



Kevlar.

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DARE BIGGER™

When extreme is not a sport. It's your job.

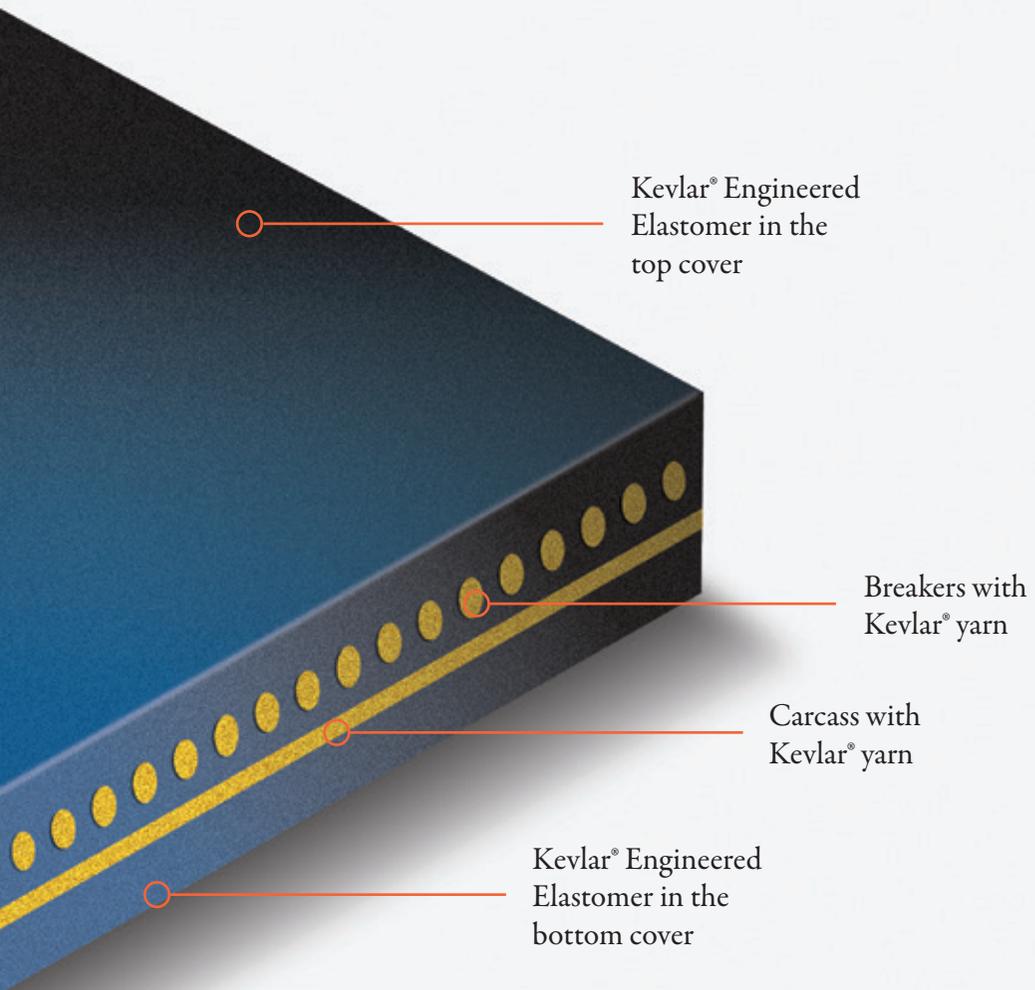


The toughest job on earth requires the toughest fiber on earth.

DuPont™ Kevlar® helps create long-term solutions for conveyor belts in the mining industry. Each day, the mining industry extracts tons of ores and transports these valuable and often heavy materials to process sites using conveyor belts. The demanding conditions of the mining environment, coupled with the weight and abrasiveness of many of the materials being transported, take a toll on these conveyor belts, and many last as little as three months, while costing millions of dollars in power consumption.

Kevlar® brand fiber can be applied to four areas in belts.

Operational continuity is critical to the productivity of a mine operation, so different technologies and products have been implemented over the years to increase the lifetime of belt materials, decrease belt energy consumption and enhance the ability to predict belt failure. DuPont has been at the forefront of this technological innovation, and DuPont™ Kevlar® fiber is helping to create solutions to form lighter, stronger and longer-lasting belts to address the main concerns and needs of the mining industry. It's no coincidence that the lightweight strength of DuPont™ Kevlar® is also used in materials designed for ballistic protection for body and car armoring.



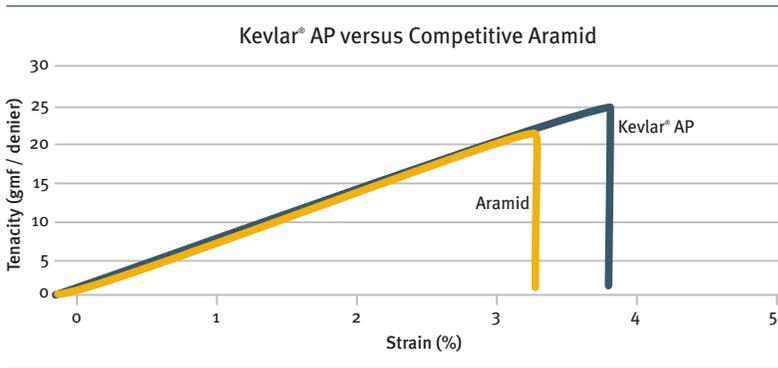
At 10 miles deep or 20 miles across, nerves of steel are good but threads of Kevlar® are better.

Straight warp fabrics made with Kevlar® are available from 800 N/mm up to 4000 N/mm with a single-layer construction. Replacing conventional polyester/nylon (EP) and steel cord in carcasses with straight warp fabrics of Kevlar® helps enable production of belts capable of delivering:

- Increased lifetime
- Reduced rolling resistance & energy consumption
- Reduced number of splices
- Reduced splice time and cost
- Conveyor system design flexibility
- Increased transportation capacity (better U-shape)
- Low creep during lifetime
- Normal operation in extreme environmental conditions

Kevlar® AP fiber

The latest innovation from DuPont is the Kevlar® Advanced Performance (AP) product family, helping improve performance, cost-effectiveness and design flexibility.



Kevlar® straight warp fabrics

Our strongest straight warp fabrics are available from 800 N/mm up to 4000 N/mm with a single-layer construction.

Fabric Warp Strength (N/mm)	Thickness (mm)	Specific Weight (g/m ²)
800	2.1	1290
1000	2.4	1385
1800	3	1940
4000	3.6	2920

*Also available in other configurations.

Lightweight conveyor belts

Conveyor belts with a carcass made with Kevlar® can be much lighter and help provide a variety of benefits to end users:

- Ease of handling and transport
- Reduced freight costs
- Increased productivity
- Energy savings
- Design flexibility

Belt Weight (kg/m)	Comparison to Kevlar®	
Kevlar® 2000 N/mm	22.0	
EP 2000/5	31.5	43% heavier
ST 2000	33.5	52% heavier

*All belts have same top and bottom cover thicknesses (12/6)

Thinner conveyor belts

Belts produced with single-layer reinforcement using Kevlar® help provide:

- Longer belts per spool with fewer splices
- Fewer operational investments when designing systems
- Increased top cover thickness and increased belt lifetime
- Increased transportation capacity (U-shape)

Low creep

Kevlar® can be used in high loads without significant growth of the belt, an excellent option to replace polyester and nylon belts in long systems. The Kevlar® straight warp carcass helps avoid periodic maintenance due to growth, reducing plant downtime and increasing productivity.



Kevlar® fiber in breaker fabrics

Several types of damage can occur in conveyor belts due to the loading operation of bulk materials and sharp ores, including puncture (cut) and slitting of the belt. Belts must be highly engineered to avoid these types of damage that often require replacement.

Kevlar® fiber has excellent mechanical properties that allow for the design of robust cords used in the weft of breaker fabrics in conveyor belts, which experience less damage when submitted to harsh environments. Kevlar® reinforced breakers are a significant improvement when compared to current solutions used in the market, such as nylon/nylon breakers.



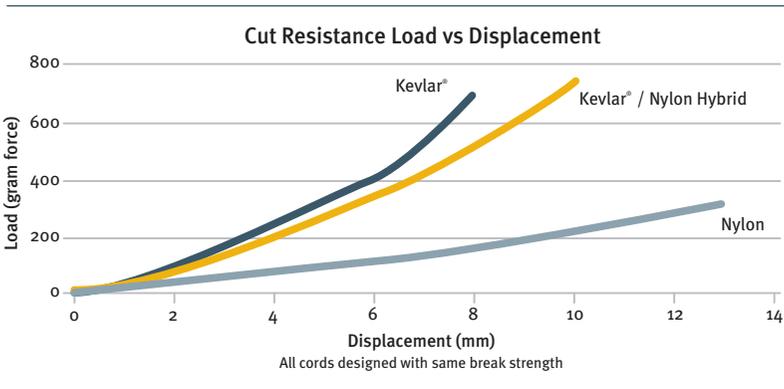
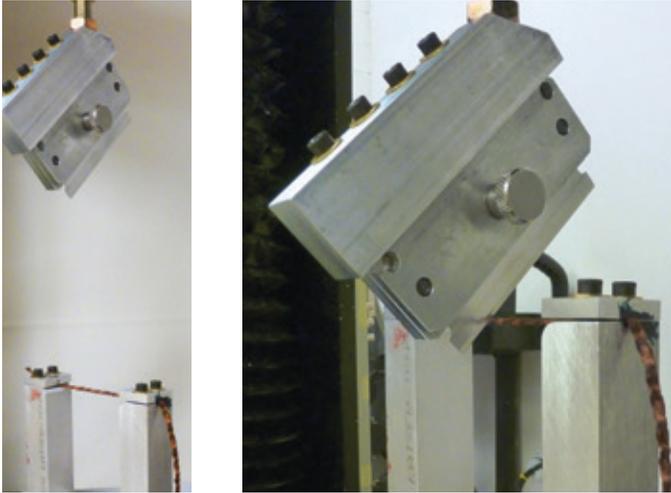
Nylon

Kevlar®

Kevlar®
Nylon
Hybrid

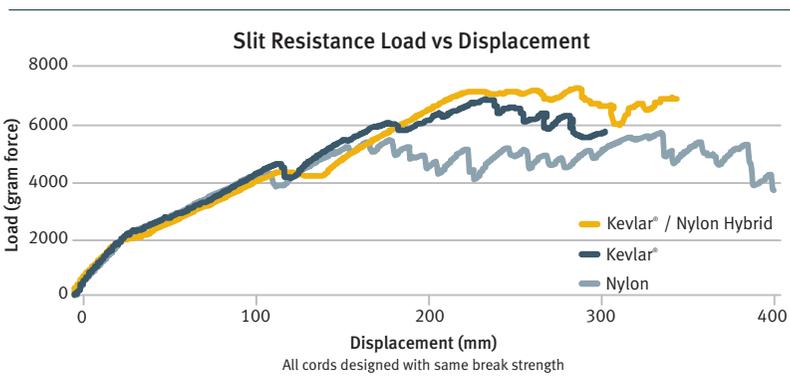
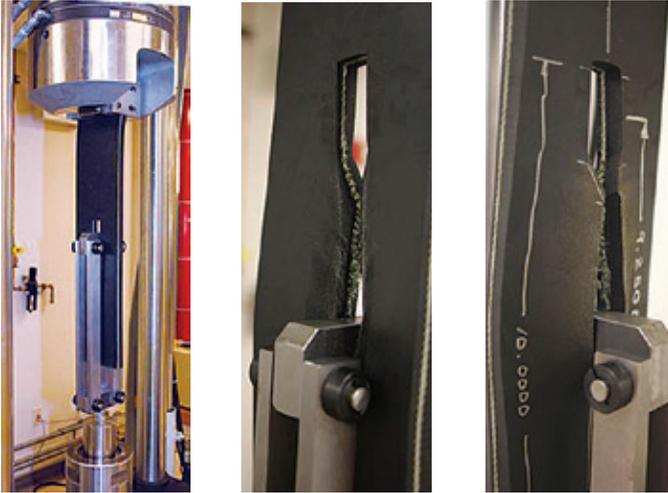
Improving cut resistance

Reinforcing the cross direction of conveyor belts, Kevlar® fiber helps improve cut resistance to help protect the entire belt from external threats. Lab tests show that Kevlar® and Kevlar® hybrid cords are three times more cut resistant than a typical nylon cord used in commercial breaker fabrics.



Improving slit resistance

When detection systems fail to detect that sharp ores and non-mineral materials are trapped between rollers of conveyor belts, the entire belt can be slit. Kevlar® cords in the weft of breaker fabrics allow threats to be expelled or simply stop the movement of equipment, preventing the complete failure of the belt and allowing simple maintenance instead of a complete change. Lab tests show that Kevlar® and Kevlar® hybrid cords are 20 to 40 percent more resistant than typical nylon cords.



Kevlar® Engineered Elastomer in rubber covers

DuPont™ Kevlar® Engineered Elastomer uses a dispersion of a highly branched para-aramid pulp available in a family of rubber matrices. It is based upon a proprietary technology that opens the structure of the highly branched Kevlar® pulp and allows it to be uniformly dispersed into our customers' rubber formulations, helping to enable efficient reinforcement.

Kevlar® Engineered Elastomer reinforces differently than conventional fillers such as carbon black and silica by increasing stiffness (modulus) with little or no change in hysteresis that can lead to heat buildup. Field-use performance in a range of applications has demonstrated improvements in abrasion resistance, tear strength, rubber green strength, modulus and cut and chip resistance.



Microscopy picture of pulp dispersed in rubber.

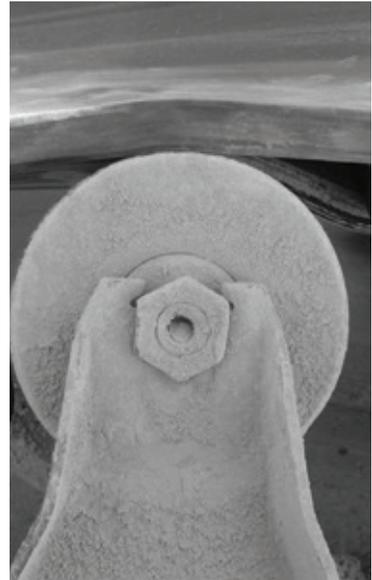
Easy to disperse

In the Engineered Elastomer form, Kevlar® pulp is pre-dispersed in a rubber matrix, making it easy to disperse using common mixers in conveyor belt manufacturing facilities. DuPont offers different types of Kevlar® Engineered Elastomer based on different rubber matrices. It helps the rubber compounders to decide which grade to use in their compositions.

DuPont Code	1F722	1F723	1F724	1F819	1F770
Elastomer Matrix	Natural Rubber	Neoprene GW	SBR 1502	Neoprene WRT	NBR Med ACN
Kevlar® Pulp Content (%)	23%	23%	23%	23%	23%

Top and bottom belt covers

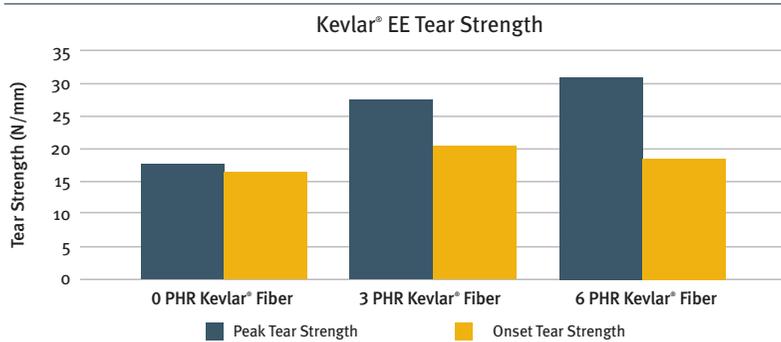
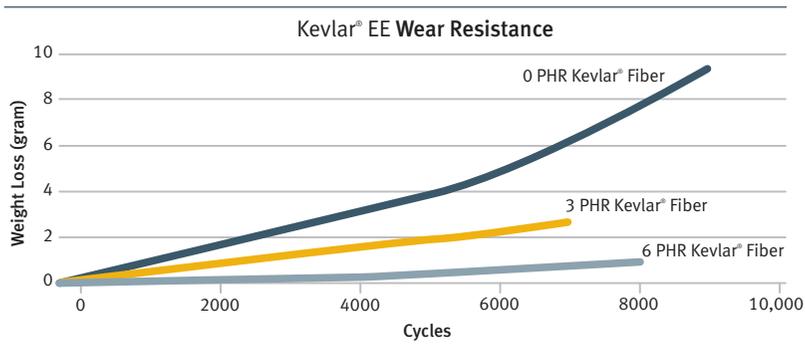
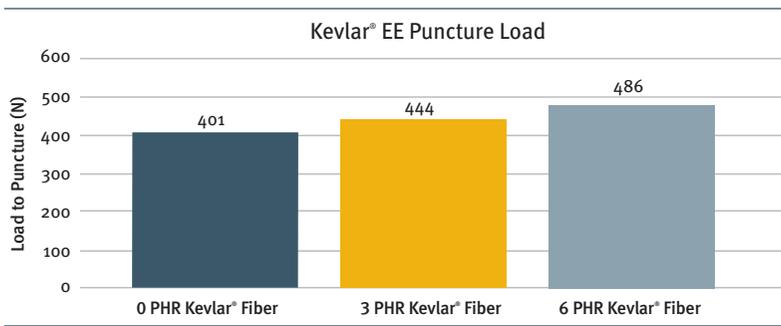
The top and bottom covers of conveyor belts are designed to meet different requirements. The top cover must have high damage resistance (cut, abrasion, wear and puncture), while the bottom cover must be highly engineered to have low hysteresis properties, providing low indentation rolling resistance, so the belt consumes less power under operation.



Kevlar® Engineered Elastomer in top covers

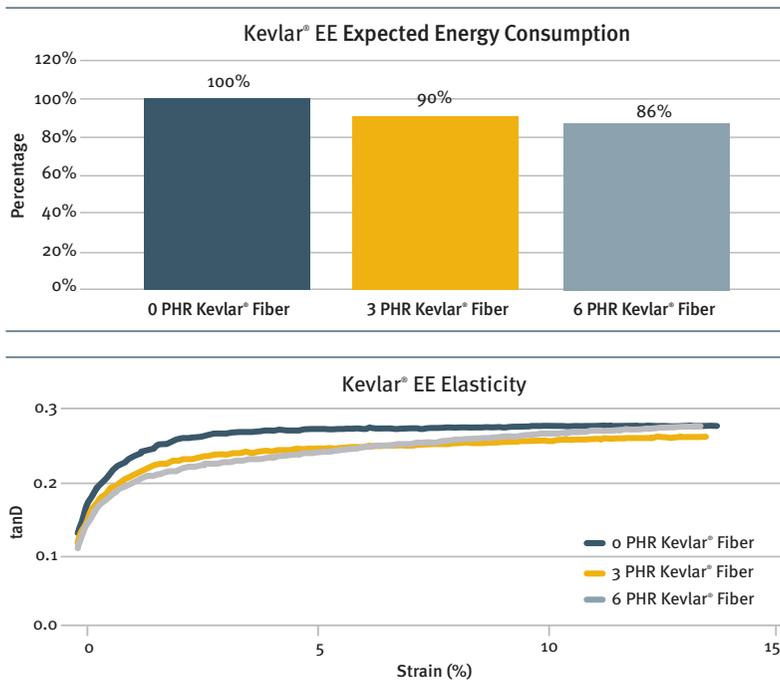
Conveyor belts transport heavy, highly abrasive and sharp ores inside mining sites. The weight of ores varies from operation to operation, but even the most engineered rubbers suffer a lot of damage during belt operation. Typical damage to top covers includes puncture (cut), tear, abrasion, chunking and gouge. The incorporation of Kevlar® Engineered Elastomer can help improve belt lifetime and avoid unexpected failures that might stop the entire production. DuPont has developed special tests simulating damages that rubber can suffer during operations. The incorporation of Kevlar® helps:

- Increase wear resistance 2 to 4 times;
- Improve puncture resistance by 10 to 20%;
- Increase tear resistance by 50 to 70%.



Kevlar® Engineered Elastomer in bottom covers

Conveyor belts are one of the main sources of energy consumption inside mining sites. Studies show that indentation rolling resistance is the primary source (61%) of energy losses in conveyor belt applications. Belt manufacturers are investing to develop rubber compounds with properties that help lower belt indentation resistance. When Kevlar® Engineered Elastomer is incorporated into rubber compounds, it allows more elastic properties that help to lower hysteretic losses that reduce indentation rolling resistance and belt energy consumption.





Conveying cost savings

Many mining companies are concerned about the amount of money spent on conveyor belts operation. The use of Kevlar® products as carcasses or incorporated into top and bottom belt covers can help companies save thousands of dollars per year. DuPont has even developed an energy calculator to help belt manufacturers and mining companies evaluate the benefits of adding Kevlar® carcass or Kevlar® Engineered Elastomer into conveyor belts.

Please contact a DuPont representative in your region to conduct a specific evaluation for you.

The reference example below shows comparison performance data for a conveyor belt made with DuPont™ Kevlar® and a belt made without DuPont™ Kevlar®.

Case Study – Operational Conditions	
System length (m)	350
Belt width (mm)	1200
Belt speed (m/s)	6.0
Capacity (ton/h)	1000
Elevation change (m)	10
Energy cost (US\$/kW)	0.15
Loaded operating time (%)	80%
Unloaded operating time (%)	10%
Non operating time (%)	10%

Case Study – Modeled Energy Consumption				
		Reference Example	Comparative 1	Comparative 2
Reinforcement Carcass		Multi-Layer EP	Multi-Layer EP	Kevlar®
Rubber Compound		Without Kevlar® EE	With Kevlar® EE (3 PHR fiber)	With Kevlar® EE (3 PHR fiber)
Belt mass (kg/m ²)		31.5	31.5	22
Unloaded Condition – Power Requirement Model	Power Requirement (kW)	66.29	61.52	49.10
	Comparative Savings (%)	–	7.2%	25.9%
Loaded Condition – Power Requirement Model	Power Requirement (kW)	121.28	114.55	102.13
	Comparative Savings (%)	–	5.5%	15.8%
Expenditures with Energy in One Year Operation	Operational Cost (US\$)	\$136,200.04	\$128,498.69	\$113,810.80
	Total Savings (%)	–	5.7%	16.4%

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