Toray PTFE Fibers

General Properties

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Unparalleled Friction Properties

- Lowest coefficient of friction among synthetic fibers
- Does not exhibit stick-slip behavior

Outstanding Service Temperature Range

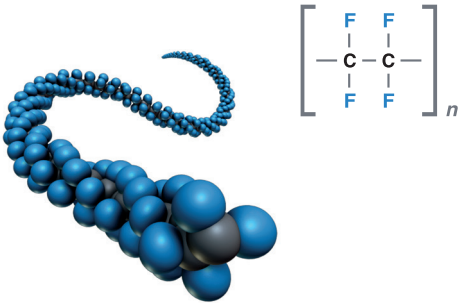
- Suitable for service up to 260°C (500°F)
- Maintains elasticity down to -80°C (-112°F)

Excellent Chemical Resistance

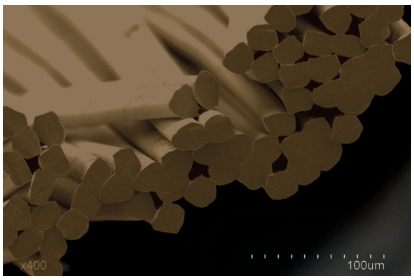
- Resistant to virtually all chemicals
- Stands up to highly oxidative and corrosive environments

Fiber's Diverse Processing Possibilities

- Easily woven or knitted as fabric, or can be converted to felt
- Can be combined with other substances to meet a range of shapes and performance demands



PTFE in its purest form: long chains of carbon atoms (black) tightly saturated with fluorine atoms (blue).



Highly even fibers and their distribution maximize PTFE's performance for a wide range of applications.

How Toray PTFE Compares to Other Industrial Fibers

Material	Toray PTFE	PPS	Meta-aramid	Para-aramid	Polyimide	Polyester	Polyamide
Specific Gravity (g/cm³)	**2.30**	1.34 to 1.36	1.38	1.39 to 1.45	1.41	1.38	1.14
Tenacity (g/d)	**1.4 to 2.0**	5.0 to 6.0	4.5 to 5.5	23	4.2	4.3 to 6.5	4.8 to 6.4
Elongation (%)	**15 to 100**	20 to 35	22 to 38	1.5 to 4.5	30	20 to 50	28 to 45
Melting Point,Thermal Decomposition (˚C)	**327**	285	400 to 430	480 to 570	450	252 to 292	160 to 260
Outstanding Service Temperature (˚C)	**260**	170 to 190	210 to 230	200 to 250	260	100	80 to 100
Resistance to Acid	★★★★	★★★	★	★	★★★	★★	★
Resistance to Alkali	★★★★	★★★	★★	★★	★★	★★	★★
Resistance to Organic Chemicals	★★★★	★★★	★★	★★	★★	★★★	★★
Noncombustibility (LOI)	**65**	34	29 to 32	25 to 29	36 to 38	20 to 21	20 to 21
Initial Cost Impact	**$$$$**	$$	$$ - $$$	$$$	$$$	$	$ - $$

LOI (Limited Oxygen Index)

Toray Fluorofibers (America), Inc. 2032 Highway 20 Decatur, AL 35601 Tel: 256-260-5900 Fax: 256-260-5910 www.torayfluorofibers.com

Toray PTFE Fibers

Continuous Multi Filaments: Standard Grade

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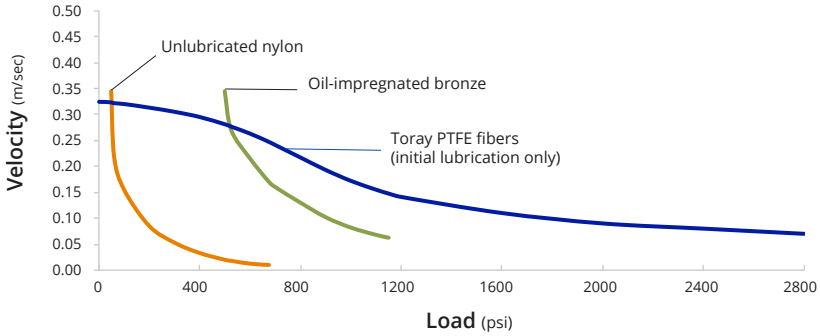
Product Benefits

- Toray matrix-spun PTFE fibers for optimum performance
- Multi-filament yarns with a highly even fiber diameter
- Easily used for woven, knitted and winding as diverse processes
- PTFE fibers perform excellently, especially under high-load and low-velocity conditions

Physical Properties

Product	Total Denier (d)	# of Filament (-)	Specifications		
			Denier (dpf)	Tenacity (g/d)	Elongation (%)
Plain	200	30	6.7	2.0	18
	400	60	6.7	2.0	15
	1200	180	6.7	1.7	21
Twisted (up to 6 turns/inch)	400	60	6.7	2.0	15
	1200	180	6.7	1.7	21
	1600	360	4.4	1.4	27

1,000-hour Service Test Comparison of Spherical Bearings of Teflon Fabric vs. Other Materials



Oscillating Test Comparison of Spherical Bearings of Toray PTFE Fabric vs. Steel

	PTFE Fabric	Steel	PTFE Fabric	Steel	PTFE Fabric	Steel
Load, psi (Mpa)	3,000	3,000	16,000	16,000	25,000	25,000
	(21)	(21)	(110)	(110)	(172)	(172)
Arc of Oscillation	60˚	60˚	60˚	60˚	60˚	60˚
Cycles/Min	60	60	6	6	6	6
Total Cycles	1,000,000	1,000,000	65,000	65,000	6,000	-
Lubrication	Initial	Full	Initial	Full	Initial	Full
Remarks	Serviceable	Shaft Scored	Serviceable	Severe Shaft Scoring	Serviceable	Seized at Start Up

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Toray PTFE Fibers

Continuous Multi Filaments: Extra Wear-Life Grade

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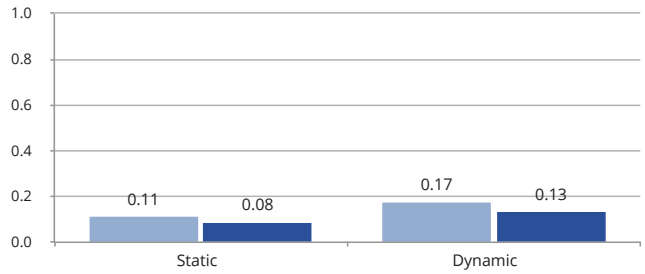
Product Benefits (Compared to Standard Grade)

- Same levels of fiber properties
- Same levels of fabric coefficient friction to metal
- 4 times longer life under higher load
- Same levels of fiber coefficient friction to metal
- Same levels of wear rate under low to medium load

Physical Properties

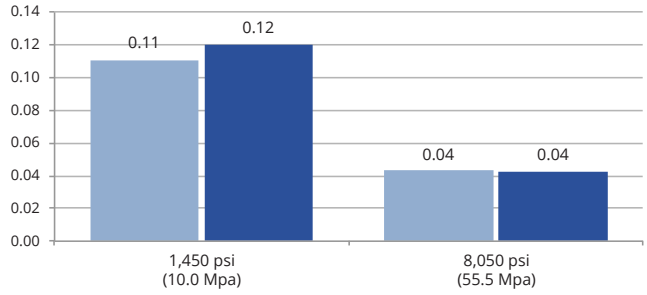
Product	Total Denier (d)	# of Filament (-)	Specifications		
			Denier (dpf)	Tenacity (g/d)	Elongation (%)
Extra Wear-Life Grade	400	60	6.7	1.7	10
Standard Grade	400	60	6.7	2.0	15

Fiber Coefficient Friction (to Matte Finished Metal)



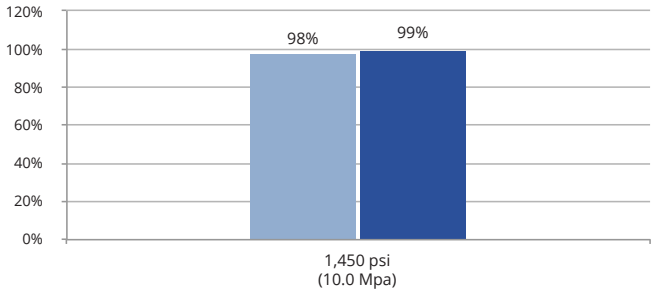
Velocity; Static / Dynamic; 0.00042 / 0.050 m/sec (0.082 / 9.8 ft/min)
Based on ASTM D3108

Fabric Coefficient Friction (to Metal)



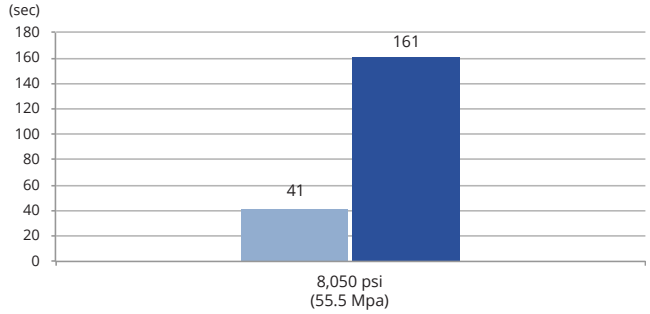
Velocity; 0.016 m/sec (3.2 ft/min), Metal Material; S45C
Based on ASTM D3702

Wear Rate



Velocity; 0.016 m/sec (3.2 ft/min), Metal Material; S45C, 30 minutes
Based on ASTM D3702

Wear Life



Velocity; 0.016 m/sec (3.2 ft/min), Metal Material; S45C
Based on ASTM D3702

Standard Grade Extra Wear-Life Grade

* Extra Wear-Life Grade is under development as of July 2016. Please inquire for product availability.

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Toray PTFE Fibers

Flock Fibers

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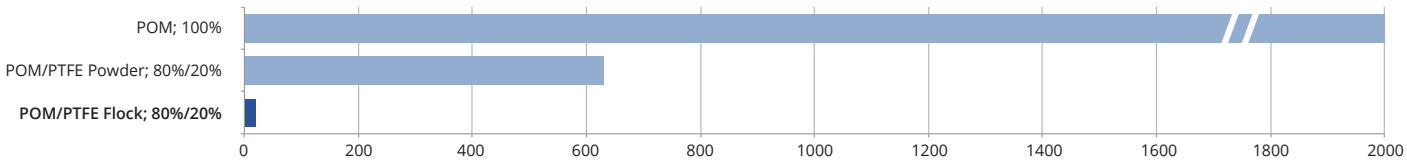
Product Benefits

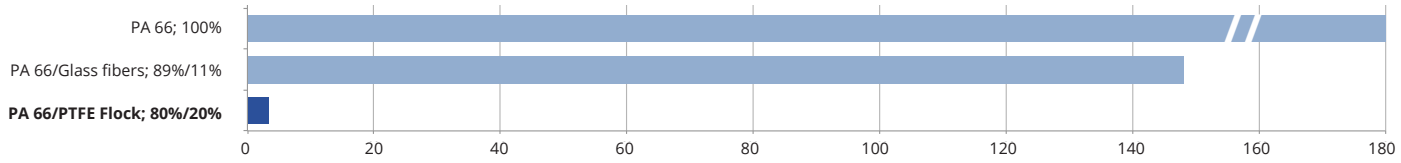
- Superior friction control for a variety of bearings
- Widely used for compounding and mixed with plastics and resins
- Extends the life of plastic composites
- Oil-free, low-maintenance ease of use

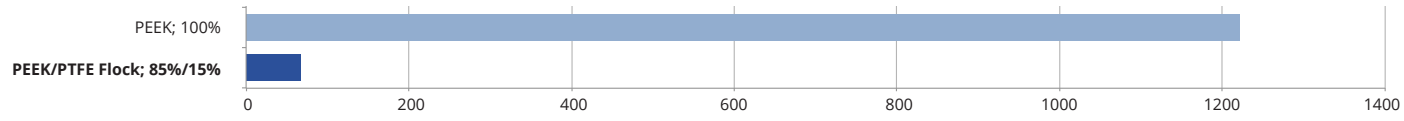
Physical Properties

Product	Specifications	
	Denier (d)	Cut Length (in)
Cut Length 1/100" to 1/4"	6.7	0.01
	6.7	0.016
	6.7	0.25

Wear Factor Based on ASTM D3702







Wear Factor; Shows the Ratio of Wear Volume (Lower Number = Higher Resistance for Wear)

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Toray PTFE Fibers

Staple Fibers

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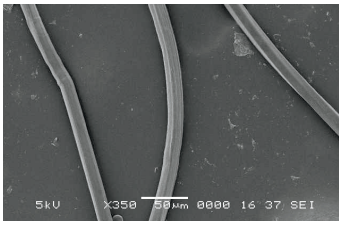
Product Benefits

- Dry and wet filtration applications
- Friction-control parts for equipment, such as business machines
- High-temperature protective apparel

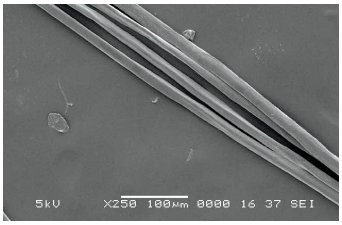
Physical Properties

Product	Specifications		
	Denier (d)	Crimp/inch (-)	Finish (%)
Cut Length 1.5" to 4"	1.75	10	0.32
	3.5	10	0.22-0.40
	6.7	10	0.22-0.40

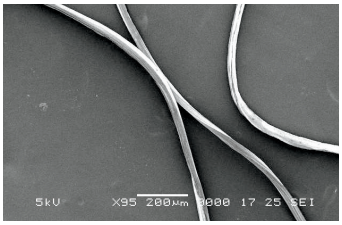
Superior Abrasion Resistance vs. PTFE Paste-Extruded Fibers



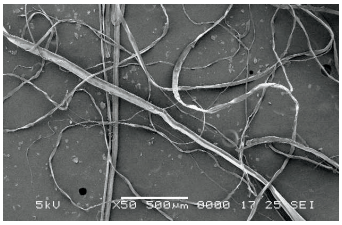
Mechanical Work



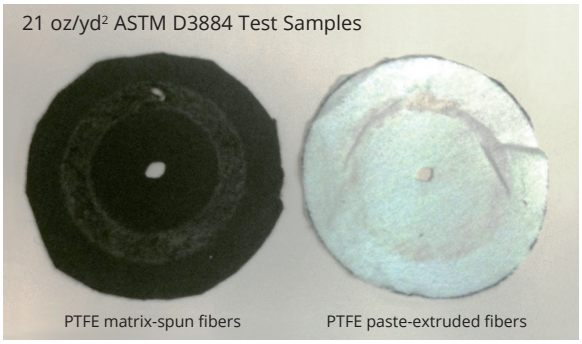
Upon subjecting PTFE matrix-spun fibers to scraping with a knife edge, **no abrasion was observed.**



Mechanical Work



Upon subjecting PTFE paste-extruded fibers to scraping with a knife edge, **severe abrasion damage was observed.**



Toray matrix-spun PTFE felt (Brown) can withstand on average 26% longer cycles before breakthrough in abrasion testing compared to PTFE paste-extruded PTFE felt (White). After the abrasion test, the white sample demonstrated wear. The brown felt remained almost completely opaque, showing no sign of wear. (In ASTM D3884; Subject to a Taber abrader with a H22 abrading wheel at 1 kg pressure.)

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