

3M™ Nextel™ 610 Spread Tow and Spread Tow Fabrics

Experimental Product

Overview

Oxide-oxide ceramic matrix composites (Ox-Ox CMCs) enable aircraft to operate more efficiently, through hotter engine temperatures and lower weight materials relative to existing metallic parts. The majority of these composites are based on 1,500 denier fabrics of either 3M™ Nextel™ 610 or 720 continuous filament ceramic oxide fibers. 3M has developed higher denier fabrics that deliver equivalent performance to 1,500 denier fabrics at a lower price. More recently, 3M has developed spread tow versions of 10,000 and 20,000 denier Nextel 610 and 720 ceramic oxide fibers. These products enable, for the first time, a viable input for automated composite processing of Ox-Ox CMCs, as well as spread tow fabrics with unique combinations of denier and fabric thickness. 3M™ Nextel™ Spread Tow and Spread Tow Fabrics can also be used in Polymer Matrix Composites (PMC) and Metal Matrix Composites (MMC).



Properties

3M™ Nextel™ 610 Spread Tow is available in 10,000 and 20,000 deniers (g/9,000 m). The included table compares the width and thickness of the spread tow. Note that these are 30-40% less thick than standard high denier Nextel rovings, making them comparable to 3M™ Nextel™ 610 DF-11 Fabric thicknesses and an attractive input for automated composite layups. In addition, the Nextel Spread Tow products are sized with a water soluble sizing that is compatible with water based ceramic slurries and also provides excellent tow bundling and flexibility. This eliminates the need for heat cleaning (sizing removal) prior to infiltration. Sizing chemistries currently available include polyvinylpyrrolidone (PVP), polyvinyl alcohol (PVA), polyethylene glycol (PEG), polyethylene oxide (PEO), and copolymers/blends of these.

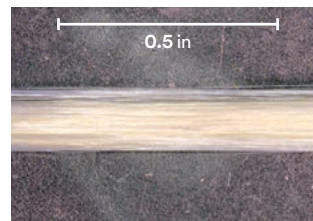
Elliptical Tow



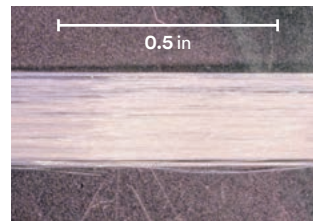
Spread Tow



10,000 denier

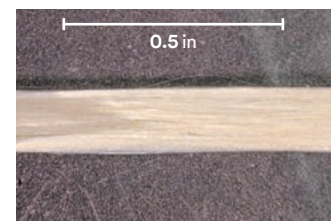


width	thickness
3.8 mm (0.15")	0.18 mm (7.0 mil)

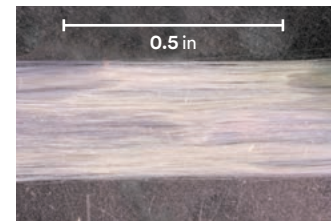


width	thickness
7.6 mm (0.30")	0.10 mm (4.0 mil)

20,000 denier



width	thickness
3.8 mm (0.15")	0.27 mm (10.7 mil)



width	thickness
12.7 mm (0.50")	0.19 mm (7.6 mil)

Width and thickness are nominal and not for specification purposes. Thickness was measured under 0.6 psi with a pressure foot gauge.

Product	Denier (g/9000m)	Width (mm)	Thickness (mm)	Sizing
3M™ Nextel™ 610 10,000 Denier Spread Tow	10,000	7.6	0.10	water soluble
3M™ Nextel™ 610 20,000 Denier Spread Tow	20,000	12.7	0.20	water soluble

Width and thickness are nominal and not for specification purposes. Width, thickness, and sizing can be modified for specific applications.

Spread tow fabrics

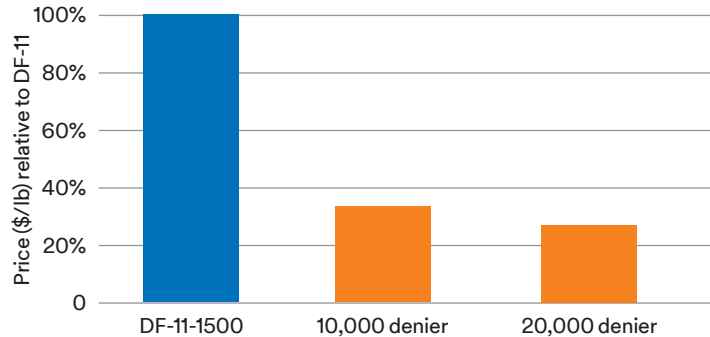
3M™ Nextel™ 610 Spread Tow is also available as a fabric, in both a plain weave and 2×2 twill weave. The included table compares properties of these two fabrics relative to the 3M™ Nextel™ 610 DF-11 Fabric. Note that the Nextel Spread Tow fabrics offer similar thicknesses to the DF-11 fabric, but lower areal densities, providing greater design flexibility in the composite layup. The Nextel Spread Tow that is used to weave the fabrics has the same water soluble sizing options that are described above, eliminating the need for heat cleaning (sizing removal) prior to infiltration with the ceramic slurry during composite layup.

Fabric	DF-11	Experimental	Experimental
Fiber	Nextel 610	Nextel 610	Nextel 610
Denier (g/9000 m)	1,500	10,000	10,000
Weave	8HS	Plain	2×2 Twill
Areal Density gsm (oz/in ²)	370 (10.9)	280 (8.3)	280 (8.3)
Thickness μm(mil)	254 (10.3)	262 (10.3)	267 (10.5)

Fabric properties are not for specification purposes.

Pricing

Nextel 610 Spread Tow offers significant cost savings over comparable inputs for a CMC application such as DF-11 fabrics. This chart estimates the relative price difference between a DF-11 fabric and Nextel 610 10,000 Denier and 20,000 Denier Spread Tow.



Contact

For additional details and sampling, please contact:

Aaron Beaber, Product Developer
Ceramics Platform
3M Advanced Materials Division
arbeaber@mmm.com

Warranty, Limited Remedy, and Disclaimer: This 3M product is an experimental or developmental product that has not been introduced or commercialized for general sale, and its formulation, performance characteristics and other properties, specifications (if any), availability, and pricing are not guaranteed and are subject to change or withdrawal without notice. User is solely responsible for evaluating the 3M product and determining whether it is fit for a particular purpose and suitable for user's method of application. User is solely responsible for evaluating third party intellectual property rights and for ensuring that user's use of 3M product does not violate any third party intellectual property rights. This 3M product is sold or made available "AS IS." 3M MAKES NO WARRANTIES OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OR CONDITION OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY IMPLIED WARRANTY OF NON-INFRINGEMENT OR ANY IMPLIED WARRANTY OR CONDITION ARISING OUT OF A COURSE OF DEALING, CUSTOM OR USAGE OF TRADE.

Limitation of Liability: Except where prohibited by law, 3M will not be liable for any loss or damages arising from the 3M product, whether direct, indirect, special, incidental or consequential, regardless of the legal theory asserted, including warranty, contract, negligence or strict liability.

Technical Information: Technical information, recommendations, and other statements contained in this document or provided by 3M personnel are based on limited information and the accuracy or completeness of such information is not guaranteed. Such information is intended for persons with knowledge and technical skills sufficient to assess and apply their own informed judgment to the information. No license under any 3M or third party intellectual property rights is granted or implied with this information.

Export Control: The 3M product(s) listed here may be controlled commodities under applicable U.S. export control laws and regulations, including, but not limited to, the U.S. International Traffic in Arms Regulations (ITAR) and the Export Administration Regulations (EAR). These laws and regulations may, among other things, prohibit the export and/or reexport of controlled product(s) to any or all locations outside of the United States without prior U.S. Government export authorization, the sharing of export controlled technical data and services with those anywhere who are not U.S. citizens or U.S. permanent residents, dealings with U.S. Government, United Nations and other "Restricted Parties," and proliferation activities including those that further nuclear, chemical, or biological warfare, missile stockpiling/use, or the use of rockets or unmanned aerial vehicle systems. 3M and purchasers or prospective purchasers of the 3M product(s) shall comply with all applicable export control laws and regulations, which may require obtaining and maintaining applicable export control authorization or licenses, and understand that the ability of a party to obtain or maintain such authorization or license is not guaranteed. The exporter of record has the sole responsibility to determine whether the export or subsequent reexport of the 3M product(s) requires export authorization. An explicit condition to 3M selling or making available the 3M product(s) is the customer's agreement to comply with all applicable trade compliance laws and regulations.



3M Advanced Materials Division
3M Center
St. Paul, MN 55144-1000 USA

Phone: 1-800-367-8905
Website: 3M.com/ceramics

3M and Nextel are trademarks of 3M Company. Used under license by 3M subsidiaries and affiliates.

Please recycle. Printed in USA. © 3M 2019.
All rights reserved. Issued: 5/19 15101HB
44-0061-2961-1 Rev. B