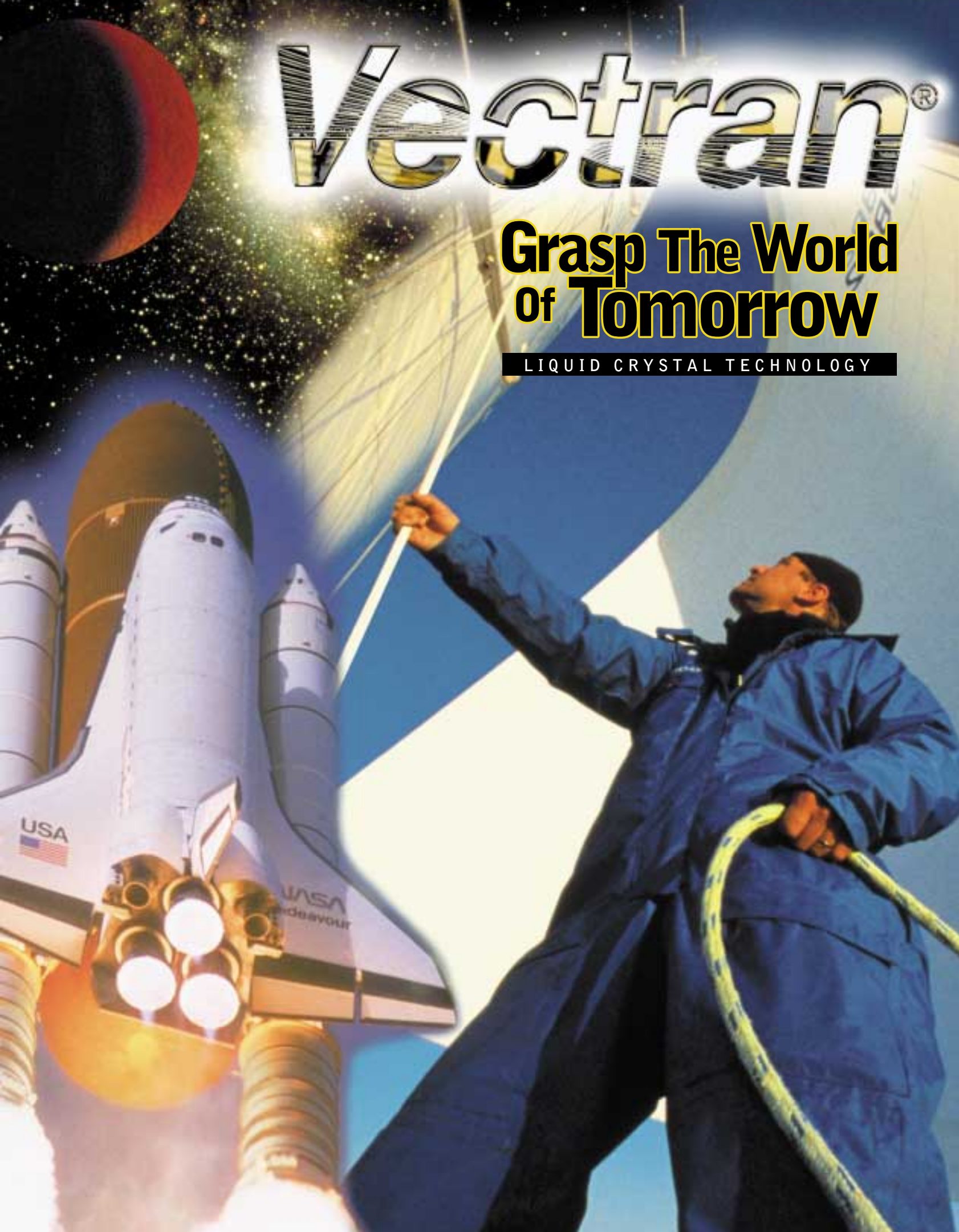

Vectran®
Grasp The World Of Tomorrow
LIQUID CRYSTAL TECHNOLOGY
USA

More than 15,000 people in 14 nations
are engaged in global research and development at Hoechst,
funded by an annual budget on the order of 1 billion dollars.

Current and Possible Applications

Ropes and Cables

Sonobuoy Cables
Seismic/Magnetometer Tow Cables
Sidescan Sonar Cables
Towed ASW Sensor Systems
Thermistor Cables and Strings
Aircraft Geophysical Tow Cables
Drill Hole Logging Cables
Pumped Water Sampler Cables
Environmental Ocean Sensors
Aerial Camera Tethers
Fishing System Sensors
Divers Comm/Strength members
Air Tow Cables (Countermeasures)
Array Cables
Subsea Mooring Lines
Balloon Tethers
Parachute Cords
Taglines-River/Canyon
Helicopter Sling Legs
Aircraft Target Tow Cables
Astronaut Safety Tethers
Center Core Strength Members
Pull Through Cables
Ship Handling Cables
Helicopter Rescue Hoist Cables
Choker/Snatch Cables
Fish Net Trawl Ropes
Stainless Wire Replacement
Sewing Thread
Optical Fiber Tension Members

Industrial

Heat Resistant Belting
High Pressure Inflatables
Tape Reinforcement
Abrasion Resistant Baggage
Chemically Resistant Packings
Chemically Resistant Gaskets
Cut Resistant Gloves
Fragmentation Fabric
Prison Industry Garments
Oil Well Tension Members
Chain Saw Chaps
Cut Resistant Clothing
Concrete Reinforcement
Ballistic Materials
Pressure Vessels
Electronic Reinforcement
Military
NASA/Aerospace

Sports and Leisure

Sailcloth
Mountaineering Ropes
Skis and Snowboards
Fishing Pole Reinforcement
Bow Strings
Yachting Ropes
Bicycle Components
Reinforced Hulls
Golf Clubs
Tennis Raquets and Strings

Vectran®

LIQUID CRYSTAL POLYMER

Vectran Fiber
A Unique Combination of Properties For The Most Demanding Applications

Celanese

ACETATE LLC

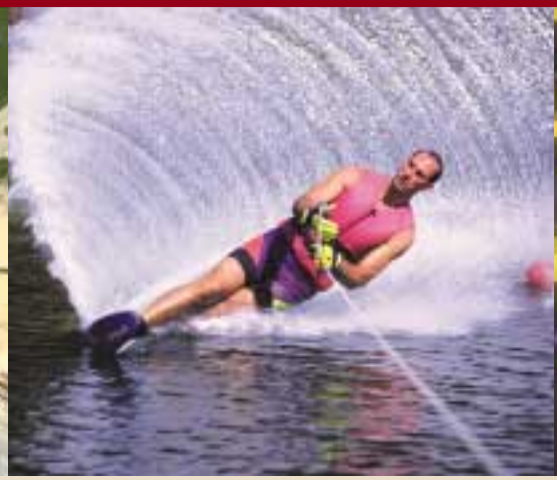
Celanese is a world leader in the production of commodity chemicals, acetate products, and advanced fibers. Celanese employs 11,000 people in some 30 sites worldwide. With these facilities, including our research, development and technical centers, as well as our affiliation with Hoechst's international facilities, Celanese is strategically positioned to accomodate the needs of global customers. Our ongoing global research and development activities resulted in another breakthrough in liquid crystal polymer technology... Vectran Fiber.

Vectran® Liquid Crystal Polymer Fiber:

Vectran

Vectran is a high-performance thermoplastic multifilament yarn spun from Vectra® liquid crystal polymer (LCP). Vectran is the only commercially available melt spun LCP fiber in the world. Vectran fiber exhibits exceptional strength and rigidity. Pound for pound Vectran fiber is five times stronger than steel and ten times stronger than aluminum. These unique properties characterize Vectran:

- High strength and modulus
- Excellent creep resistance
- High abrasion resistance
- Excellent flex/fold characteristics
- Minimal moisture absorption
- Excellent chemical resistance
- Low coefficient of thermal expansion (CTE)
- High dielectric strength
- Outstanding cut resistance
- Excellent property retention at high/low temperatures
- Outstanding vibration damping characteristics
- High impact resistance



The result of more than 15 years of dedicated research and development by Hoechst Celanese scientists and the establishment of over 130 LCP-related U.S. patents, Vectran fiber provides engineers with exciting material selection options. This new fiber is available as Vectran HS, a high-strength reinforcement fiber and Vectran M, a high-performance matrix fiber.

A Unique Combination of Properties For Demanding Applications

Where Existing Materials Fail to Perform

A unique combination of properties differentiates Vectran fiber from other high-performance fibers and makes it the material of choice in demanding applications where other fibers fail to meet performance requirements. The remarkable range of mechanical properties exhibited by Vectran fibers and their unique combination of properties permits them to be used for a variety of purposes. Vectran fibers are used in aerospace, ocean exploration and development, electronic support structures, the recreation and leisure industry, safety materials, industrial applications, ropes and cables, composites, and protective garments.

Ropes And Cables

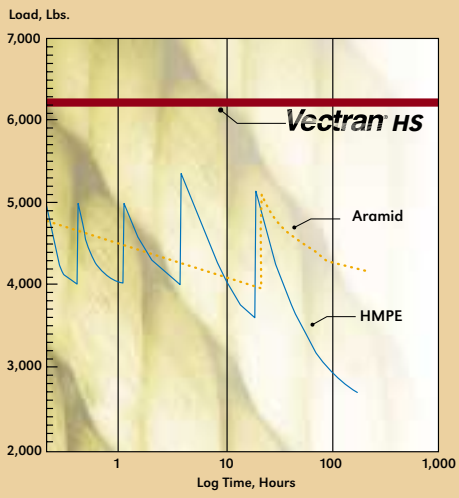
Ropes and Cables Demand a Balance of Outstanding Properties

Vectran HS is solving performance problems in critical marine, military, and industrial rope and cable applications. High strength with no creep allows manufacture of high performance ropes that are stable to extended loads. Superior abrasion resistance, excellent moisture resistance, and exceptional property retention over broad ranges of temperature and chemical environments, provide solutions to industrial wear and degradation problems experienced with existing fiber products. Vectran HS is an outstanding candidate for replacement of steel and stainless steel constructions.

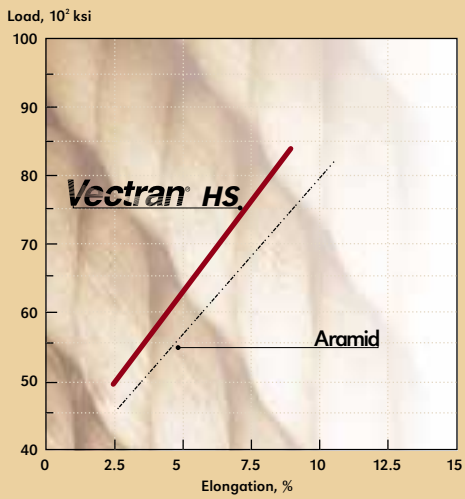
Vectran fiber can be found on yacht ropes and sails powering

Archers have benefited from bow strings made with Vectran fiber. Offering archers increased arrow speed with no measurable creep, Vectran fiber has solved problems associated with string relaxation.

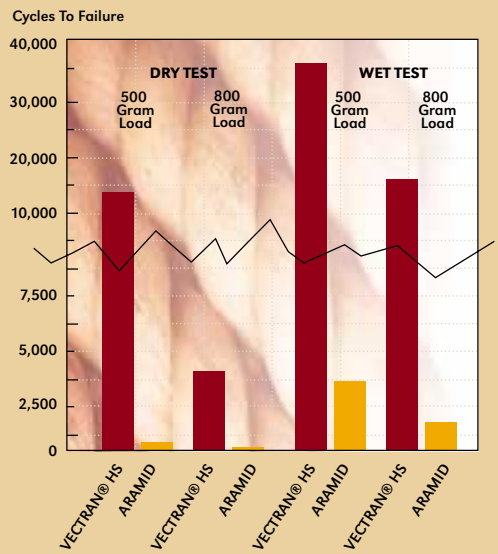
Vectran HS Wire Rope Creep



Break Strength vs D/d Wire Rope Construction



Vectran HS Fiber Abrasion Comparison



Specialized Electronic Uses

Specialized Electronic Uses Require a Unique Fiber

Vectra® LCP polymer is used world-wide in precision molded electronic products. The same LCP in Vectran HS fiber form is an excellent candidate for printed circuit boards, fiber optic strength members, and conductor reinforcements. High dielectric strength coupled with elevated temperature resistance and outstanding moisture resistance provide new levels of electrical efficiency in prevention of current leakage. This combination along with excellent dimensional stability and low CTE provide a unique fiber for specialized electronic uses.

Americas Cup vessels and high-performance yachts.

Recreation & Leisure

Recreation and Leisure

Vectran fibers are an excellent option for recreation and leisure products such as sailcloth, reinforced hulls, fishing poles and lines, golf clubs, bicycle forks, skis, tennis racquets, snowboards, and paragliders. Performance is critical in many specialty sporting goods applications. Of particular importance are the unique vibration damping characteristics of Vectran fiber combined with high strength, minimal moisture absorption and excellent flex/fold/abrasion/impact resistance.

Photo Courtesy of ILC Dover

Aerospace & Military

Aerospace and Military

The first use of Vectran fiber was for demanding and specialized military applications. The unique properties of this high performance fiber satisfies many of the military and aerospace needs of today. In fact in July 1997 the airbags above, made with Vectran fibers were deployed to cushion the Pathfinders successful landing on the surface of Mars. A stellar-strength fiber, Vectran is lightweight and stable providing superior load handling characteristics for tow ropes, cargo tie-downs and inflatables.

Composite Options

New Textile and Composite Options

The Vectran fiber family is available in a range of deniers for textile and composite processing and offers new options in design and material selection. Vectran HS fiber offers benefits for applications requiring high strength, vibration damping, low moisture absorption, and low CTE. Vectran M fiber is a high modulus thermoplastic matrix fiber for applications requiring high impermeability, excellent property retention over a broad temperature range, and low moisture absorption.

Industrial Applications

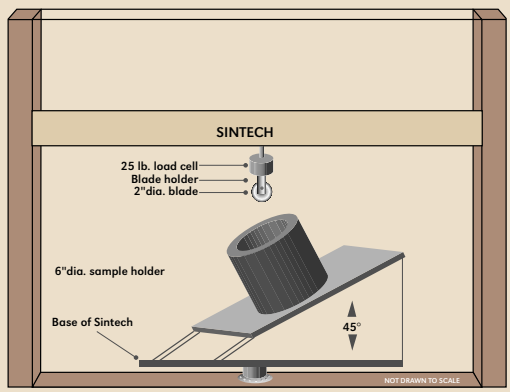
Industrial Applications For The 21st Century

Vectran Fiber brings unique solutions to industrial applications. Stability to most chemicals allows the manufacture of chemically resistant packings and gaskets. Users of protective apparel such as gloves and workwear benefit from excellent cut and stab resistance, elevated temperature resistance, outstanding flex/fold resistance, and durability to multiple wash/dry cycles even in the presence of bleach.

For example, the meat processing industry suffers from some of the highest incidents of hand cuts and abdominal stabs. Worker safety is improved when garments provide increased cut resistance or stab resistance. Because of the high cost of safety apparel and the high costs of injuries, meat processing companies are sensitive to cost/performance of safety workwear. Aramid fibers have poor resistance to bleach and UHMWPE fibers are sensitive to high temperatures associated with drying. Therefore, the cost/performance of safetywear improves when garments can resist exposure to bleach and are durable enough to resist multiple wash/dry cycles without loss of strength or shape due to shrinkage. Vectran fiber workwear is meeting the cost/performance needs of this industry.

Sintech Cut Resistance

MATERIAL	DENIER	RELATIVE LOAD
Vectran HS	1,500	3.4
Vectran M	1,500	2.2
Aramid	1,500	1.1
HMPE	1,300	1.0



Vectran Fiber Product Line

Vectran HS Fiber Products

Denier	DPF	Filament Diameter, Microns	Filament Counts	Yield, Yards/lb
3,750	5.0	23	750	1,200
2,250	5.0	23	450	2,000
1,500	5.0	23	300	3,000
1,000	5.0	23	200	4,460
750	5.0	23	150	6,000
400	5.0	23	80	11,150
250	5.0	23	50	18,000
200	5.0	23	40	22,300
150	5.0	23	30	30,000
100	5.0	23	20	44,600
50	5.0	23	10	89,200
25	5.0	23	5	178,400

Vectran M Fiber Products*

Denier	DPF	Filament Diameter, Microns	Filament Counts	Yield, Yards/lb
1,500	5.0	23	300	3,000
1,000	5.0	23	200	4,460
750	5.0	23	150	6,000
200	5.0	23	40	22,300
50	5.0	23	10	89,200

*Cut fiber and pulp also available

Typical Properties of 1500/300 Vectran Fibers

	Vectran HS	Vectran M
Tensile Strength*	23-26 g/denier	9 g/denier
	412-465 ksi	161 ksi
Tensile Modulus*	525-585 g/denier	425 g/denier
	9.4-10.5 Msi	7.6 Msi
Elongation at Break*	3.3% - 3.7%	2.00%
Melting Point	625° F	529° F
	330° C	276° C
Moisture Regain	<0.1%	<0.1%
Dielectric Constant @ 1 kHz**	3.3	3.3
Density	1.4 g/cm^3	1.4 g/cm^3
	0.05 lbs/in^3	0.05 lbs/in^3
Chemical Resistance	Hydrolytically stable. Resistant to organic solvents.	
	Stable to acids (<90% conc.). Stable to bases (<30% conc.).	

* ASTM D885, 10 in. gauge length, 10% strain rate, 2.5 tpi twist
** Measured on Vectra resin

Celanese
ACETATE LLC

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