DuPont™ Vamac® GXF

Technical Information — Rev. 7, July 2010

Description

DuPont™ Vamac® GXF is a terpolymer of ethylene, methylacrylate, and a cure site monomer cured using an amine-based vulcanization system. Compared with Vamac® G, Vamac® GXF has improved high temperature properties and better dynamic flex fatigue resistance. Vamac® GXF includes a small amount of processing aid, and has a nominal specific gravity of 1.03. It has a mild acrylic odor. Use adequate ventilation during storage, mixing, and processing to prevent accumulation of residual vapors. Storage stability is excellent.

Product Properties

Property	Target Value	Method
Mooney Viscosity ML 1'+4' at 100 °C (212 °F)	17.5	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 5)	Visual inspection
Color	Clear to beige	Visual inspection

Major Performance Properties and Applications

Vamac® GXF is well suited for those applications which need improved high temperature properties or improved dynamic flex fatigue resistance over Vamac® G and can tolerate a slightly longer cure time. Typical applications that would benefit from the improved properties of Vamac® GXF are air ducts, hoses and torsional dampers.

Compounds of Vamac® GXF compared to Vamac® G have longer scorch time for improved processing and slightly higher compression sets. Elongation and properties at elevated temperature are improved resulting in significantly improved dynamic flex fatigue resistance. Heat and fluid aging is similar.

Vamac® GXF is well suited for injection, transfer and compression molding, and is easily extruded.

Handling Precautions

Because Vamac® GXF contains small amounts of residual methylacrylate monomer, adequate ventilation should be provided during mixing and processing to prevent 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.

Compound and Vulcanizate Properties

Compounds of Vamac® are formulated and processed by customers to meet their own specific performance requirements. Many of the highest-performing compounds and vulcanizates of Vamac® are thus proprietary, and cannot be published by DuPont.

DuPont has independently formulated a wide variety of Vamac® compounds for its own short- and long-term properties testing programs. A comparison of the performance differences of typical compounds of Vamac® GXF and Vamac® G is reviewed below, followed by vulcanizate performance test data that can help end users evaluate the potential fitness of similar compounds for their own applications. Data is presented with the elimination of Armeen® 18D from the Vamac® GXF compound to improve the compound cure time t(50).

Table 1 – Sample Compound, Vamac® G vs. GXF
Cure: 5 min. At 190 °C (374 °F) – Post Cure: 4 hr. at 175 °C (347 °F)

Ingredients	Parts	Parts
Vamac® G	100	
Vamac® GXF		100
Antioxidant: Naugard® 445	2	2
Release agent: Stearic acid	1.5	1.5
Release agent: Vanfre® VAM (alkylphosphate)	1	1
Release agent: Armeen® 18 (octadecylamine)	0.5	0.5
SRF black (N772)	45	45
Curative: Diak™ No. 1 (hexamethylene diamine carbamate)	1.5	1.5
Coaccelerator: DOTG (guanidine coagent)	4	4
Total Parts	**155.5**	**155.5**
Stock Properties		
Mooney Viscosity: M-L (1+4) at 100 °C (212 °F), Mooney units	31.9	30.6
Mooney Scorch: MS at 121 °C (250 °F)		
Time to 2-unit rise, min.	7.6	10.1
Time to 5-unit rise, min.	10.5	17.1
MDR, 12 min. at 180 °C (356 °F)		
ML (dNm)	0.23	0.24
MH (dNm)	10.6	9.39
t2 (min)	1.08	1.58
t(10) (min)	0.8	1.0
t(35) (min)	1.55	2.24
t(50) (min)	2.09	3.15
t(90) (min)	5.63	8.03
Stress/Strain and Hardness		
Original Values at 23°C		
100% Modulus, MPa (psi)	2.7 (392)	2.7 (392)
Tensile Strength, MPa (psi)	17.1 (2480)	19.5 (2828)
Elongation at Break, %	367	440
Hardness, “A” Durometer	59	63
Tear Strength, ISO 34 (N/mm)	17.8	21.5
Compression Set, 70 hrs at 150 °C (%)	18.4	27.3

Table 2 – Compounds, DuPont™ Vamac® G vs. GXF without Armeen® 18D
Cure: 5 min. At 190 °C (374 °F) – Post Cure: 4 hr. at 175 °C (347 °F)

Ingredients	**Parts**	**Parts**
Vamac® G	100	
Vamac® GXF		100
Antioxidant: Naugard® 445	2	2
Release agent: Stearic acid	1.5	1.5
Release agent: Vanfre® VAM (alkylphosphate)	1	1
Release agent: Armeen® 18 (octadecylamine)	0.5	
FEF black (N550)	50	50
Curative: Diak™ No. 1 (hexamethylene diamine carbamate)	1.5	1.5
Coaccelerator: DOTG (guanidine coagent)	4	4
Total Parts	**160.5**	**160.0**
Stock Properties		
Mooney Viscosity: M-L (1+4) at 100 °C (212 °F), Mooney units	45.2	50.0
Mooney Scorch: MS at 121 °C (250 °F)		
Time to 5-unit rise, min.	8.3	11.17
Ingredients	Parts	Parts
MDR, 12 min. at 190 °C (374 °F)		
ML (dNm)	0.34	0.42
MH (dNm)	13.24	12.98
t2 (min)	0.64	0.82
t(50) (min)	1.29	1.92
t(90) (min)	3.70	4.97
Stress/Strain and Hardness		
Original Values at 23 °C		
100% Modulus, MPa (psi)	5.0 (725)	5.1 (740)
Tensile Strength, MPa (psi)	17.8 (2582)	17.3 (2509)
Elongation at Break, %	305	349
Hardness, “A” Durometer	67	71
Tear Strength, ISO 34 (N/mm)	25.0	30.6
Compression Set, 70 hrs at 150°C (%)	21.2	26.8
Tg by DSC (°C)	–26.5	–27.2

Note: The data shown here for these sample compounds of Vamac® fall within the normal range of compound properties, but they should not be used to establish specification limits, nor used alone as the basis for predicting performance under end-use conditions. Additional test data for this and other compounds of Vamac® are available from DuPont on request.

Figure 1 – Tensile Properties at 150 °C – DuPont™ Vamac® G vs. GXF without Armeen® 18D

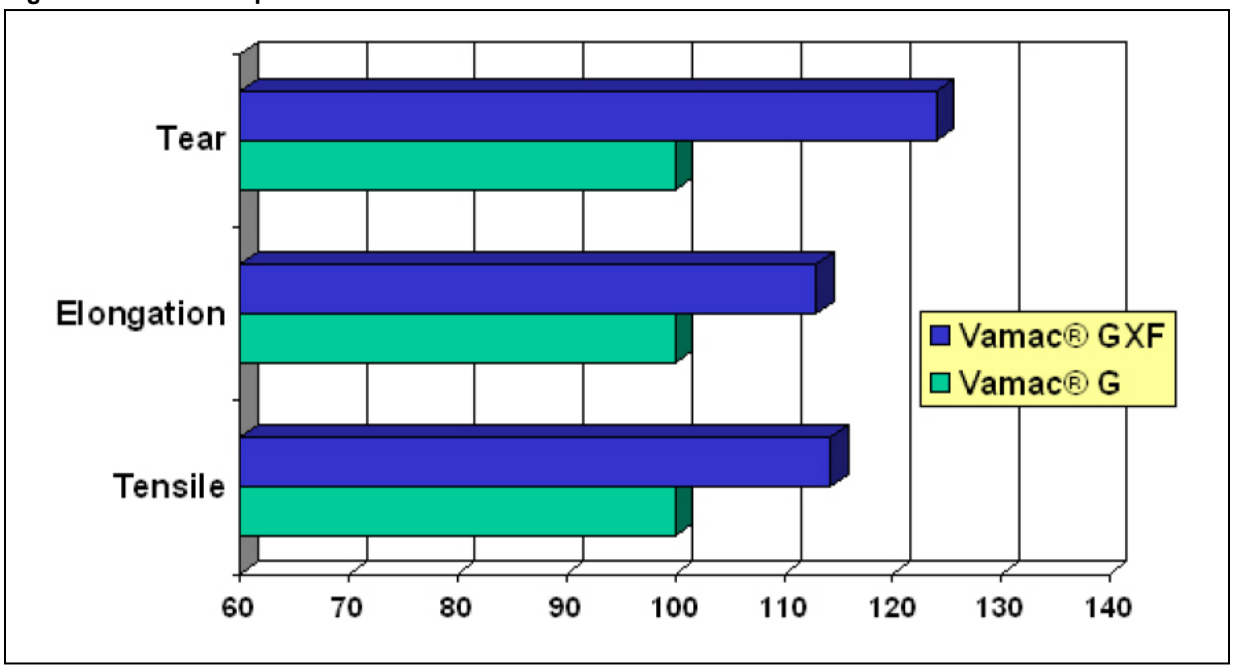


Figure 2 – DeMattia Dynamic Fatigue (ASTM D430) – Vamac® G vs. GXF without Armeen® 18D

Relative cycles to failure, avg. from 3 slabs (not pierced), three different test temperatures, test at RT without any failure, stopped after 600,000 cycles

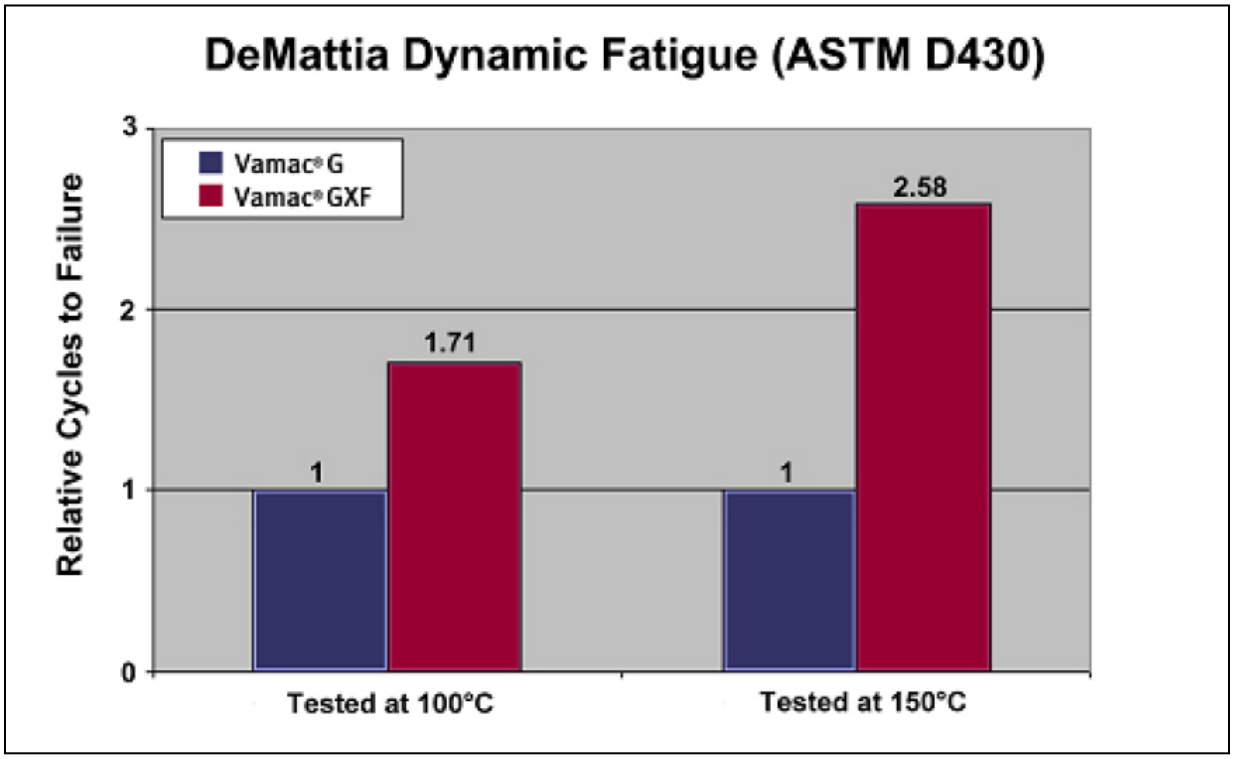
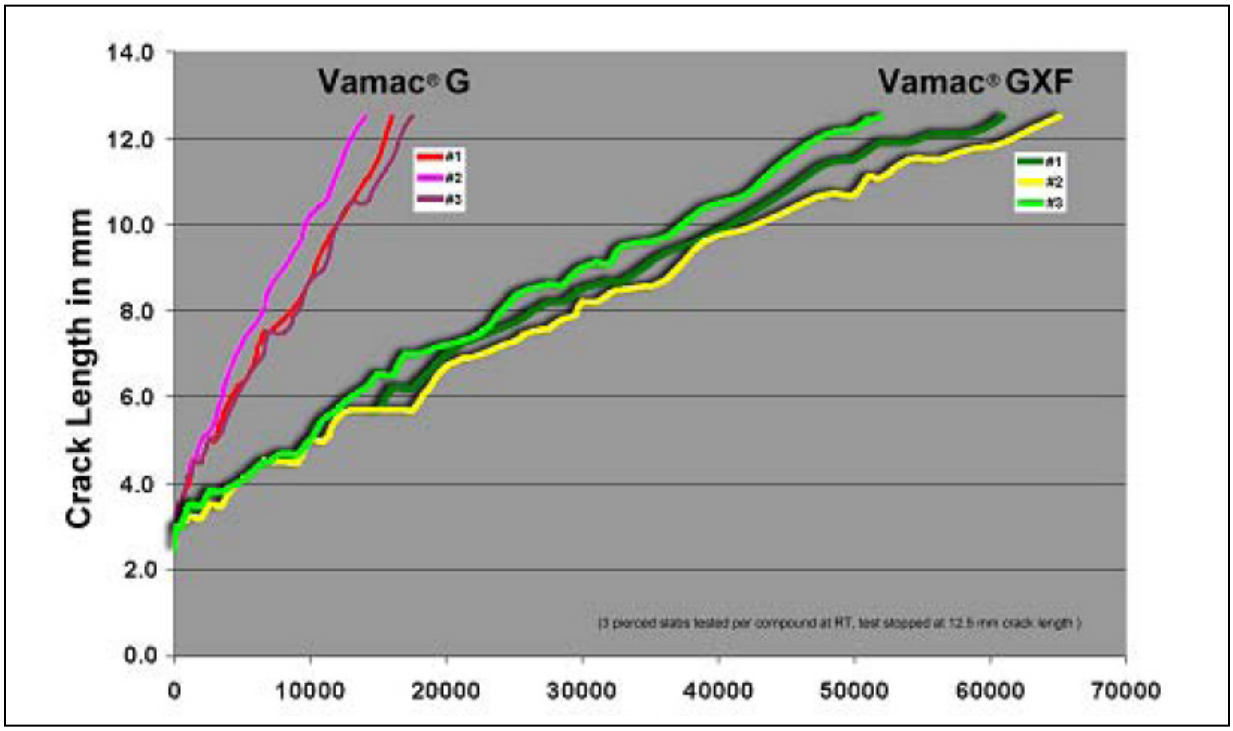


Figure 3 – DeMattia Crack Growth (ASTM D813)

(3 pierced slabs tested per compound at RT, test stopped at 12.5 mm crack length)



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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