



Design Without Compromise

Evaluating the Durability of Print-Dyed Nylon Technology vs. Solution-Dyed Nylon (SDN)

Imagine a world where you don't have to choose between durability and design when it comes to flooring. Picture a bustling office, a high-energy retail space, or a dynamic educational facility—each with carpets that not only endure the daily grind but also captivate with their vibrant designs.

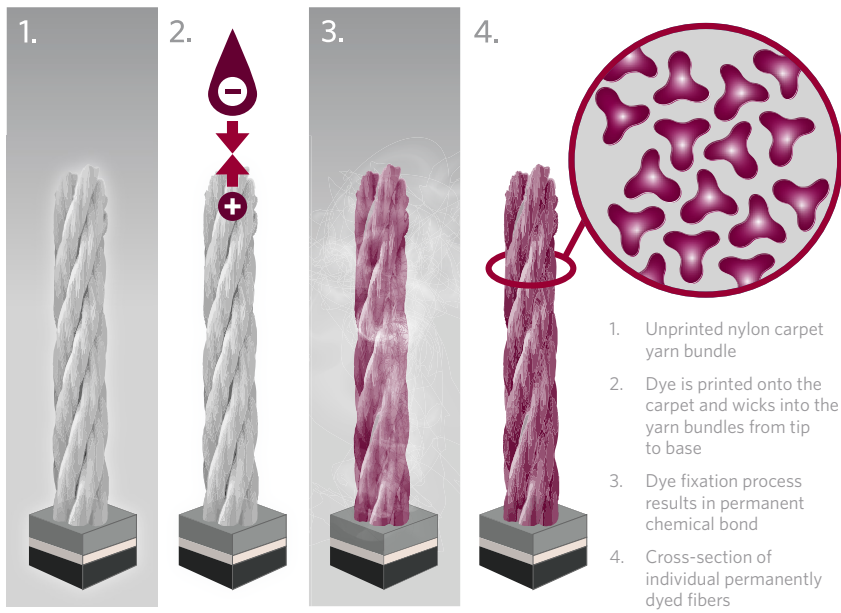
For years, solution-dyed nylon (SDN) has been the go-to choice for interior spaces, prized for its robustness and colorfastness. However, as design demands evolve, the industry faces a growing conundrum: Can we achieve the same durability with more versatile and intricate designs?

Milliken's PrintWorks™ technology presents an exciting solution. By diffusing color directly into the carpet fibers, it is a blank canvas opportunity for intricate, vibrant designs for any application. This technology promises aesthetic versatility and long-lasting resilience. But can print technology truly hold its ground against SDN? In this case study, we delve into the heart of this question, exploring how print technology is as durable as SDN and stands up to the demands of the commercial environment. Through testing and analysis, we uncover the truth behind the myths and misconceptions, presenting a clear comparison driven by data and real-world performance.

Milliken™

CURRENT LANDSCAPE

Milliken



Commercial carpets use these common methodologies, among others, to create the patterns that define market use: Solution-Dyed Nylon (SDN) and Print Dyed Nylon Technology. At Milliken, we employ both SDN and Print technologies in our extensive range of commercial carpet products, providing the same robust commercial warranty for our products regardless of the technology used. This ensures confidence in durability and performance across the board.

SDN is a type of carpet where the color is added to the nylon polymer before it is extruded into fibers. This means that the color is integrated into the fiber rather than being applied after the fibers have been formed.



Print-dyed nylon is a type of carpet where the color pattern is applied after the carpet is manufactured, using a printing process like digital printing, essentially “painting” the design onto the carpet surface instead of dyeing the fibers before they are tufted into carpet. Milliken carpets are made using this methodology, harnessing our proprietary PrintWorks™ technology.

PrintWorks™—like SDN—chemically bonds color and fiber during the printing process. It is colorfast and extremely durable, typically achieving a TARR durability rating of “severe.” It allows for unique aesthetic effects and precise registration from tile to tile—creating an agile manufacturing process for quicker turnaround and lead times, along with limitless customization.

How does it work? The technology employs heat to infuse color into the structure of the fiber itself. Color is bonded directly into the fiber at the molecule level. We take the chemistry of the dyes and polymers into account to precisely control color, saturation, and durability.

Both SDN and print-dyed nylon make longevity claims, with SDN being perceived as more resilient due to its through-and-through coloration, while print-dyed nylon offers unique design capabilities and rapid customization.

We understand that there may be market perceptions and anecdotal reservations about the durability of PrintWorks™ compared to SDN. Some stakeholders may believe that SDN color is far more resilient and that PrintWorks™ wears off because the color is only on top. However, PrintWorks™ products are just as durable in commercial applications. By comparing these two technologies, we aim to thoroughly examine these perceptions and demonstrate the strengths and possibilities that each technology brings to the table. This will help illuminate why we are committed to rigorous testing and provide a comprehensive view that helps stakeholders make informed, confident decisions.

TESTING METHODOLOGY

Our approach was multifaceted, designed to assess a variety of performance metrics critical to commercial use.

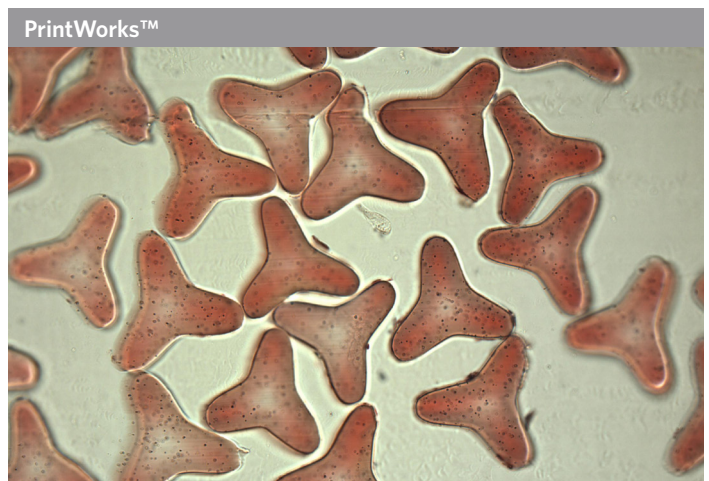
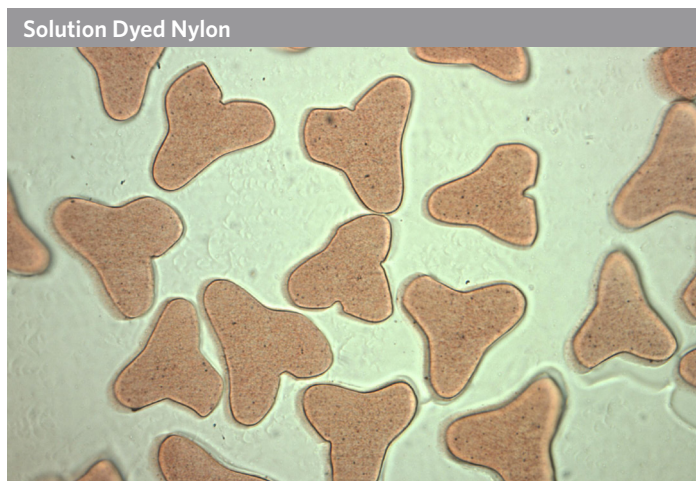
- 1. Stain Resistance:** Both print technology and SDN carpets were subjected to a series of common staining agents. The goal was to evaluate how well each carpet resisted stains and how easily they could be cleaned.
- 2. Appearance Retention:** Wear testing simulates the effects of heavy foot traffic over time. Both types of carpets were exposed to continuous wear to measure their durability and retention of appearance.
- 3. Soil Resistance:** To test soil resistance, the carpets were exposed to dust, dirt, and grime, assessing how well they repelled these particles and how easily they could be cleaned to restore their original look.



KEY FINDINGS 1.0

VISUAL ANALYSIS

Microscopic imagery played a crucial role, allowing us to visualize the color penetration into the fibers in both print technology and SDN carpets. The imagery demonstrates that the color is consistent throughout the fibers in both SDN and PrintWorks™ carpets.



STAIN RESISTANCE

To evaluate the stain resistance of print technology carpets versus SDN carpets, we subjected both types to a series of common staining agents, including colored drink, ketchup, and mustard. The test involved applying these agents to the carpet samples, allowing them to air dry for 24 hours, followed by rinsing with water. Milliken products Coastline (PrintWorks™) and First Sight (SDN) were qualitatively evaluated on its initial and post-cleaning appearance.

PRINT TECHNOLOGY OBSERVATIONS:

- **Initial Staining:** Both colored drink, ketchup, and mustard visibly stained the PrintWorks™ carpet sample.
- **Post Cleaning:** After 24 hours of air drying and subsequent rinsing, the PrintWorks™ carpet showed that colored drinks and ketchup stains were significantly reduced, while mustard stains persisted slightly. Overall, the appearance was notably improved post-cleaning, indicating a strong resistance to common stains and ease of maintenance.

SOLUTION-DYED NYLON (SDN) OBSERVATIONS:

- **Initial Staining:** Similar to the PrintWorks™ carpet, colored drink, ketchup, and mustard visibly stained the SDN carpet.
- **Post Cleaning:** Following the same cleaning process, the SDN carpet demonstrated a high level of stain removal. Colored drink and ketchup stains were substantially reduced, and mustard stains remained slightly noticeable. The overall appearance post-cleaning indicated strong resistance to common stains and ease of maintenance.



COMPARATIVE ANALYSIS:

- Both print technology and SDN carpets exhibited high stain resistance, effectively reducing the visibility of common staining agents after the cleaning process. Each type showed comparable performance, with colored drink and ketchup stains being significantly minimized, and both carpets struggling slightly with mustard stains, which remained barely visible.

WEAR RESISTANCE

To evaluate the wear resistance of PrintWorks™ technology carpets versus SDN carpets, samples were subjected to testing using the Vettermann Drum. The samples were trafficked for 11,000 cycles in both the machine and cross-machine directions to simulate the effects of heavy foot traffic over time. Subsequently, the samples were submitted to a third-party lab for grading. Milliken products, Grand Plaza (PrintWorks™) and Clean Break (SDN), were evaluated and rated on a scale of one to five.

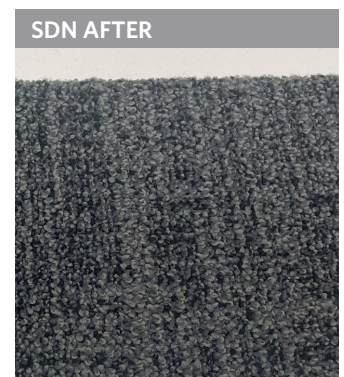
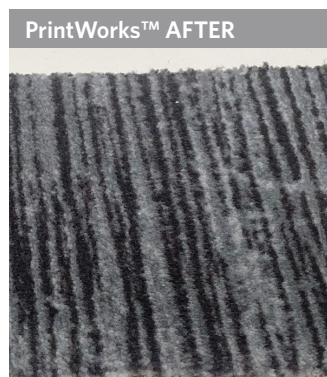
PRODUCT	RATER 1	RATER 2	RATER 3	AVERAGE
Grand Plaza - Made by Milliken with PrintWorks™	3.5	4	4	3.8
Clean Break - Made by Milliken with SDN	4	4	3.5	3.8

PRINT TECHNOLOGY OBSERVATIONS:

- **Before Wear:** The PrintWorks™ carpet samples exhibited consistent, robust appearance prior to wear testing.
- **Post Cleaning:** After 11,000 cycles, the carpet sample demonstrated substantial resilience, retaining its structural integrity and aesthetic quality. The average grading was comparable to SDN carpets, with products like Grand Plaza achieving an average grade of 3.8 out of 5.

SOLUTION-DYED NYLON (SDN) OBSERVATIONS:

- **Before Wear:** The SDN carpet samples presented a consistent and vibrant appearance
- **Post Cleaning:** Following 11,000 cycles, the SDN carpet samples maintained a high level of structural integrity and appearance. The grading averaged 3.8 out of 5, indicating excellent wear resistance.



COMPARATIVE ANALYSIS:

- Both print technology and SDN carpets exhibited commendable wear resistance under rigorous testing conditions. The average grades from the third-party lab indicate that both carpet types performed similarly, maintaining their appearance and structural integrity after extensive simulated foot traffic. These findings show that Milliken’s PrintWorks™ carpets can match the durability of SDN carpets, offering a viable option for environments demanding high wear resistance. Both technologies provide robust performance, ensuring longevity and ease of maintenance in commercial settings.

SOIL RESISTANCE

The soil resistance test was an integral part of our evaluation, aimed at understanding how well both PrintWorks™ technology and SDN carpets repel dust, dirt, and grime, while maintaining their original appearance after cleaning. Milliken products, Coastline (PrintWorks™) and Clean Break (SDN), were reviewed visually, and changes were measured using a spectrophotometer. The ΔE value was used to compare the perceived change in color from soiling, where a lower ΔE indicates less change in color and better soil resistance.

PRODUCT	BEFORE			AFTER			ΔE
	1	1	1	2	2	2	
Delta E (ΔE) Color Difference	1	1	1	2	2	2	ΔE
Coastline - Made by Milliken with PrintWorks™	32.32	0.66	-1.53	29.74	0.55	-0.75	2.70
Clean Break - Made by Milliken with SDN	28.14	0.55	0.9	25.24	0.57	0.83	2.90

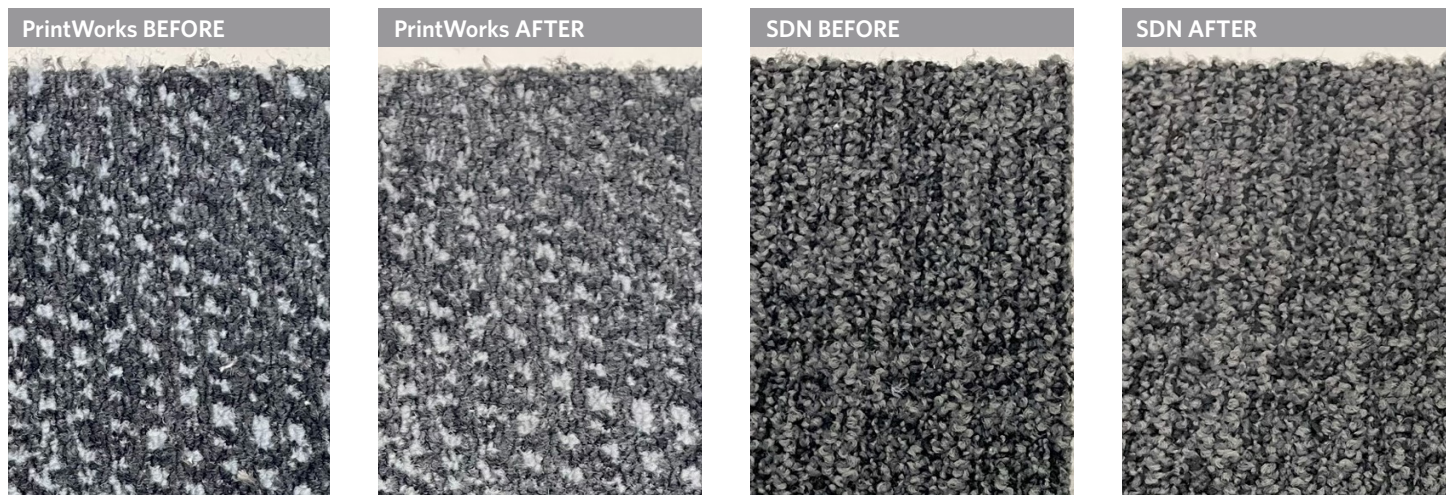
- ΔE ≤ 1.0:** Not perceptible by the human eye
- 1 < ΔE ≤ 2:** Perceptible through close observation
- 2 < ΔE ≤ 10:** Perceptible at a glance

PRINT TECHNOLOGY OBSERVATIONS:

- Milliken’s Coastline sample demonstrated the best soil resistance with a ΔE value of 2.70. The minimal color change signifies superior soil resistance, making it highly suitable for environments where dirt and grime are prevalent, such as commercial spaces with high foot traffic.

SOLUTION-DYED NYLON (SDN) OBSERVATIONS:

- Milliken’s Clean Break sample exhibited a ΔE of 2.90, indicating a minimal change in color from soiling. This suggests that the SDN carpet retains its appearance well after exposure to soil and is easily cleaned to restore its original look.



COMPARATIVE ANALYSIS:

- Based on the results of the soil resistance test, both the Coastline (PrintWorks™) and Clean Break (SDN) carpets exhibited minimal color change from soiling, with ΔE values of 2.70 and 2.90, respectively. This indicates that both carpets performed similarly in terms of soil resistance and maintained their original appearance well after cleaning.

CONCLUSION

The comparative case study between Milliken's PrintWorks™ technology and traditional SDN carpets reveals that print-dyed nylon technology excels in commercial environments. The findings highlight that PrintWorks™ technology offers equal performance in terms of stain, wear, and soil resistance.

PrintWorks™ technology not only matches the durability and maintenance ease of SDN carpets but also provides greater aesthetic versatility and customization options. This makes it a compelling choice for dynamic commercial settings, where both design and resilience are essential. Milliken's PrintWorks™ carpets thus present a robust and stylish flooring solution without compromising on performance.



Milliken