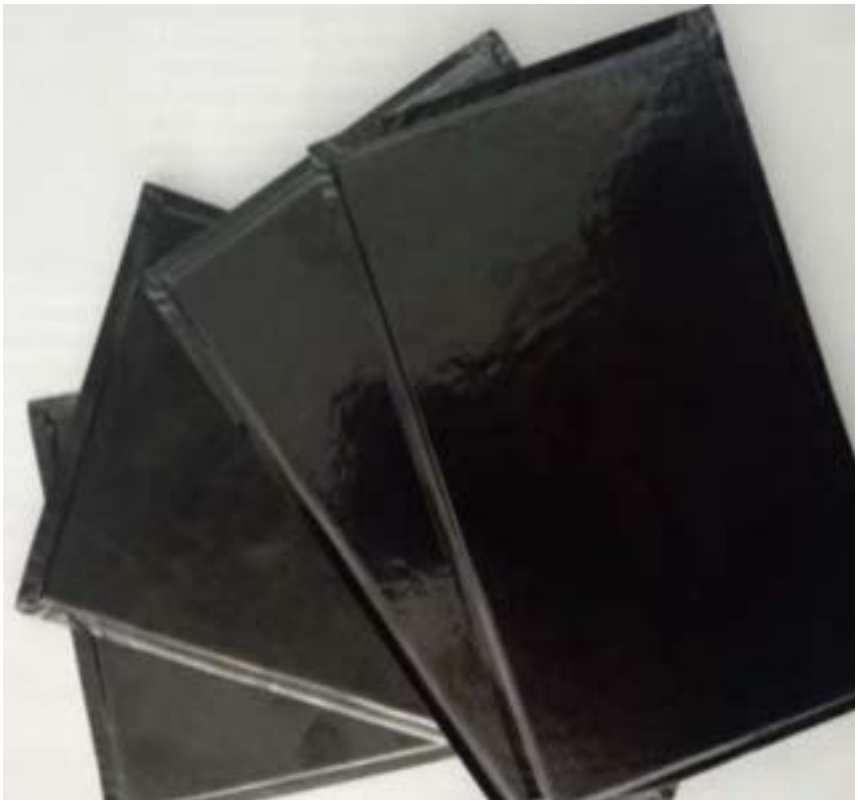
FELTS

ZOLTEK OX felts are produced from 100% ZOLTEK OX oxidized PAN staple fiber. They provide superior thermal, fire, and spark resistant barriers. Always versatile, this ZOLTEK OX solution is available in various thicknesses and areal weights. Both cost-effective and high-performing, ZOLTEK OX felts are common in a diverse range of high-temperature industrial applications.

IDEALLY SUITED FOR:

- **Welding Applications**
- **Thermal Barriers**
- **Insulation Materials**
- **Raw Material for Carbonization**



Nonwoven felts based on Zoltek OX fiber can be silica aerogel impregnated and film encapsulated to provided an outstanding thermal barrier for the most demanding of heat protection applications, such as between the individual cells of an electric vehicle battery.

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FLOCK

Like the continuous ZOLTEK OX tow from which it is made, ZOLTEK OX flock consists of oxidized and stabilized PAN fibers (OPAN) that are inherently fire resistant, thermally stable and resistant to chemicals and solvents.

IDEALLY SUITED FOR:

- **Decorative Thermoplastic and Rubber Compounding**
- **Friction Materials**

MATERIAL OVERVIEW	STANDARD DENSITY		HIGH DENSITY	
Density Minimum	1.37 g/cm^3 (0.0495 lb/in^3)		1.40 g/cm^3 (0.0506 lb/in^3)	
Fineness	1.7 dTex 1.5 dpf	2.2 dTex 2.0 dpf	1.7 dTex 1.5 dpf	2.2 dTex 2.0 dpf
Moisture Content	Maximum 12%			

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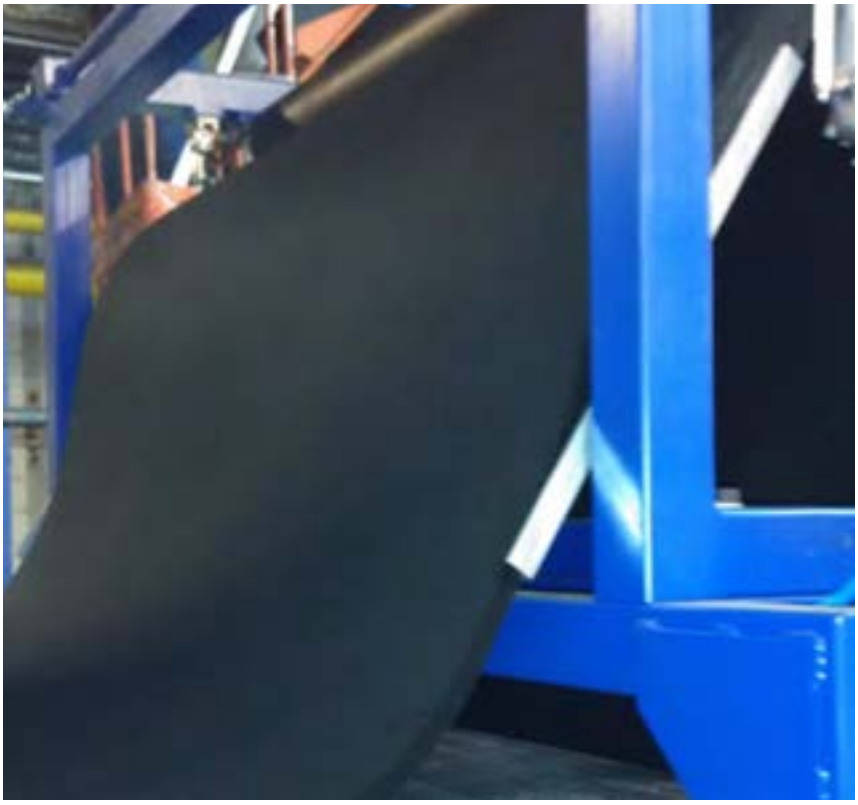
PXFT FELTS



Zoltek OX felts can be continuously carbonized to a 95% carbon content PXFT felt. ZOLTEK PXFT carbonized felts are produced from 100% ZOLTEK OX felts, being continuously carbonized and supplied in rolls.

ZOLTEK PXFT carbonized felts can be used in many applications, including: stationary energy storage batteries, fire protective insulation, high temperature furnace linings, acid gas mist eliminators and in carbon composite materials.

Customers can apply their own post treatments and the carbonized felt is easy to cut and process for specific end-use applications.

ZOLTEK PXFT carbonized felts are available in a wide range of areal weights and thicknesses for redox flow battery and many other applications.

IDEALLY SUITED FOR:

- **Redox Flow Battery Electrodes**
- **Acid Gas Mist Eliminators**
- **HT Furnace Insulation**
- **Carbon Composites**
- **Lead Acid Battery Electrodes**

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PX30

Derived from ZOLTEK OX roving, yarns and fabrics that undergo a proprietary high temperature batch carbonization process, ZOLTEK PX30 carbon products are PAN-based materials carbonized to >99%. Additionally, all ZOLTEK PX30 materials are thermally stable and chemically pure.

Designed for use in the most extreme heat applications, ZOLTEK PX30 is an industry leading solution for challenges demanding high temperature and harsh chemical resistance properties. As a high purity and high-thermal performing material these product forms are frequently used for fuel cells, carbon/carbon composites, energy storage batteries, and many other specialty applications (outlined in the box below).

IDEALLY SUITED FOR:

- **High Temperature Packings & Gaskets**
- **High Temperature Carbon/ Carbon Composites**
- **Aircraft and Automotive Brakes**
- **Friction Clutches and Brakes**
- **Composite Substructures**
- **Clutch Plates**
- **Gas Diffusion Layer for Fuel Cells**
- **Battery Electrodes**

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GLOBAL FOOTPRINT

ZOLTEK has manufacturing locations producing affordable, quality carbon fiber in Europe, Mexico, and the United States. In 2014, Zoltek joined the Toray Group – a relationship that has advanced the company's technology, strengthened its technical and financial resources, and positioned it for further growth and development as the global leader in carbon fiber.

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ABOUT ZOLTEK

ZOLTEK is on a mission to lead the commercialization of carbon fiber and to drive new energy forward through advanced technology and expanded capacity.

As the world's largest producer of oxidized and stabilized PAN fibers, ZOLTEK is dedicated to providing our customers with the highest level of quality and service required for critical safety applications.

To learn more, visit www.zoltek.com.