DuPont™ Vamac® HVG

Technical Information — Rev. 7, July 2010

Description

DuPont™ Vamac® HVG is an unfilled gum ethylene/acrylic elastomer similar to Vamac® G, but offering higher compound viscosity. The higher viscosity of compounds made with Vamac® HVG results in improved green strength and related processing advantages, such as:

- Improved collapse resistance of extrudates;
- Enhanced preform dimensional stability; and
- Improved moldability through elimination of trapped air.

Compounds of Vamac® HVG are often selected for applications such as compression molded goods, highly plasticized compounds, and extruded tubing and hose.

Vamac® HVG contains a small amount of processing aid and has a nominal specific gravity of 1.04. It has a mild acrylic odor.

Product Properties

Property	Target Value	Method
Mooney Viscosity ML 1'+4' at 100 °C (212 °F)	Nominal 26	ASTM D1646
Volatiles, wt %	≤0.4	Internal DuPont Test
Form, mm (in)	Bale size is nominally: 560 x 370 x 165 (22 x 15 x 7)	Visual inspection
Color	Clear	Visual inspection

Handling Precautions

Because Vamac® HVG contains small amounts of residual methylacrylate monomer, adequate ventilation should be provided during storage, mixing and processing to prevent accumulation of residual vapors or worker exposure to methylacrylate vapor. Additional information may be obtained in the Material Safety Data Sheet (MSDS) and the "Safe Handling and Processing of Vamac® and Vamac® Compounds Guide" available from vamac.dupont.com.

Vamac® HVG compared to Vamac® G

Vamac® HVG is a Vamac® G type polymer with a Mooney Viscosity of 26 compared to 16 for Vamac® G. The two polymers have similar compositions but the Vamac® HVG has a higher molecular weight. They have many common features, including:

- Good heat resistance in air
- Good oil and fluid resistance
- Good low temperature properties
- Compounded with similar ingredients
- Cured with same cure package

The advantage of DuPont™ Vamac® HVG compared to Vamac® G is that the compounds made from the Vamac® HVG have a higher viscosity. The viscosity of the Vamac® HVG compound can be double that of a Vamac® G compound. This can lead to better processing. Specifically, the potential for a collapsed hose is reduced for an extrusion process and the potential for trapped air in an injection molded compound is reduced.

Physical Properties of Compounds of Vamac® HVG and Vamac® G

Table 1 shows the physical properties of compounds made from the two polymers, as well as a 50/50 blend of Vamac® G and Vamac® HVG. The first three compounds contain 60 phr of N550 carbon black. The last three compounds contain 80 phr of N774 carbon black. In both sets of compounds, the compound viscosity increases as the level of Vamac® HVG increases.

Scorch levels also increase with Vamac® HVG, probably due to higher viscosity. The physical properties of the cured compounds are similar.

Table 1 – Compounds made from Vamac® HVG, Vamac® G

Formulation: Polymer and carbon black as shown, and 10 phr TP759, 1.5 phr Stearic Acid, 1.0 phr Vanfre® VAM, 0.5 phr Armeen® 18D, 2.0 phr Naugard® 445, 1.5 phr Diak™ #1, 4 phr DOTG Cure conditions – 5 min. press cure at 175 °C (347 °F) and 4 hr post cure at 175 °C.

	G	HVG	G/HVG	G	HVG	G/HVG
Vamac® G	100		50	100		50
Vamac® HVG		100	50		100	50
Black, N550	60	60	60			
Black, N774				80	80	80
Rheology of Compounds Test Methods: Mooney Viscosity – ASTM D1646; Mooney Scorch – ASTM D1646; MDR, ASTM D5289						
Mooney Viscosity ML (1+4) at 100 °C	33	55	41	28	57	41
Mooney Scorch – 121 °C						
Minimum Viscosity – MU	11.2	23.4	17.2	11.1	25.6	16.9
t10 – metric minutes	14.1	10.5	12.7	13.7	8.3	10.2
t18 – metric minutes	>21	17.6	>21	>21	15.6	16.3
MDR summary at 177 °C, 1° arc						
ML, dNm	0.6	1.3	0.8	0.6	1.1	0.8
ML, lbf-in	0.5	1.1	0.7	0.5	1.0	0.7
MH, dNm	22.0	25.8	23.8	21.5	25.9	23.9
MH, lbf-in	19.3	22.7	20.9	18.9	22.8	21.0
tS2, metric minutes	1.0	0.8	0.9	1.0	0.8	0.9
t50, m minutes	3.0	2.3	2.6	2.9	2.2	2.5
t90, m minutes	13.2	9.7	12.1	11.9	7.0	9.8
Physical Properties After Cure Test Methods: Hardness – ASTM D2240; Tensile, Elongation, Modulus – ASTM D412; Volume Increase – ASTM D471; Compression Set – ASTM D395						
Hardness, Shore A	66	64	64	65	63	62
Modulus at 100% Elongation, MPa	5.1	6.0	5.7	4.8	6.0	5.3
Modulus at 100% Elongation, psi	740	865	825	695	870	775
Tensile Strength, MPa	14.7	16.4	15.8	14.2	16.0	15.8
Tensile Strength, psi	2135	2380	2295	2060	2320	2290
% Elongation	295	275	290	290	255	270
Compression Set – 70 hrs/150 °C	20	16	18	22	16	18

Materials Used in Formulations – General Composition and Supplier

Material	Composition	Supplier
Release Aids		
Armeen® 18D	Octadecyl Amine	Akzo Nobel
Vanfre® VAM	Complex Organic Phosphate ester	R. T. Vanderbilt
Stearic Acid		
Anti-Oxidants		
Naugard® 445	Diphenyl Amine	Uniroyal Chemical
Plasticizers		
TP-759	Mixed Ether/Ester Plasticizer	Rohm & Haas
Palamoil® 654	Polymeric Polyester Plasticizer	BASF
Fillers		
N550, N774	Carbon Black	
Cab-o-sil M7D	Fumed Silica	Cabot Corporation
Curatives		
Diak™ #1	Hexamethylene Diamine Carbamate	DuPont
DOTG	Di-ortho-tolyl Guanidine	

The test methods used in the work are shown below:

Rheology	
Mooney Viscosity	D 1646
Mooney Scorch	D 1646
MDR	D 5289
Physicals	
Hardness	D 2240
Tensile, Elongation, Mod	D 412
Tear, Die C	D 624
Fluid Aging	D 471
Compression Set	D 395
Tg by DSC	D 3418
Aging in Air	D 573
Temperature of Retraction	D 1329

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