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TECHNICAL BULLETIN

NBR

Thermax® medium thermal carbon black N990 is manufactured by the thermal decomposition of natural gas. The thermal process provides a unique carbon black characterized by a large particle size and low structure. Thermax® is widely used in applications that require excellent heat, oil and chemical resistance and dynamic properties. The large particle size (low surface area) and low structure allow for low compression set, high rebound and low hysteresis, maintaining the inherent elastomeric properties of the rubber compound. As a non-reinforcing black, thermal black is often blended with furnace carbon blacks and/or mineral fillers to achieve cost reduction and specific physical properties in the rubber compound.

Thermax® can be used in all polymers and is commonly used in elastomers such as NBR, EPDM, HNBR, ACM and ECO. High loadings of Thermax® are possible, while maintaining low compression set and high resiliency, thereby allowing manufacturers to reduce compound cost. The combination of Thermax® N990 and NBR provides excellent oil and chemical resistance, and excellent high temperature properties. NBR compounds filled with Thermax® are used for applications such as:

- Seals, gaskets, o-rings
- Tubing, hose, belts
- Roll coverings, tank linings

The following data shows the effect of increasing loadings of Thermax® N990 carbon black in an NBR compound.

Formulation (pts by wt)

Hycar 1042	100.0	100.0	100.0	100.0
Aminox (antioxidant)	1.0	1.0	1.0	1.0
Stearic Acid	1.0	1.0	1.0	1.0
Zinc Oxide	3.0	3.0	3.0	3.0
Thermax® N990	50.0	100.0	150.0	200.0
DOP	25.0	25.0	25.0	25.0
MBTS	1.5	1.5	1.5	1.5
Spider sulphur	1.5	1.5	1.5	1.5
TOTAL	**183.0**	**233.0**	**283.0**	**333.0**

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Compound Properties				
Compound Viscosity (ML, 1 + 4 @ 100°C)	36	49	64	87
Mooney Scorch Time (t5 @ 121°C)	>30	>30	>30	>30
Rheometer, 166°C, 3° arc, 1.7 Hz, 0° Preheat				
MH	55.4	65.6	74.6	88.7
ML	5.8	7.4	8.6	11.6
tc50	6.2	5.6	5.3	5.2
tc90	11.6	11.6	12.4	12.9
ts1	4.1	3.5	3.2	3.0
Vulcanizate Properties				
Cured tc90 + 5 minutes @ 166°C	17	17	17	18
Hardness, Shore A2	49	58	69	76
100% Modulus, MPa	1.0	1.9	3.2	5.6
200% Modulus, MPa	1.9	4.2	6.6	9.4
300% Modulus, MPa	3.3	6.3	9.0	-
400% Modulus, MPa	4.8	8.0	9.7	-
500% Modulus, MPa	6.4	9.7	-	-
Tensile Strength, MPa	15.7	14.0	9.7	9.0
Ultimate Elongation (%)	730	680	495	275
Tear Strength, Die C, kN/m	27.3	38.8	43.7	42.0
Compression Set, Method B (%)				
70 hours @ 100°C, cured + 15 minutes	51	48	48	47
Zwick Rebound, cured + 20 minutes (%)				
@ 0°C	17	16	14	11
@ RT	45	41	36	31
@ 100°C	64	62	58	55
Aged Properties, aged in ASTM Oil #3, 168 hours @ 100°C				
Hardness	43	51	63	71
pts change	-6	-7	-6	-5
100% Modulus, MPa	1.2	2.4	3.9	6.0
% change	20	26	22	7
Tensile Strength, MPa	2.9	6.3	8.0	9.0
% change	-82	-55	-18	0
Ultimate Elongation (%)	220	300	270	180
% change	-70	-56	-45	-35
Volume change (%)	11	8	7	5
Weight change (%)	7	5	4	3

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Dynamic Properties

BFGoodrich Flexometer @ 55°C, cured + 10 minutes, (load 11 kg, stroke 4.45 mm, comp 17.5%)				
Heat Rise (°C)	23	29	36	47
Permanent Set (%)	2	2	2	2
MER 1100 (Static deformation 5%, dynamic deformation 2%)				
E′ @ 0°C, MPa	7.395	14.407	25.559	40.020
E′ @ 25°C, MPa	5.283	8.827	16.244	26.664
E′ @ 100°C, MPa	3.996	6.789	10.560	16.376
E″ @ 0°C, MPa	3.025	6.310	12.422	20.090
E″ @ 25°C, MPa	0.845	1.580	3.672	8.319
E″ @ 100°C, MPa	0.491	0.993	1.880	3.275
E* @ 0°C, MPa	7.990	15.728	28.418	44.780
E* @ 25°C, MPa	5.350	8.967	16.659	27.932
E* @ 100°C, MPa	4.027	6.870	10.726	16.700
Tan delta @ 0°C	0.409	0.438	0.486	0.502
Tan delta @ 25°C	0.160	0.179	0.226	0.312
Tan delta @ 100°C	0.125	0.146	0.178	0.200