CLEMSON
UNIVERSITY

NYLON FIBER FACTS

The following information has been reviewed and found to be an accurate representation of performance characteristics of nylon 6 and 6,6 as related to carpet. There is no evidence that the use of either nylon type as the base raw material will negatively impact the physical performance of a carpet when subjected to extreme wear.

Adolph Beyerlein
Chair and Professor of Chemistry
Clemson University

DEPARTMENT OF CHEMISTRY
College of Engineering & Science 223 Howard L. Hunter Chemistry Laboratory Box 340973, Clemson, SC 29634-0973
864.656.3065 FAX 864.656.6613

NYLON FIBER FACTS

The following is information regarding nylon 6 and nylon 6,6 polymer as the two relate to the manufacture of nylon carpet fiber. There are other types that are used for many different products, each having somewhat different performance characteristics.

History of nylon:

Both nylon 6 and 6,6 were developed and patented simultaneously in the 1930's. In the 1950's, the evolution of nylon technology made application of both nylon types suitable for use as carpet fiber. Fifty years later, nylon 6 and 6,6 continue to be recognized as the most durable and versatile carpet fibers in the carpet industry. Nylon 6 commands 54% of the current world market share, nylon 6,6 represents 46% with respect to carpet fiber. Future capital manufacturing investments by both nylon 6 and 6,6 fiber producers strongly favor nylon 6 technology as the polymer type for the future.

Characteristics affecting performance properties of nylon carpet fibers:

Colorfastness

A function of the proper selection of dyestuffs and pigments -- not polymer type.
Properly selected pigments allow colors to resist fading up to five times better than conventional dyestuffs or other lesser quality pigments.

Dyeability

All nylon is dyeable and dyeability is not a function of polymer type.
Both nylon 6 and nylon 6,6 polymer are engineered to be acid dyeable or cationic dyeable depending on the carpet's desired aesthetic properties.

Hardness

Nylon is renowned for its durability, which is a direct result of its flexibility and elastic recovery properties. According to the Rockwell Hardness Test both nylon types are of equal hardness. Some polymers are too hard and can be brittle when used as fiber. Polyester is harder than nylon and is not considered appropriate for use in commercial carpet end use areas.

Environmental Attributes

Nylon 6 is manufactured using up to 11% less energy than nylon 6,6.
Recovered post-consumer nylon 6 carpet fiber is currently being closed loop recycled into new nylon 6 at large scale manufacturing facilities in the US and Canada.
Nylon 6,6 carpet fiber is down cycled into various molded products, but closed loop technology on a large scale basis is not currently economically feasible.

Soil Resistance and Soil Release

A characteristic that is not determined by polymer type, but rather by how the yarn is engineered and the carpet is manufactured.

Quality fluorochemical is necessary to aid in soil resistance and soil release on both nylon 6 and nylon 6,6.

Acceptable appearance levels and soil removal are dependent upon proper cleaning methods, equipment, cleaning solutions and trained technicians and not nylon polymer type.

Staining

Nylon 6 and nylon 6,6 polymers are both readily dyeable and therefore will stain.

Stain resistant technology is a feature that is applicable to both nylon 6 and nylon 6,6 with equal results.

Stain removal, like soil removal, is successful when proper methods, equipment, cleaning solutions and trained technicians are used.

Wear Characteristics

Nylon 6 and nylon 6,6 have the highest abrasion resistance of any fiber used for carpet yarns.

Well-constructed carpet made with quality nylon yarn can ugly out long before it will wear out.

Product Lifecycle

In carpet performance comparisons conducted by a leading independent certified textile testing lab, the results showed no performance differences in carpets made from either nylon 6 or nylon 6,6 yarns.

Proper carpet performance and end-user satisfaction are achieved by specifying proper construction, color and the use of appropriate cleaning procedures and is not based on the use of nylon 6 or nylon 6,6 polymer.

Melting Point

Dropped cigarettes can melt both nylon 6 and nylon 6,6.

Both nylon types have melting points high enough to resist accidental fusing when moving heavy objects across the carpet.

Fiber Cross-section

Any cross-section developed can be utilized to make carpet fiber and the physical shape of the cross-section has nothing to do with polymer type.

A trilobal cross-section is by far the most popular and most efficient shape used for carpet fiber.

Cleaning procedures and methods will override any visual soiling differences realized with different fiber cross-sections.

Resilience

Nylon 6, nylon 6,6 and wool have identical resilience characteristics.

Nylon yarn recovery characteristics are the result of properties specifically engineered into the yarn and not the polymer type.

Proper removal of soil and cleaning solutions allows for maximum yarn recovery potential.

Molecular Structure

TYPE 6		TYPE 6,6	
Oil		Oil	
Cyclohexane		Cyclohexane, Butadiene	
Caprolactam + H_2O		Adipic Acid + HMD	
Nylon 6		Nylon 6,6	
Carbon	63.7%	Carbon	63.7%
Hydrogen	9.8%	Hydrogen	9.8%
Nitrogen	12.4%	Nitrogen	12.4%
Oxygen	14.1%	Oxygen	14.1%
	100%		100%
Density	1.14g/cm^3	Density	1.14/cm^3
Tenacity	3.0-4.5g/d	Tenacity	3.0-4.5g/d
Moisture Regain	4.5%	Moisture Regain	4.5%
Melt Point	428ºF/220ºC	Melt Point	491ºF/255ºC

Source: Handbook of Chemistry and Physics

What the experts say about performance differences in carpets directly attributable to nylon 6 and nylon 6,6 polymers:

The Canadian government monitored the testing of ten carpet styles made with nylon 6 and nylon 6,6 yarns. A certified testing lab was used for performance testing and the results indicated that both polymer types performed to equal and acceptable levels.

Carey Mitchell, Director of Technical Services, Shaw Industries, states in an article he authored: "Some minor differences exist between the two types of nylon. When examined critically in the perspective of overall carpet performance, it becomes very apparent that these differences are of no consequence in real world terms."
Source: The Bane-Clene® Professional Cleaning Digest®, July/August 1996

A recent survey was conducted by asking textile department professors at leading universities if they have been able to determine any performance differences in carpet, related to the use of nylon 6 or nylon 6,6. The answer – absolutely none!

Ed Van Wely, Vice-President and General Manager of DuPont's nylon business states: "We expect the major growth penetration to be in nylon 6 based on new technology, while maintaining our position in nylon 6,6."
Source: Textile World, January 1998