

# DuPont™ Vamac®

## Ethylene Acrylic Elastomer for Wire and Cable Applications

### VAMAC® - WHAT IS IT?

DuPont™ Vamac® ethylene acrylic elastomers (AEM) have been successfully used for many years in the transportation sector where superior material performance is required.

Cured Vamac® compounds offer excellent heat and fluid resistance while maintaining very good low temperature flexibility.

Target market for Vamac® wire and cable application are in the automotive, building, and railway industry where high safety requirement regarding smoke density and toxicity are critical.



### VAMAC® - ULTRA GRADES

The latest manufacturing technology has led to the introduction of the Vamac® Ultra grades which offer significant improvement in terms of processability and performance compared to the existing standard Vamac® grades.

Higher viscosity is the major difference between the Vamac® standard grades and the Vamac® Ultra family.

Vamac® DP and Vamac® Ultra DX (VMX2122) are peroxide curable Dipolymers and the first choice for wire and cable applications where fire safety and low compound toxicity is critical. Both grades can be compounded with high amounts of flame retardant fillers without negatively impacting compound viscosity like often seen with Vamac® Terpolymers.

### VAMAC® - HFFR FORMULATION

Typical non-halogenated flame retardant fillers like aluminium or magnesium hydroxide (ATH, Mg(OH)<sub>2</sub>) are used with Vamac® Dipolymer to achieve flame resistance, low smoke density, and low toxicity performance required by the railway industry.

A standard halogen free flame retardant (HFFR) starting point formulation based on Vamac® Dipolymers is shown in Table 1.

TABLE 1: HFFR STARTING POINT FORMULATION WITH VAMAC® DIPOLYMERS

Formulation	phr	Description
Vamac® DP/Ultra DX	100	Polymer
Armeen® 18D	0,5	Process aid
Stearic Acid	1	Process aid
Naugard® 445	1	Antioxidant
Martinal® OL 111 LE	150	ATH
Silanogran® HVS	2	Silane coupling agent
Ofalub® SEO	1	Process aid
Luperox® 101 XL 45	5	Peroxide
Vulcofac® 13 PDM	2	Co-agent

*phr: parts per hundred rubber*

Some basic properties of Vamac® DP and Vamac® Ultra DX compounds are shown in Table 2 highlighting the improved physical properties of the Ultra grade.

TABLE 2: COMPARISON OF VAMAC® DP AND ULTRA DX IN A HFFR FORMULATION

Property	DP	Ultra DX
Polymer Mooney ML(1+4) 100°C	22.0	27.5
Compound Mooney ML(1+4) 100°C	40.5	51.0
Tensile Strength [MPa]	9.8	11.5
Elongation at Break [%]	261	267
Trouser Tear Die A [N/mm]	5.5	6.5
Tg by DSC [°C]	-28.6	-27.8

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## for Wire and Cable Application

### VAMAC® - FIRE SAFETY

Vamac® base polymers are not inherently resistant to burning and have a Limited Oxygen Index (LOI) of ~21%. However, in compounds with flame retardant fillers like ATH (e.g. 150 phr), the LOI is increased to >35% and the UL-94 V0 protocol is easily passed.

Vamac® HFFR compounds are frequently blended with thermoplastic polymers, partly to reduce cost but also to improve processing and physical properties. Suitable thermoplastic resins include Elvax® and Hytrel® and these offer further compounding options to obtain materials with excellent heat and chemical resistance, low temperature flexibility and low fire hazard properties.



Additional critical fire and toxicity data of a HFFR Vamac® Ultra DX based compound as well as of a 70/30 phr blend with Hytrel® 4056 are shown in Table 3 and highlight the attractive material performance of Vamac® compounds as possible low smoke free zero halogen (LSOHF) compounds.

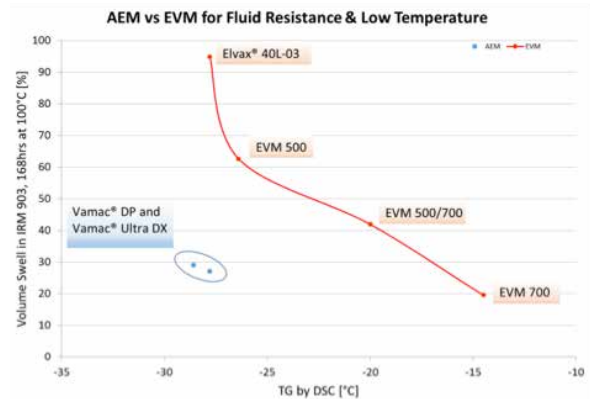
TABLE 3: VAMAC® ULTRA DX AND HYTREL® BLEND: HFFR LOW SMOKE LOW TOXICITY DATA

	Vamac® Ultra DX	Ultra DX/Hytrel®
<b>LOW TEMPERATURE FLEXIBILITY</b>		
TG by DSC [°C]	-26	-27
<b>FIRE SAFETY</b>		
LOI [%]	37	37
Dsmax	20	21
VOF <sub>4</sub>	7	7
CIT EN 45545-2	0,11	0,06

### COMPARISON AEM VS EVM

Besides excellent heat resistance Vamac® HFFR compounds show low swell in oils, e.g. IRM 903, while maintaining superior low temperature flexibility.

GRAPH 1: COMPARISON OIL SWELL AND TG OF AEM VS EVM



Vamac® compounds will have a ca. 10°C lower Tg at a comparable oil swell to EVM and a ~20-30% better oil resistance at the same Tg as EVM.

### VAMAC® BENEFITS SUMMARY

- **Safety & Environment:** Halogen Free Flame Retardant (HFFR), low smoke and toxicity compounds
- **Broad Temperature Range:** -40°C to 160°C
- **Excellent Chemical Resistance:** engine oils, transmission fluids, power steering fluids
- **Thinner wall cable construction:** Lower weight and maintains good flexibility at very low temperature

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