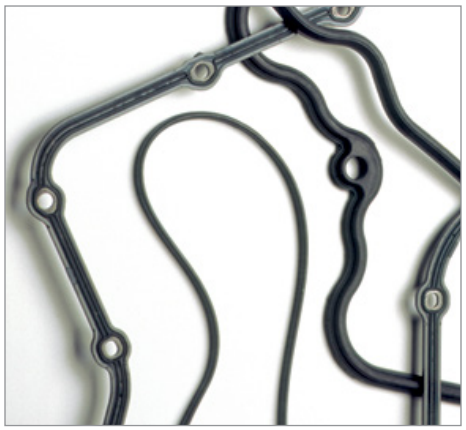
SOLUTION SHOWCASE

Celanese

CELANESE VAMAC® ELASTOMER (AEM) – THE PERFECT FIT FOR SEALS, DUCTS, AND WIRE & CABLE APPLICATIONS IN E-MOBILITY



KEY PROPERTIES OF VAMAC® AEM

- Temperature range: - 40 °C to +175 °C (and up to +190 °C for VMX5000 series)
- Very good resistance to new fluids for electric vehicles
- Good resistance to water-based coolants
- Outstanding ozone/weather resistance
- Excellent compression set and compressive stress relaxation resistance (CSR)
- Good flex fatigue resistance
- Vibration damping consistency
- Halogen-free, non-toxic, and low-smoke density emissions
- Excellent bonding to metal and other substrates
- Insulating or conductive compounds
- Electrical & Electronics Friendly

Celanese Vamac® ethylene acrylic elastomers (AEM) can be made into cured compounds that have excellent resistance to high temperatures, and good resistance to automotive fluids such as transmission fluids, engine oils, coolants, acidic condensates, urea solution, greases, and new E-fluids.

LOW-TEMPERATURE PERFORMANCE

The low-temperature performance of Vamac® AEM surpasses that of most other heat- and oil-resistant polymers. Typical compounds meet OEM specifications for performance at –40 °C. Vamac® AEM compounds can be designed to meet end-use requirements as low as –50 °C.

RESISTANCE TO FLUIDS

End products based on Vamac® AEM have excellent resistance to hot oils and hydrocarbon- or glycol-based lubricants, transmission fluids, and power steering fluids. Low oil swell can be obtained with proper Vamac® AEM grade selection and compounding. Vamac® AEM shows good retention of properties and low permeation in new fluids for E-mobility (E-motor, E-transmission, power electronics) and with dielectric fluids used to cool batteries.

Vamac® AEM is not recommended for use in components immersed in gasoline, esters or highly aromatic fluids.

Vamac® AEM can be compounded without plasticizer and with very low levels of volatile ingredients that could possibly be washed out by fluids used in EVs.

Performance Property	Typical Range
100% Modulus[1], MPa	2 to 10
Tensile Strength[1], MPa	7 to >20
Elongation[1], %	100 to 600
Hardness[2], Durometer Shore A	40 to 90
Tear Strength[3], N/mm	15 to 45
Compression Set[4], % (168h at 150 °C, 25% compressed)	15 to 30

[1] ASTM D412, [2] ASTM D2240, [3] ASTM D624 (Die C), [4] ASTM D395 (Method B)

EXCELLENT NVH VIBRATION DAMPING

The high vibrational damping characteristic of Vamac® AEM compounds remains nearly constant over broad ranges of temperature, frequency, and amplitude.

NHFR COMPOUNDS

Vamac® AEM is not inherently resistant to burning. However, when properly compounded with non-halogenated flame retardants (NHFR), a Vamac® AEM compound will pass the demanding UL-94 V0 protocol. These Vamac® AEM NHFR compounds exhibit a combination of good oil resistance, good heat resistance, and good low-temperature properties and can be used for sealing elements, tubes, hoses, flooring, and wire & cable applications such as Automotive T4 150 °C continuous class temperature.

HIGH-TEMPERATURE DURABILITY

Parts made with Vamac® AEM retain elasticity and remain functional after continuous air oven exposures. Conventional filled Vamac® AEM compounds can meet heat requirements of six weeks (1,000 h) at 165 °C, 18 months (13,000 h) at 121 °C or five days (120 h) at 204 °C. VMX5000 series pre-compounds provide superior high-temperature performance (up to six weeks at 180 °C, and three weeks at 190 °C).

COMPRESSIVE STRESS RELAXATION

Vamac® AEM compounds perform exceptionally well in seal and gasket applications and have good CSR performance in oils up to 5,000 hours at 150 °C. VMX5000 series pre-compounds provide a step change for CSR (in hot air) sealing force retention at +15 to 20 °C higher temperature than conventional filled Vamac® AEM.

SELECT CELANESE VAMAC® AEM FOR SEALS, GASKETS, TUBES, HOSES, AND WIRE & CABLE APPLICATIONS

GRADE SELECTION CRITERIA:

BASIC HEAT AND OIL SWELL CHARACTERISTICS

Compounds based on the Vamac® AEM G family (Vamac® AEM G, GXF, Ultra IP, and Ultra HT) and the Vamac® AEM dipolymers (DP and Ultra DX) typically exhibit IRM903 oil swell of 40–60%. Appropriately compounded, Vamac® AEM can withstand three weeks of continuous use at 175 °C, retaining 50% of initial elongation. Compounds based on the Vamac® AEM G family are generally rated as EE or EF by ASTM D2000/SAE J200.

REDUCED OIL SWELL

For reduced oil swell, compounds based on the Vamac® AEM GLS family (GLS, Ultra LS, Ultra HT-OR, VMX3123) exhibit about one half the IRM903 oil swell of its G counterpart. The improved oil swell of Vamac® AEM GLS results in tradeoff of low-temperature flexibility (7 °C Tg increase). Compounds based on the Vamac® AEM GLS family are rated as EG and EH by ASTM D2000.

EXTRUSION

Vamac® AEM GXF was designed for the demanding requirements of turbo charger hose, having improved physical properties, and dynamic fatigue resistance compared to Vamac® AEM G. Compounds of Vamac® AEM GXF demonstrate improved extrudability with lower head pressure, and less scorch, resulting in hose with smoother surface appearance.

Vamac® AEM Ultra HT and Ultra HT-OR compounds have the best combination of processability, compression set, and dynamic properties for high-temperature hoses. The Ultra HT-OR compounds have lower volume swell in fluids while the Ultra HT compounds have better low- temperature properties.

Vamac® AEM Ultra XF and VMX3123 offer intermediate viscosity between Vamac® AEM GXF and Ultra HT, respectively between Vamac® AEM GLS and Ultra HT-OR, allowing an excellent combination of good extrusion at moderate extruder head pressure of Shore 70A compounds and good green strength.

MOLDING

Vamac® AEM Ultra IP and Ultra LS compounds can vastly improve productivity in the rubber molding process through reduced mold fouling, scrap, improved hot tear resistance, and cycle time compared with the standard Vamac® AEM G compounds. With higher viscosity, Vamac® AEM Ultra IP provides superior compound dispersion with a one pass mix. Vamac® AEM compound can be processed via 2K rubber plastic molding technology.

LOW-TEMPERATURE PERFORMANCE

The combination of Vamac® AEM Ultra LT and a low volatility plasticizer can be used to make compounds with a Tg of –50 °C. These compounds can be used in automotive hoses and tubes as well as in damping elements where functional performance is required throughout a thermal range as wide as –50 °C to 160 °C. Ultra LT can also be chosen to improve low-temperature properties of compounds when a plasticizer shall not be used, to avoid negative impacts on fluids in contact with seals or other rubber parts.

BRIGHT/COLORED COMPOUNDS

Vamac® AEM Ultra & VMX5000 series allow fabrication of bright/colored molded parts with good mechanical properties and processing performance. Celanese can provide starting formulation/recipe.

CURING METHOD

Most grades of Vamac® AEM are curable with diamine and require a post cure for the best properties. If a post-cure step is impractical or undesirable, Vamac® AEM DP or Vamac® AEM Ultra DX peroxide-cured dipolymers can be used.

Vamac® AEM invites opportunities to help you formulate compounds to meet specific processing needs.

CELANESE VAMAC® AEM GRADES

Grade	ML (1+4) at 100 °C	Tg (by DSC) °C[1]	Key Feature
Vamac® AEM G	16.5	-30	General purpose
Vamac® AEM GXF	17.5	-30	Dynamic fatigue resistance
Vamac® AEM GLS	18.5	-23	Low oil swell
Vamac® AEM Ultra IP	29	-30	Improved performance grade for molding & extrusion
Vamac® AEM Ultra XF	23	-30	Intermediate viscosity
Vamac® AEM Ultra HT	29	-30	High temperature
Vamac® AEM Ultra LS	33	-23	High viscosity / Low oil swell
VMX3123	24	-25	Intermediate viscosity, low swell extrusion grade
Vamac® AEM Ultra HT-OR	31	-24	High temperature / Oil resistance
Vamac® AEM Ultra LT	12	-42	Low temperature
Vamac® AEM DP	22	-29	Peroxide curable dipolymer
Vamac® AEM Ultra DX	28	-29	Improved processing peroxide curable dipolymer

CELANESE VAMAC® AEM PRE-COMPOUNDS FOR HIGH HEAT RESISTANCE

Grade	ML (1+4) at 100 °C	Tg (by DSC) °C[1]	Key Feature
VMX5015	67	-30	Compression molding pre-compound[2]
VMX5020	53	-30	Injection molding pre-compound[2]

[1] Tg of compounds with Vamac® AEM may be extended typically -10 °C lower with addition of plasticizer.
[2] Not suitable for steam autoclave cure.

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