Natural Rubber Automotive Bushings

In this study, the effects of replacing N660 with Thermax® N990 on the properties of natural rubber bushing compounds were evaluated. Natural rubber is often chosen for this application due to its high toughness and good dynamic properties. The low surface area and structure of N990 allows the elastomer to maintain its inherent dynamic properties resulting in superior vibration isolation.

The benefits of Thermax® N990 found in the study were:

- Increased rebound resilience
- Decreased tan δ
- Lower dynamic to static spring ratio
- Improved vibration isolation
- Increased scorch safety

The natural rubber compound test formulations are provided in Table 1. The N660 was replaced at a ratio of 1.9 phr N990:1.0 phr N660 in order to maintain a Shore A hardness of 60. Mooney, MDR, hardness, tensile, compression set, resilience, heat aging, dynamic properties and adhesion properties were collected for each compound.

Table 1. Test Formulations

Ingredient	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Natural rubber RSS1	100	100	100	100	100	100	100	100	100
Thermax® N990	**-**	**10**	**19**	**29**	**39**	**48**	**58**	**68**	**77**
N660	40	35	30	25	20	15	10	5	0
Aromatic process oil	5	5	5	5	5	5	5	5	5
Antioxidant	1	1	1	1	1	1	1	1	1
Zinc oxide	5	5	5	5	5	5	5	5	5
Stearic acid	3	3	3	3	3	3	3	3	3
Accelerator	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Sulfur	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25
Total loading	**157**	**162**	**166**	**171**	**176**	**180**	**185**	**190**	**194**

Detailed compound test results are provided in the figures and tables on the following pages.

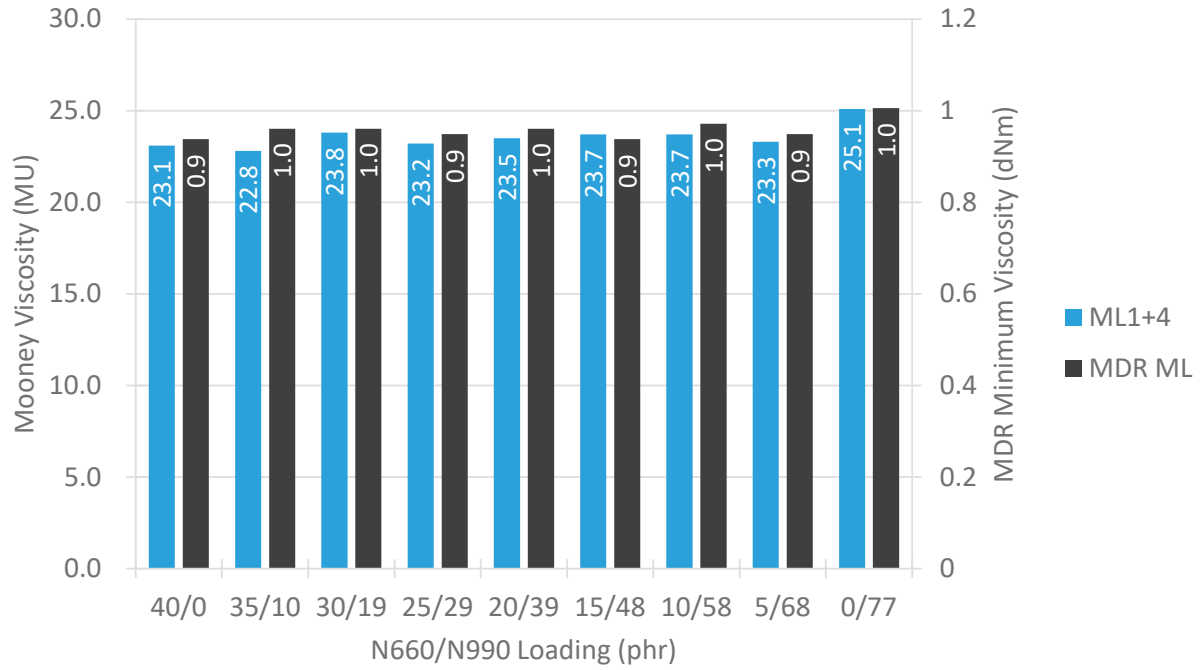

Figure 1. Mooney viscosity and MDR ML for the compounds. Mooney tests were run at 125°C and MDR tests were run at 150°C. No significant differences in viscosity were observed.

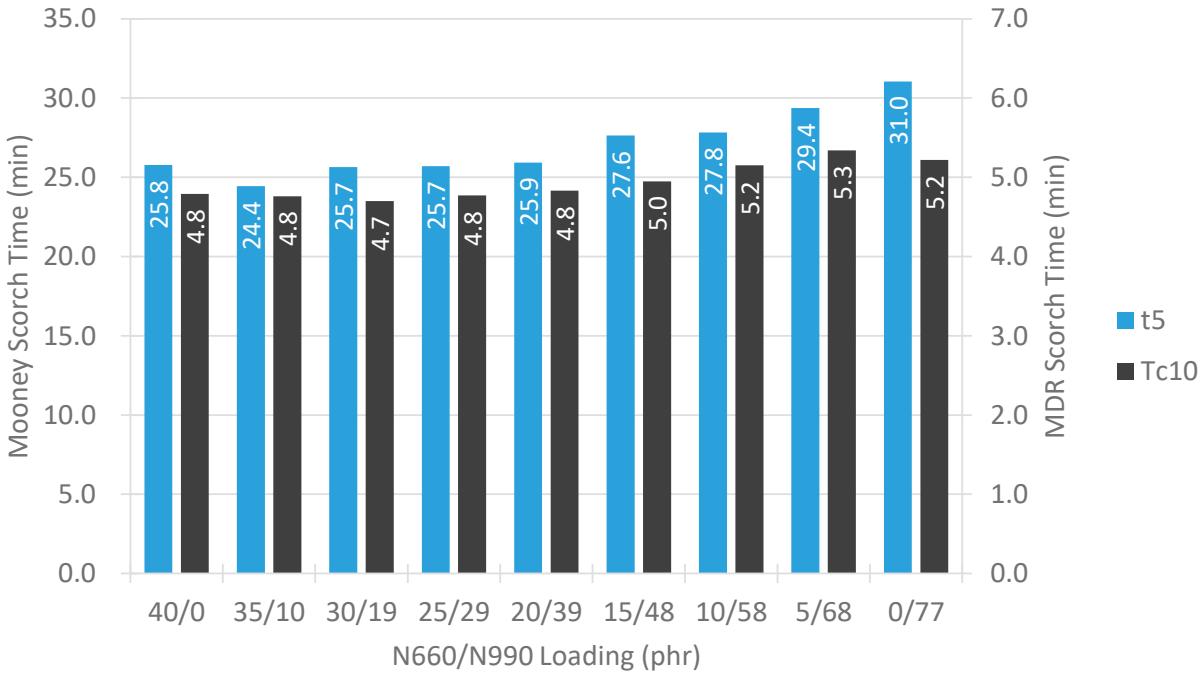

Figure 2. Mooney scorch time, t_5, and MDR scorch time, Tc10, for the compounds. Scorch time tended to increase slightly as N990 replaced N660.

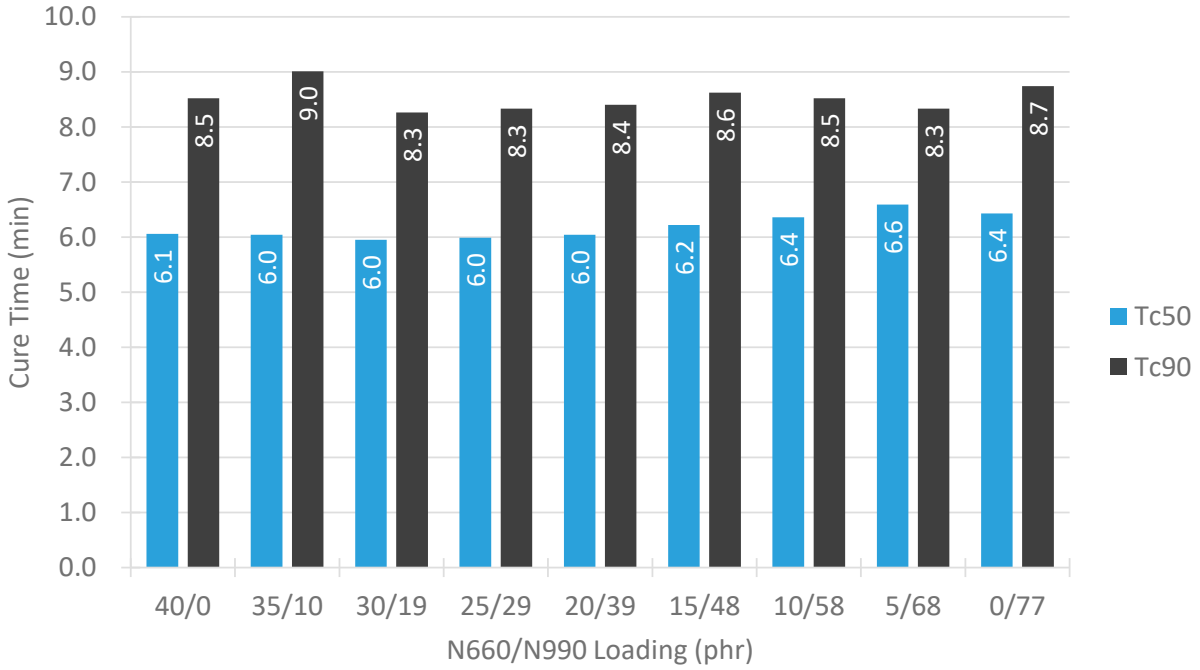

Figure 3. MDR cure times, Tc50 and Tc90, for the compounds. There were no significant differences in cure times.

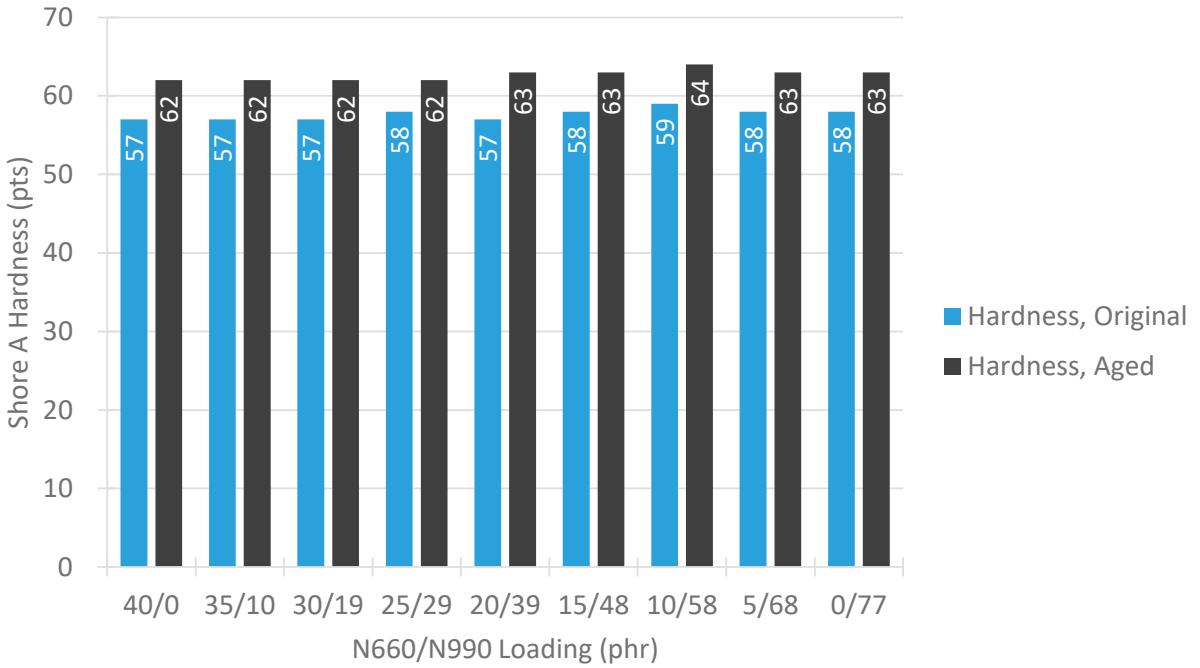

Figure 4. Shore A hardness, original and oven aged 72 hours at 100°C, for the compounds. All compounds met the 60±5 specification.

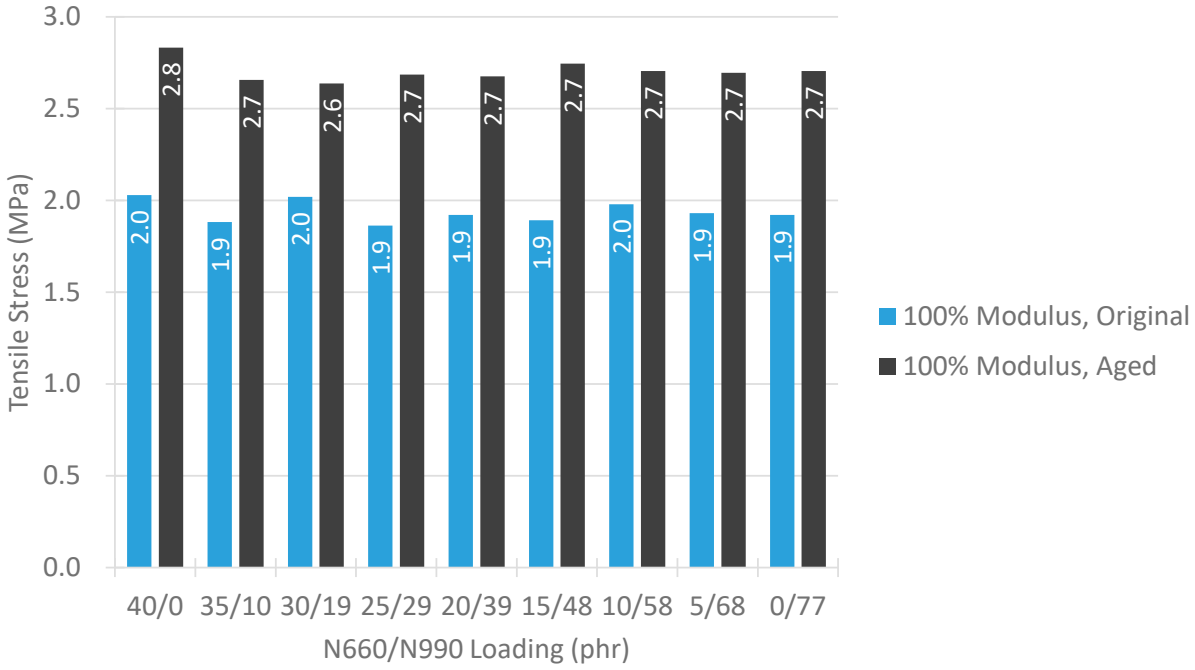

Figure 5. Stress at 100% strain, original and oven aged 72 hours at 100°C, for the compounds. No significant differences were observed.

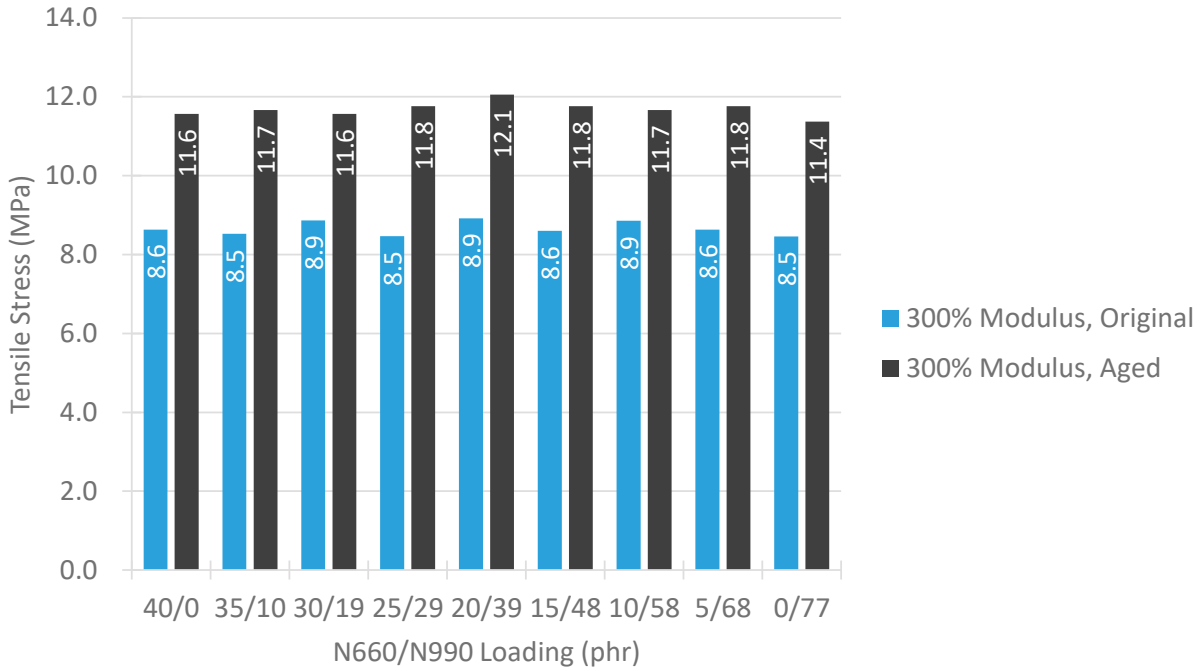

Figure 6. Stress at 300% strain, original and oven aged 72 hours at 100°C, for the compounds. No significant differences were observed.

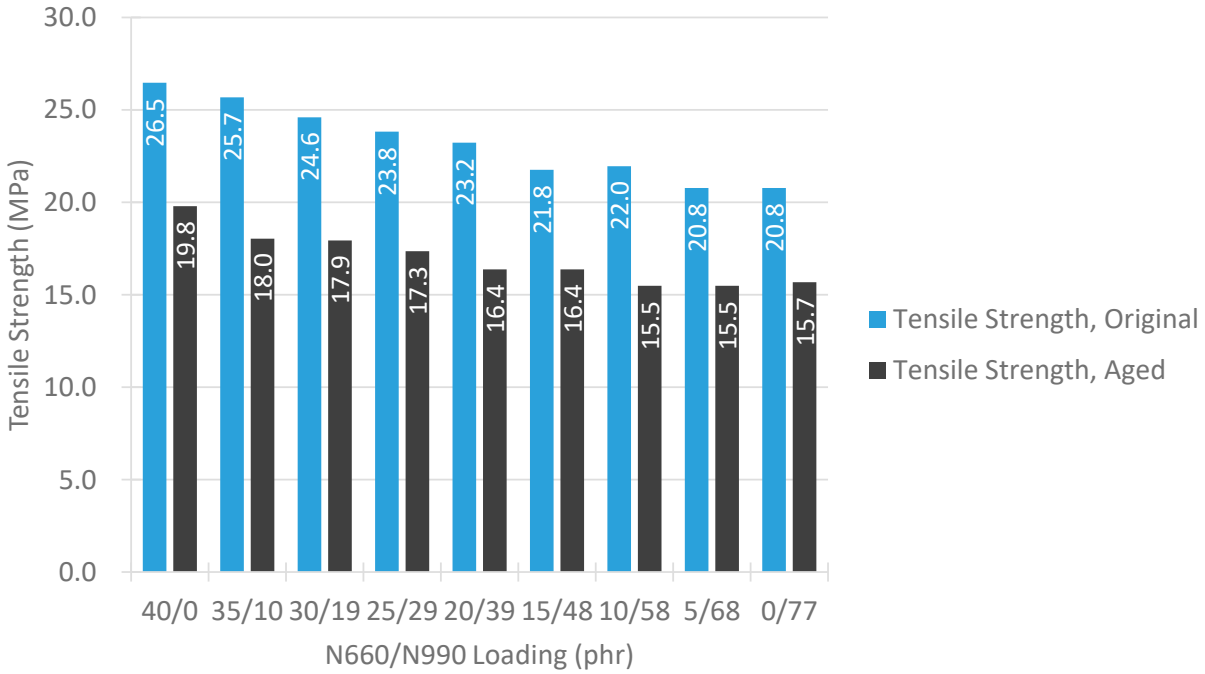

Figure 7. Tensile strength, original and oven aged 72 hours at 100°C, for the compounds. Tensile strength tended to decrease as N990 replaced N660.

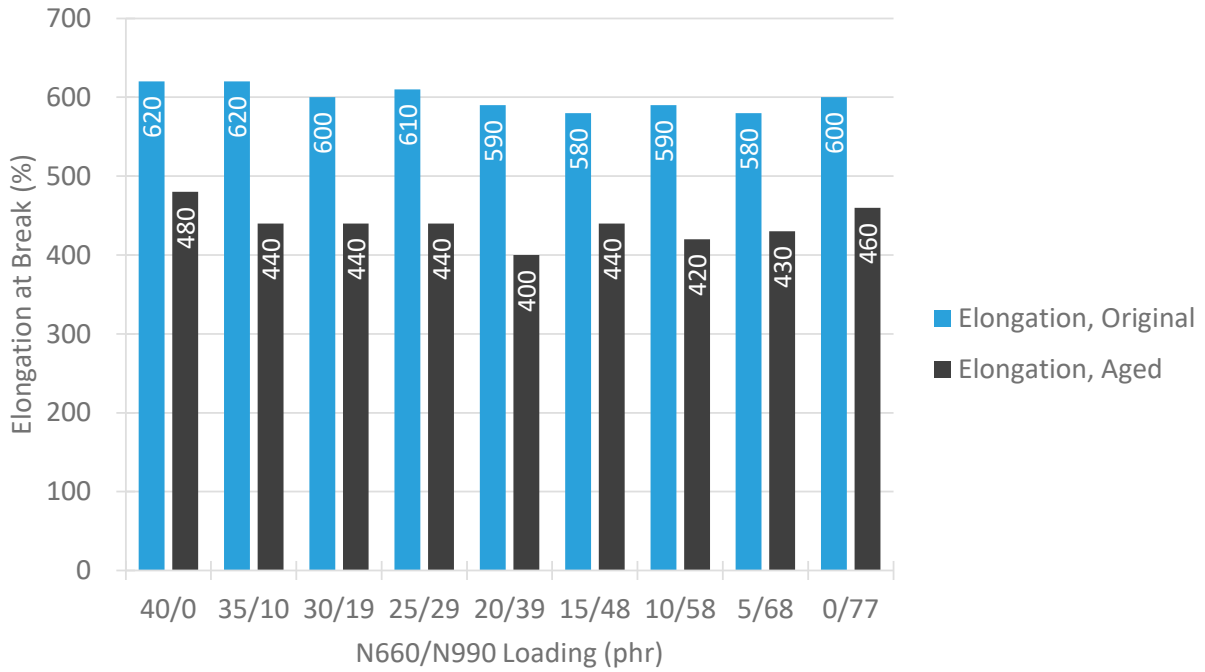

Figure 8. Elongation at break, original and oven aged 72 hours at 100°C, for the compounds. There were no significant differences in elongation observed.

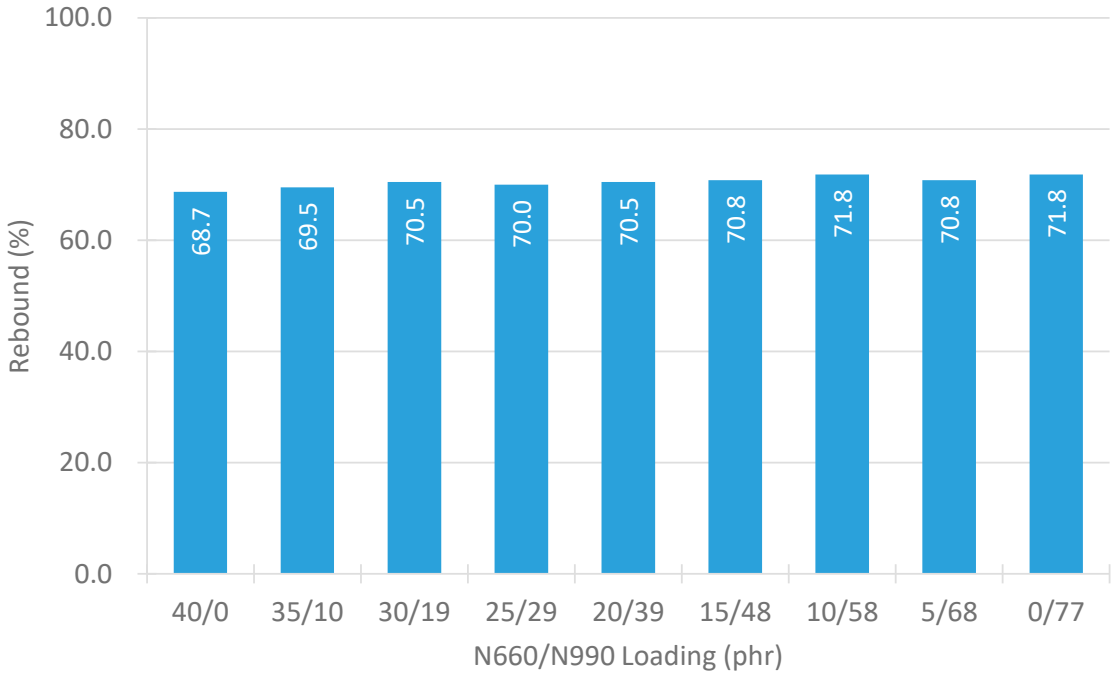

Figure 9. Rebound percentage for the compounds. Rebound tended to increase slightly as N990 replaced N660.

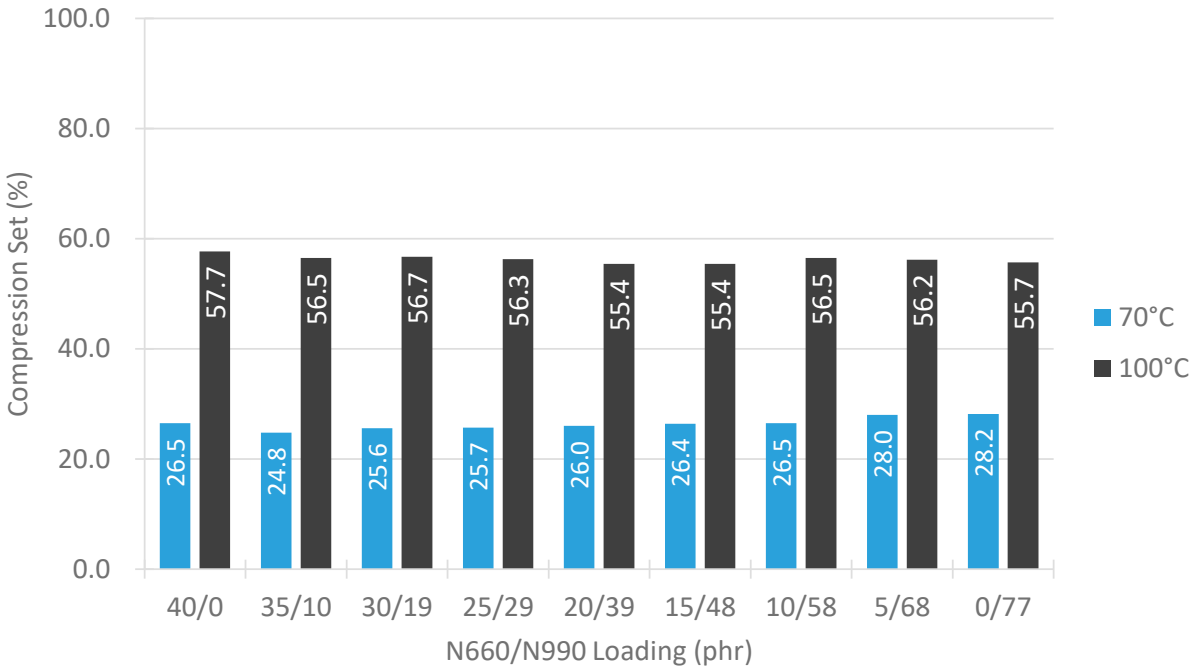

Figure 10. Compression set, 24 hours at 70°C and 24h hours at 100°C, for the compounds. There were no significant differences in compression set.

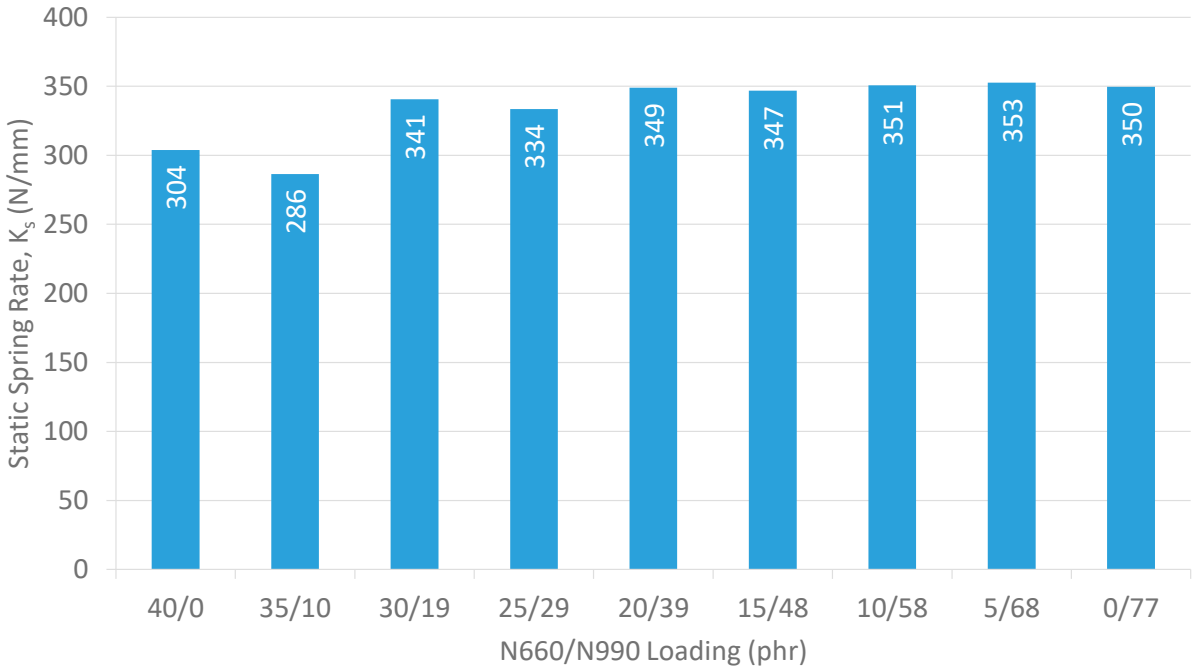

Figure 11. Static spring rate for the compounds. Static spring rate tended to be higher for compounds with N990.

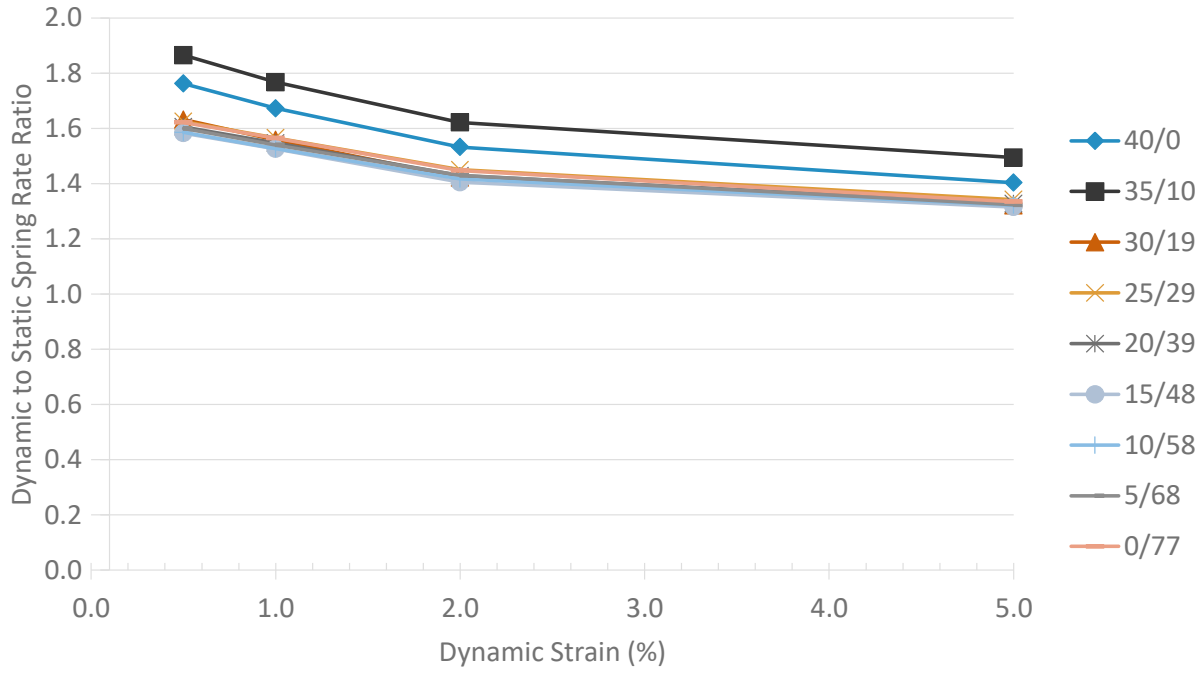

Figure 12. Dynamic to static spring rate ratio versus strain for the compounds. The dynamic spring rate was determined at 100 Hz. The ratio tended to be lower for the compounds with N990.

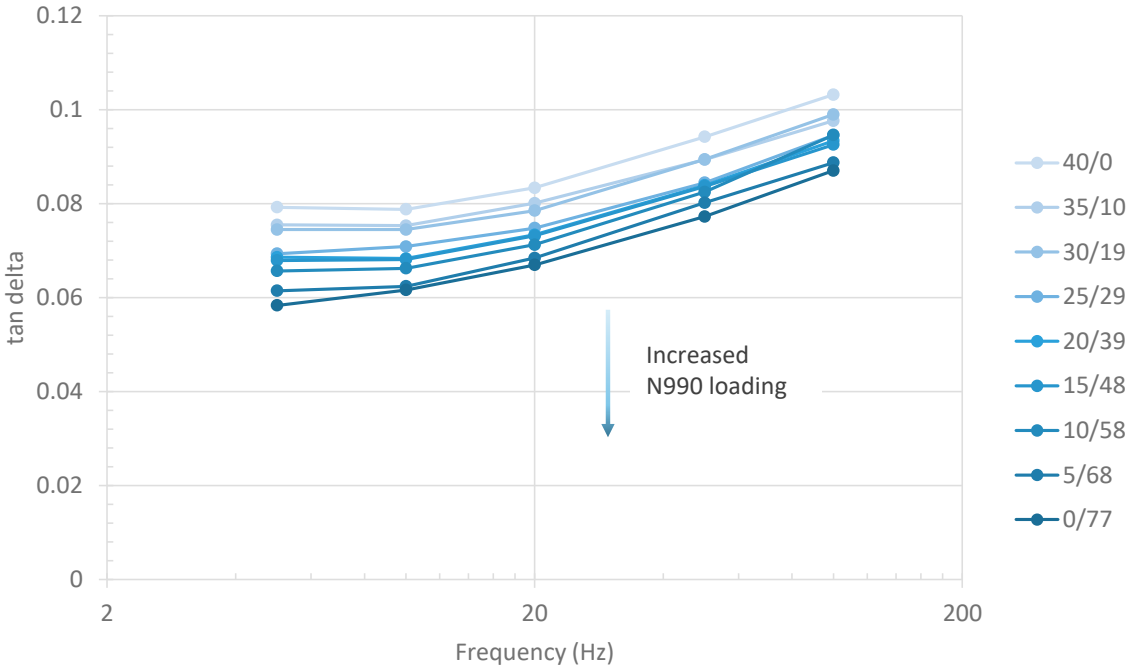

Figure 13. Tan δ versus frequency at 0.5% strain for the compounds. Tan δ tended to decrease as N990 replaced N660.

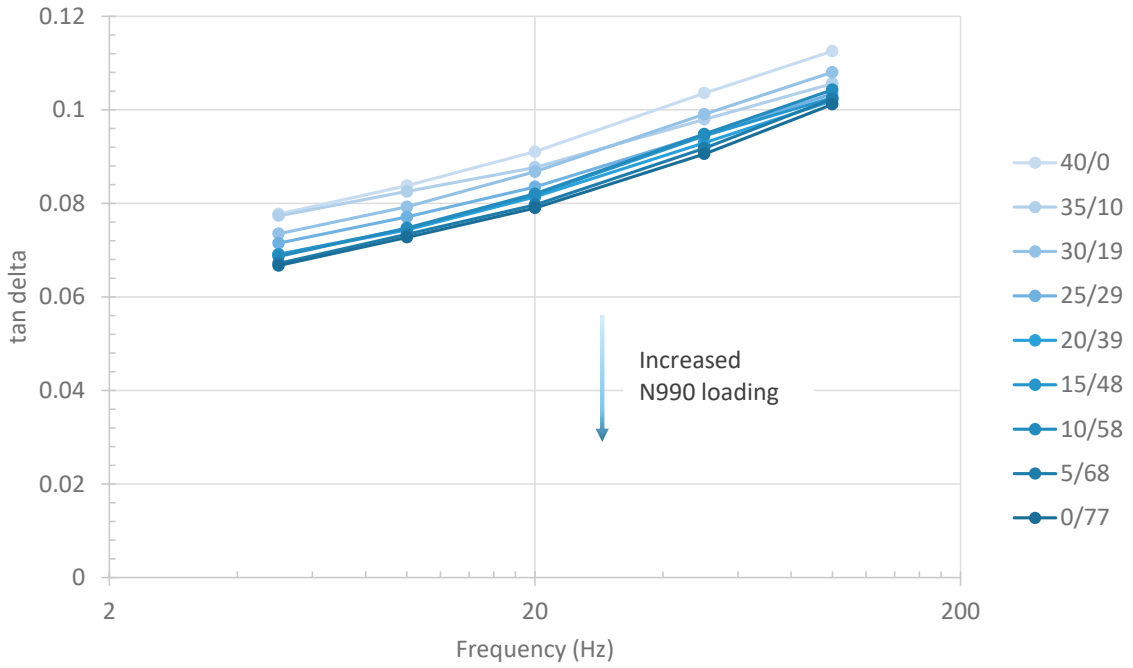

Figure 14. Tan δ versus frequency at 5.0% strain for the compounds. Tan δ tended to decrease as N990 replaced N660.

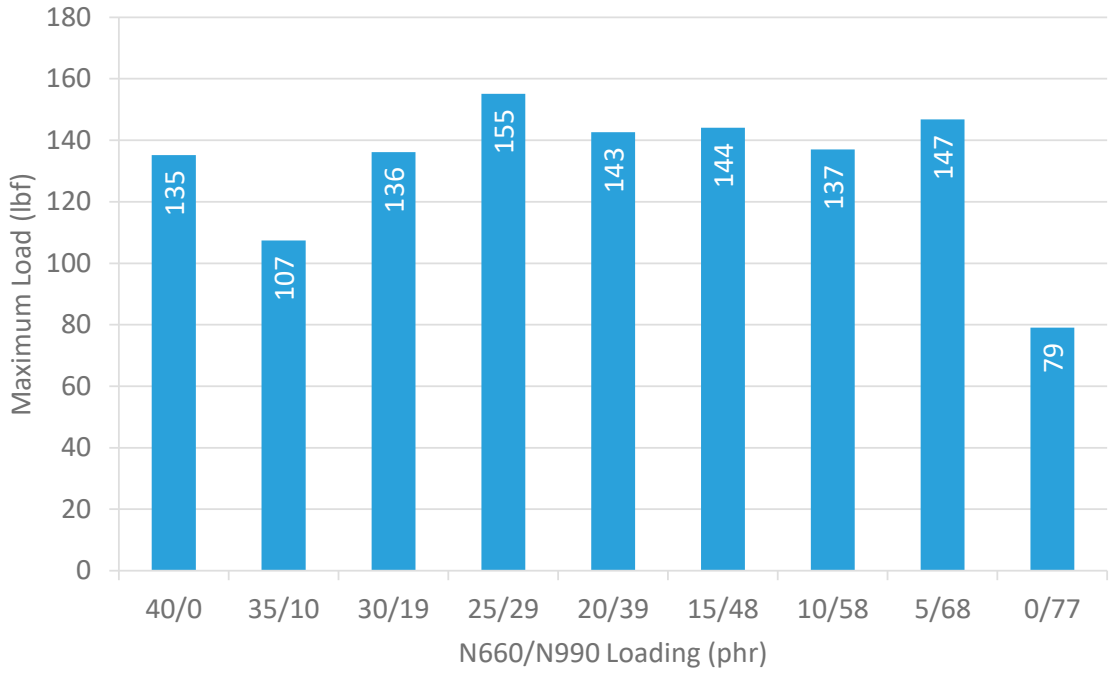

Figure 15. Adhesion of steel to rubber using Chemlok 205 as primer and Chemlok 6250 as top coat. All failures occurred in the rubber layer.

For more information about this study, please contact customer_service@cancarb.com