Product Sheet

Achieve High-Performance Flame Resistance in EV Electrical Components

Transforming the world's fleet to electric vehicles (EVs) is only possible with components that withstand highly demanding automotive conditions the way DuPont™ Vamac® and DuPont™ Zytel® materials do. The proven flame-resistance of Vamac® ethylene acrylic elastomers makes them ideal for EV applications where thermal runaway creates a risk of fire. Vamac® used in combination with Zytel® provides excellent sealing solutions too.

Vamac® Compounds for Flame Resistance

While Vamac® is not inherently resistant to burning, when properly compounded with non-halogenated flame retardants (NHFR), a Vamac® compound will pass the demanding UL-94 V0 protocol.

Vamac® compounds are an excellent choice for:

- Sealing elements
- Tubes
- Hoses
- Flooring
- Wire and cable applications

Electrical Friendly Vamac® Compounds

Vamac® can be compounded for high conductivity, using conductive fillers like carbon black or carbon nanotubes. With use of inorganic fillers, Vamac® can be compounded to achieve high electrical resistivity. Through customization of fillers, it's possible to reach CTI values of 600V while maintaining excellent sealing properties. Compound composition determines the final performance of electrical properties.

Cable jackets manufactured with Vamac® compounds using inorganic flame retarders like Al(OH)3 or Mg(OH)2 are known for their excellent heat and oil resistance, as well as their outstanding low level of fume density and fume toxicity in the case of fire. In fact, Vamac meets the standards of leading OEMs for flame retardance to keep passengers out of the danger zone.

Vamac® is highly valued for its excellent resistance to high temperatures and its good resistance to automotive fluids—including new E-fluids, transmission fluids, engine oils, water-based coolants, acidic condensates, urea solution, and greases.

Plus, Vamac® performs under extreme temperature conditions that range from -40°C to +175°C (and up to +190°C for VMX500 series), provides outstanding ozone/weather resistance, and offers excellent compression set and compressive stress relaxation resistance (CSR).

Vamac® Performance Properties	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)

Source: DuPont

Ideal for Plastic BEV Parts

The latest OEM requirements for low toxicity of fumes in the case of fire have led to a clear trend of replacing standard FR plastics with non-halogenated flame retarders. Vamac® is ideal for plastic BEV parts like connectors, housings, or busbars that must be flame retardant.

Vamac®: An Alternative to Liquid Silicone Rubber

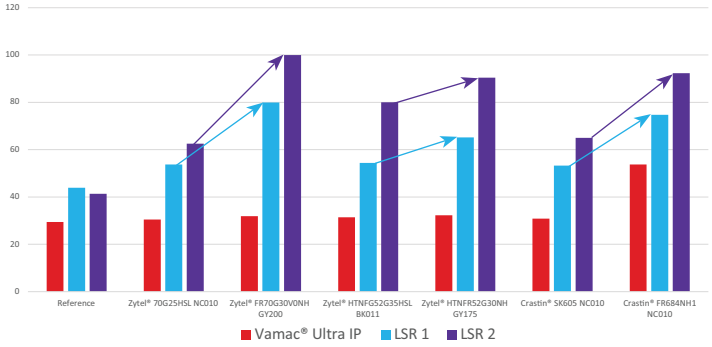
While silicone rubber (LSR or HCR) has been established as a primary sealing material for busbars and electrical connectors, and good material for inverter and battery housing seals, Vamac® proves to be a superior alternative.

A study conducted in our lab provides clear evidence that Vamac® offers better compression set performance with resistance to halogen-free flame-retarded plastics.

Generally, flame retarding, halogen-free additives used in plastics show a significant negative impact on compression set performance of LSR and therefore on LSR's long-term sealing performance. Vamac® solves this problem and serves as an excellent sealing material for high-temperature seals with good oil-, water-, and glycol- resistance.

Vamac® meets UL 94 safety standards for V-O classification. Vamac® is also compatible with plastics containing halogen-free flame retardants, avoiding the formation of highly toxic acids like HBr in the case of fire.

Compression set (in %) 168 hours at 175°C



Arrows shown on chart indicate the increase in compression set from contact to FR NH plastics. Detailed technical documentation available; ask your DuPont representative.

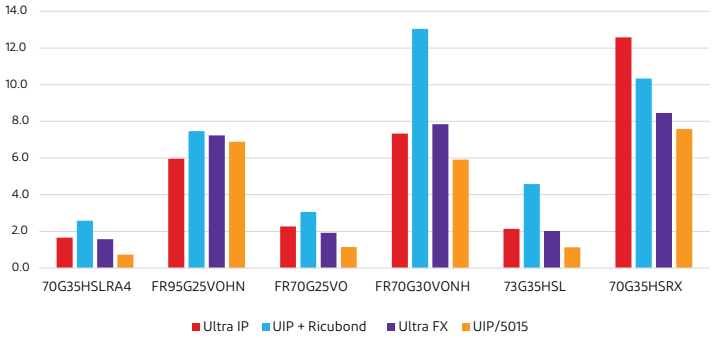
Source: DuPont

Vamac® High Performance Sealing When Used With Dupont™ Zytel®

In many 2K applications, Vamac® compounds are used for soft sealing and connecting parts in combination with polyamides. DuPont's PA66 type Zytel® 70GF35 HSRX grade provides the best adhesion to AEM and is a preferred solution for PA/AEM 2K applications. It provides better adhesion compared to the standard PA66 grade Zytel® 70HSLRA4, which is used in many applications such as air intake manifolds, cam covers, and oil pans.

During the development of new flame retardant, halogen-free Zytel® grades, DuPont tested adhesion between different polyamides and four different AEM compounds. The AEM compounds used were based on different polymers that would fully meet requirements for seals and hoses. The different polyamides allowed comparison of adhesion levels compared to Zytel® HSLR and HSRX, and to a standard PA6 grade, Zytel® 72G35HSL, which already showed better adhesion than Zytel® 70G35HSLR. Both flame-retardant, halogen-free PA66 and PA666 grades FR70G30V0NH and FR95G25V0NH show excellent adhesion to Vamac®, comparable to adhesion levels of Zytel® HSRX.

Zytel® Peel Adhesion, N/mm



Source: DuPont

The Versatility of Vamac®

The Vamac® portfolio includes multiple grades and pre-compounds that help EV manufacturers meet performance standards for:

- Flex fatigue resistance
- Vibration and noise damping
- Bonding to metal and other substrates such as polyamide
- Electrical insulation and conductivity
- Swell and permeation resistance to EV fluids

For more information, contact your DuPont representative.

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