DuPont™ Vamac® Ultra XF (formerly VMX3041)

Ethylene Acrylic Elastomer (AEM) with Intermediate Viscosity for Optimized Extrusion Process and Cost Optimized Formulating

Vamac® Ultra XF - What is it?

DuPont™ Vamac® ethylene acrylic elastomers (AEM) have been successfully used for many years in extruded hoses.
For dynamic hose applications such as Turbo Charger Hoses / TCH) which do not need best Compression Set, slow curing polymers with best scorch resistance have been introduced to the market. The grades widely used are Vamac® GXF (17.5 Mooney, introduced 2003), Vamac® Ultra HT (29 Mooney, 2009) and its high MA version Ultra HT-OR (31 Mooney, 2011) for lower volume swell in oils. The Ultra grades provide best physical properties such as Elongation at Break or Tensile Strength at high temperature and therefore best dynamic flex fatigue for AEM's typical range of application up to 160°C continuous temperature with peaks up to 180°C.

Typical TCH made from Vamac® GXF have been produced in 70-75 Shore A Hardness compounds. The higher viscosity grades Ultra HT and HT-OR provide better physical properties and better Compression Set resistance, and thus may be used at even higher temperatures. However, as these higher temperatures do not always allow the use of significant amounts of plasticizer, the compound viscosity of compounds based on Ultra HT and HT-OR sometimes leads to very high pressures during the extrusion of 70 Shore A compounds. For that reason, Ultra HT and HT-OR are often compounded at lower Hardness levels between 60 and 65 Shore A. This does not allow the addition of as much fillers as can be used for 70 Shore A, and therefore total compound cost of the Ultra HT or HT-OR based compounds was higher than for Vamac® GXF based compounds.

As customers do not want to use polymer blends in dynamic applications, Vamac® Ultra XF was developed, allowing for extrusion of 70-75 Shore A compounds which still have superior green strength and physical properties compared to Vamac® GXF.

Vamac® Extrusion Grades for Best Dynamic Flex Fatigue

Grade	ML (1+4), 100°C	Tg by DSC °C	Density, g/cc
Vamac® GXF	17,5	-30	1.03
Vamac® Ultra HT	29	-30	1.03
Vamac® Ultra HT-OR	31	-24	1.05
Vamac® Ultra XF	23	-30	1.03

Table 1: AEM Extrusion Grades for Best Dynamic Flex Fatigue

Compound Comparison

Table 2 shows some standard recipes based on Vamac® GXF, Ultra HT and Ultra XF with different FEF N-550 Carbon Black levels. Hardness varies between 60 and 75 Shore A, Tensile Strength, Elongation at Break and Compression Set improve as viscosity and molecular weight increases.

Formulation	GXF	U HT 50 FEF	U HT 60 FEF	U XF 50 FEF	U XF 60 FEF	U XF 70 FEF
Vamac® GXF	100					
Vamac® Ultra HT		100	100			
Vamac® Ultra XF				100	100	100
FEF black, N-550	60	50	60	50	60	70
Platicizer	10	10	10	10	10	10
DPA Antioxidant	2	2	2	2	2	2
Process Aids	2	2	2	2	2	2
DBU (55%)	2	2	2	2	2	2
HMDC Curative	1.1	1.1	1.1	1.1	1.1	1.1
Hardness (Sh A)	71	64	70	61	71	75
Tensile Strength (MPa)	16.5	18.9	18.3	17.6	17.8	16.2
Elongation at Break (%)	310	400	330	400	330	270
Cset, ISO815-1, B, 70 h / 150°C (%)	30	24	25	28	28	29

Table 2: Formulations and Physical Properties of Test Compounds

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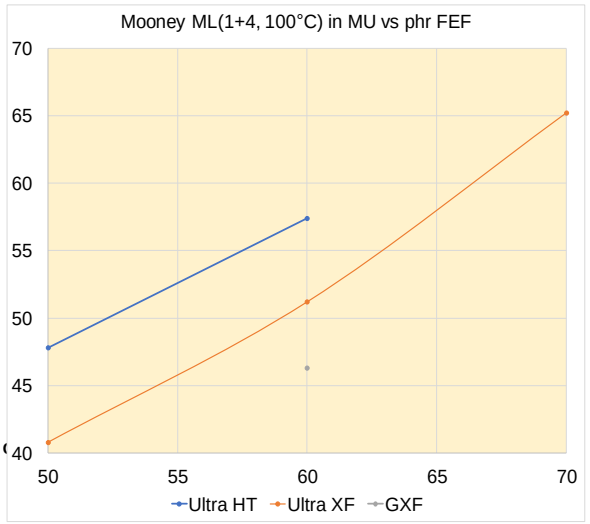
Compound Mooney Comparison

Mooney viscosity depends on the choice of polymer and filler level. When switching from Vamac® Ultra HT to Ultra XF, Mooney drops by about 6-7 MU. On the other side, Ultra XF can be filled with roughly 7 to 8 phr more FEF N-550 to reach the same Mooney viscosity like Ultra XF. Thus, Vamac® Ultra XF can provide cost savings by higher filler loadings.



Graph 1: Mooney Viscosity (ML1+4, 100°C) vs N-550 loading

Vamac® GXF provides even lower Mooney. This may help when GXF is used as base polymer for hose cover layers, to get good compound flow and good interlayer adhesion.

Vamac® Ultra XF Summary

- ❑ **Allows higher filler loading than Vamac® Ultra HT**
  - still possible to extrude at higher hardness
- ❑ **Provides better green strength than Vamac® GXF**

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