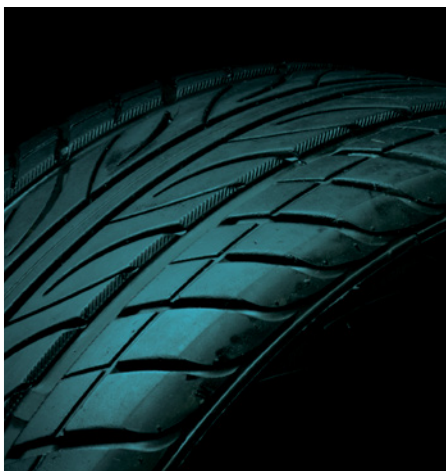




**MOMENTIVE™**  
inventing possibilities

Advanced Tire Silanes

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## Momentive keeps tires moving forward

As rapidly evolving technology and increased global fuel consumption impose new demands on tires, we understand your need to manufacture a superior product that can go the distance. We also know that making a better product often requires going beyond the standard approach. That's why we combine expertise, vision and scientific data to offer you unique solutions.

### Expertise for insight

For many of our chemists and technicians, the journey to the world of tires began in a tire plant. Before they were members of the Momentive Performance Materials team of industry experts, they were "tire guys" like you. These award-winning individuals have secured more than 50 patents and have over 250 years of combined experience in the industry. This history and first-hand experience affords them a unique perspective when developing and fine-tuning formulations for you.

### Vision for innovation

Fueled by the desire to revolutionize silica tire manufacturing, we introduced the first advanced silanes for tires over 20 years ago. Since then, we have remained committed to innovation with the NXT\* silane line. NXT silanes help deliver the lowest rolling resistance possible while maintaining wet traction. These silanes can also offer a myriad of other benefits when formulated into the solutions we develop for you.

### Science for sophistication

To ensure customers garner the ultimate benefits of NXT silanes and our unique solutions, we spend every day in the lab. Our chemists invent molecules in a synthesis facility and test materials in our state-of-the-art rubber lab. With this one-of-a-kind approach, we are able to continually examine performance properties and the effects of adjusting formulations until we reach the desired outcome. The end result is cutting-edge solutions for your specific applications.

### Products for the future

Our unique approach and advanced silanes enable us to focus on the future of tires. We welcome the opportunity to mobilize our industry experience, NXT silanes and data-driven methods to help you deliver products not only for today's world, but also for the needs of tomorrow.



## NXT\* silanes: ingredients for success

In paving the way for the future, we strive to conceive solutions that assist in realizing high-quality products and enhanced manufacturing. With NXT silanes, we offer a new level of support that can help you create tires that stand out in the showroom and perform on the road.

### Reduced rolling resistance

With fuel reduction targets being mandated worldwide in the coming decades, it will be necessary to improve the rolling resistance of tires in order to meet new standards. Incorporating NXT silanes into the tire tread can lead to greatly improved rolling resistance ratings. As a result, tires can use less energy and fuel to function, without compromising safety.

### Better wet traction

NXT silanes enable the reduced rolling resistance needed for fuel efficiency while maintaining wet traction. This critical safety feature can help vehicles stop faster and grip the road better, empowering you to further exceed consumer expectations.

### Desirable testing results

NXT silanes offer design possibilities by helping you to achieve the following effects in rubber compounds:

- Improved Payne Effect
- Increased resilience
- Lower  $\tan \delta$  values (50 °C to 60 °C)
- Better dynamic properties at low temperatures (-20 °C to +10 °C)

### More efficient manufacturing

Not only do NXT silanes enable better tire performance, they can help accelerate manufacturing. Despite high-silica loading formulas, these advanced silanes promote better dispersion. And, a reduced compound viscosity is possible for easier processing, mixing, milling and extrusion. This can result in numerous potential benefits including:

- Fewer steps in the fabrication process
- An increase in tread extrusion rate
- A smoother, cleaner tire tread profile
- A longer shelf life before re-milling is required



## NXT\* silane products

### NXT Silane

NXT silane is a thiocarboxylate functional silane that has been shown to enable reduced rolling resistance while maintaining wet traction. This advanced silane offers tire manufacturers increased overall production efficiency compared to standard sulfur silanes.

### Carbo NXT Silane

Carbo NXT silane is available in powder form for processing flexibility. This NXT silane offers tire manufacturers the same enhanced tire performance and increased efficiencies as the liquid form.

### NXT LowV\* Silane

NXT LowV silane can provide significant reductions in the ethanol released during tire manufacturing. Compared to other silanes, NXT LowV silane can reduce ethanol emissions by more than 66 percent. It also can decrease silica processing steps, saving manufacturers time and improving efficiency.

### NXT Z\* Silane

NXT Z silane is a revolutionary advanced silane that is virtually ethanol-free, features easier processing and enables shelf-stable compounds. This silane can dramatically improve the dynamic and physical properties of tires for unprecedented performance.



## Our labs: where ideas take off

We recognize that selecting the right ingredients is just one stop on your road to success, and we believe in helping you prepare for the entire journey. An integral part of that philosophy is our unique ability to test silane solutions for performance in application. Our cutting edge laboratories in Tarrytown, NY, and Charlotte, NC, are where ideas are transformed into solutions.

### Life in the lab

We spend each day in labs dedicated to evolving advanced silanes for the tire industry. We work with the materials that you incorporate into tires to know exactly how various rubber compounds will react in real-life situations. To generate this data, we develop solutions in the Tarrytown, NY, facility, and then fine-tune formulations in a series of rigorous tests at our state-of-the-art rubber lab in Charlotte, NC.


### Demonstrating material performance

In our 20,000 square-foot tire lab in Charlotte, NC, we test NXT silane and other coupling agents in silica-filled systems by evaluating physical and dynamic properties. We predict rolling resistance, traction and rubber toughness by testing under tension, compression, bending and shear. Additionally, we measure silica dispersion and numerous other properties to identify potential manufacturing efficiencies.

### Testing for complex challenges

At these facilities, we can investigate complex issues to help you find a solution specific to your requirements. Through extensive testing and analysis, we can identify and pinpoint notable performance properties that can help you produce a tire unlike any other.



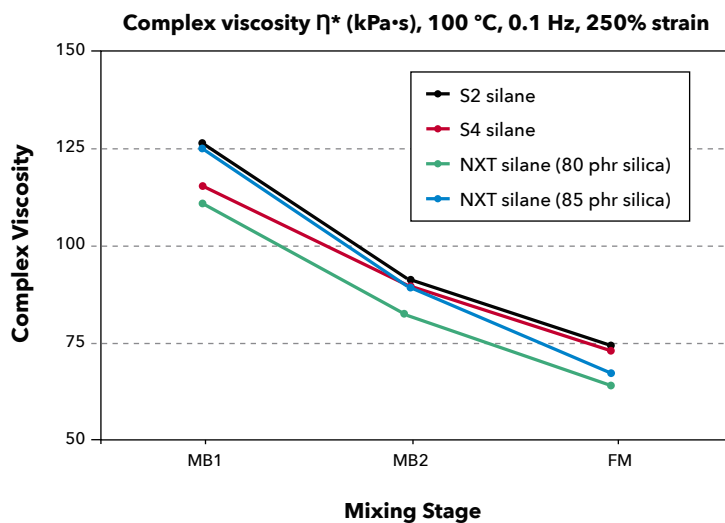
A blue car is shown from a low-angle, rear-quarter perspective, driving on a road. The car is in motion, as indicated by the blurred background and the road surface. The focus is on the front wheel and tire, which is a dark, multi-ribbed design. The car's body is a vibrant blue, and the side mirror is visible. The road is light-colored with a yellow line, and the background shows a blurred landscape with greenery and a grey sky.

## Our manufacturing facilities: prepared for the journey

With a new manufacturing facility planned for Europe and a site in North America, we are prepared for the rapidly increasing global demand for high-performance tires. The new facility in Leverkusen, Germany, will double production capacity of NXT\* silane products to deliver solutions more efficiently across the globe while our plant in the United States continues to serve customers worldwide. As global standards become more stringent, we are growing to help you ramp up the performance of your tires.

Typical compound research conducted in the lab comparing S2 and S4 silanes with NXT\* silane are depicted in the following charts. This type of data helps our scientists better understand reversion, crosslink density, scorch and other compound characteristics to help you develop a compound that meets your needs. In these studies, standard S2 and S4 silanes in 80 phr loaded silica compounds are compared to NXT silane in 80 phr and 85 phr silica loaded compounds.

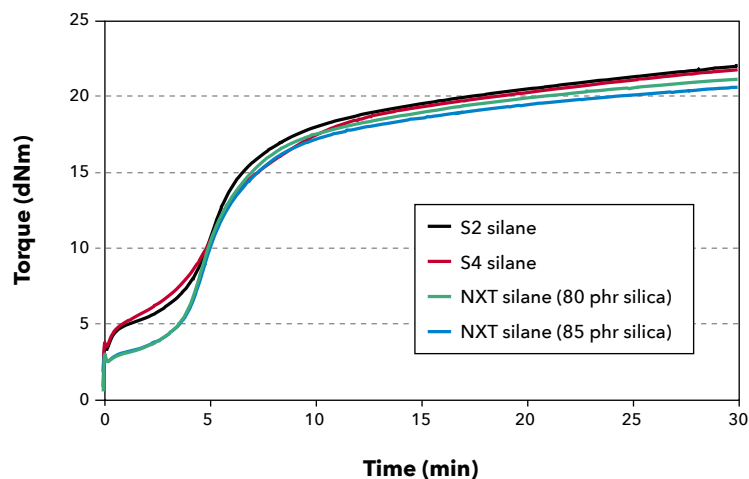
**Figure 1: Comparison of Batch Viscosities**



The viscosity of NXT compounds is typically lower than standard silane compounds, even with higher silica loading.

Note: Test data. Actual results may vary.

**Figure 2: Curve Comparison MDR at 160 °C**

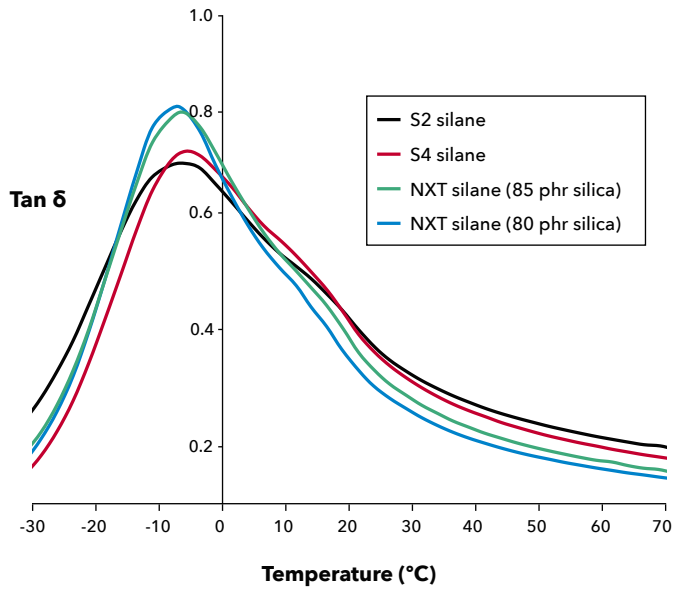


Initial torque and induction times can be improved by using NXT silane versus standard silanes, regardless of the silica loading.

Note: Test data. Actual results may vary.



**Figure 3: Temperature Sweep, 10.0 Hz at 0.5% Strain**



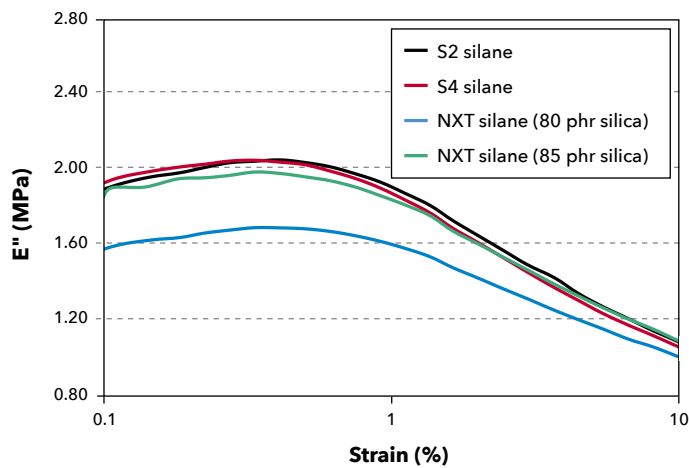
The best combination of dynamic properties can be achieved with NXT silane. Lowest tan  $\delta$  at 60 °C is indicative of lower rolling resistance, without loss of tan  $\delta$  at 0 °C, which also suggests equal or better wet traction.

Note: Test data. Actual results may vary.



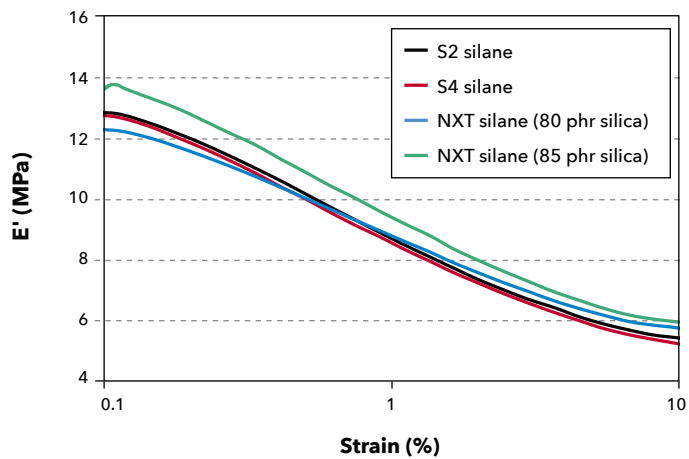
The  $E''$  curves demonstrate lower damping with NXT\* silane versus standard silanes, and the  $E''$  curves verify an equal or better dynamic modulus. Lower rolling resistance can be expected when  $\tan \delta$  max values are reduced due to strong dynamic modulus and low damping.

**Figure 4:  $E''$  Values, 10.0 Hz, at 55 °C**



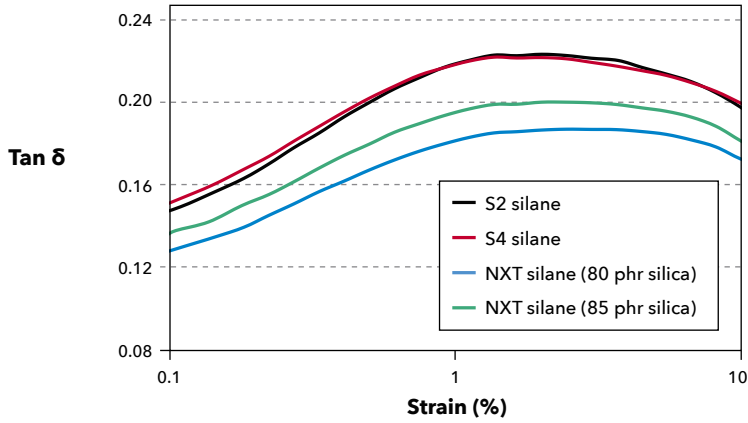
Note: Test data. Actual results may vary.

**Figure 5: Strain Sweep, 10.0 Hz, at 55 °C**



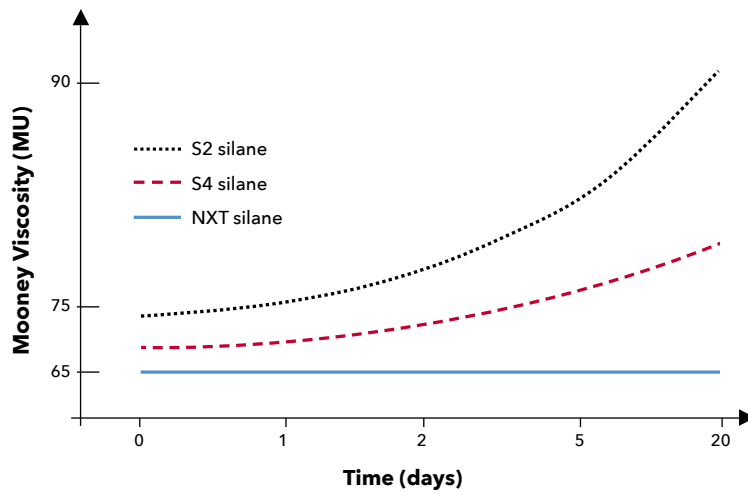
Note: Test data. Actual results may vary.

Figure 8: Tan  $\delta$  max Values, 10.0Hz, at 55 °C



Note: Test data. Actual results may vary.

Figure 7: Low Viscosity and Improved Storage Stability with NXT\* Silane



Flocculation and the need for re-milling can be minimized in compounds made with NXT silane.

Note: Test data. Actual results may vary.

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### Product Safety, Handling and Storage

Customers should review the latest Safety Data Sheet (SDS) and label for product safety information, safe handling instructions, personal protective equipment if necessary, emergency service contact information, and any special storage conditions required for safety. Momentive Performance Materials (MPM) maintains an around-the-clock emergency service for its products. SDS are available at [www.momentive.com](http://www.momentive.com) or, upon request, from any MPM representative. For product storage and handling procedures to maintain the product quality within our stated specifications, please review Certificates of Analysis, which are available in the Order Center. Use of other materials in conjunction with MPM products (for example, primers) may require additional precautions. Please review and follow the safety information provided by the manufacturer of such other materials.

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