



SOLVAY

asking more from chemistry®

High-Performance Polymers for
Wire & Cable

**SPECIALTY
POLYMERS**



A Reliable Partner for All Your Needs

Application Matrix

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Hyflon® PFA and MFA® foam

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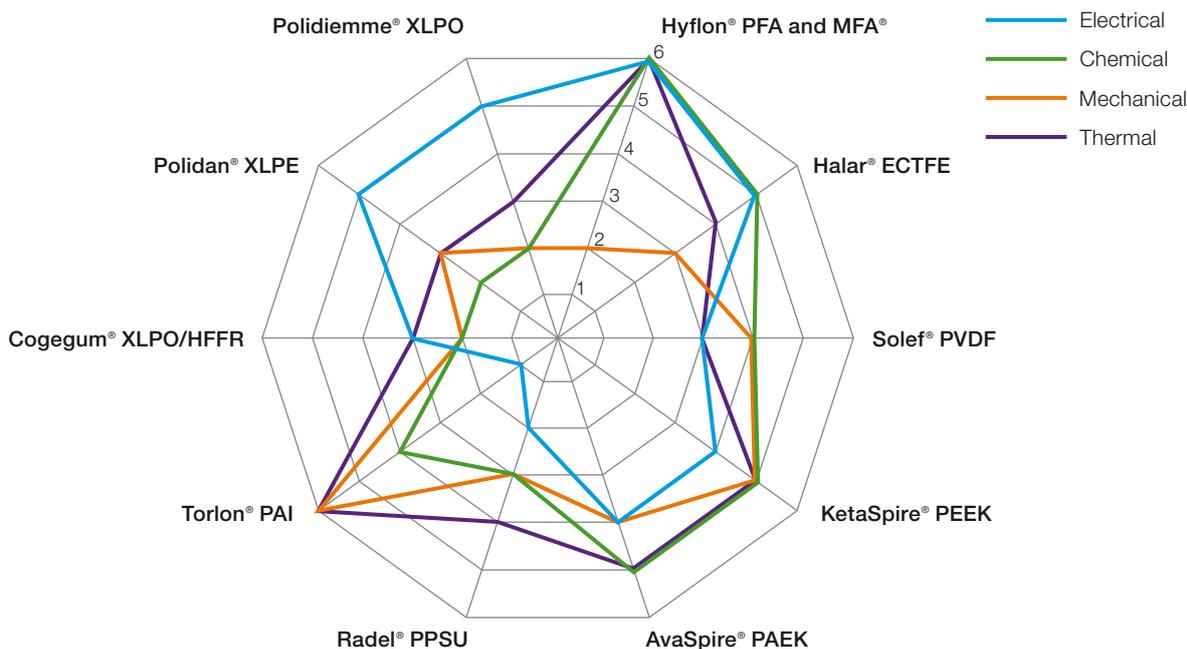
Solvay Specialty Polymers is a leader in the research, development and manufacturing of high-performance polymers, which are designed to withstand the most challenging requirements of the Wire & Cable industry.

Our broad product portfolio includes Fluoropolymers, Ultra Polymers, Sulfone Polymers and Cross-Linkable Compounds, among others. Each of these families include products that offer a unique combination of properties, making them the ideal materials of choice for power and signal cables, special applications, telecom, data and LAN cables.

Fluoropolymers feature unsurpassed electrical and thermal properties among all the families, making them the natural choice for cable designers.

Cross-Linkable Compounds are the ideal solution when manufacturers look for materials requiring a broad range of end-use temperatures, chemical and fire resistance, plus long-lasting performance in severe conditions.

The Ultra Polymers and Sulfone Polymers are the best materials when mechanical properties are critical, being the first choice for many advanced wire and cable constructions used in Aerospace, Oil & Gas, Automotive, Nuclear and Mass Transit applications.



Application Matrix

	PFA	MFA®	PVDF	ECTFE	PTFE	XLPO- HFFR	PEX	XLPO	PEEK	PAEK	PPSU	PAI
Communication cables												
Telecom/Data/LAN		●	●	●	●	●	●					
Fibre optic			●			●						
Special cables												
Defence	●	●	●	●		●		●	●	●		
Nuclear				●					●	●		
Rail						●		●	●	●		
Automotive	●	●	●	●	●		●				●	
Aerospace	●			●	●				●	●	●	
Magnet wire		●							●	●	●	●
Off-shore	●	●	●	●		●			●	●		
Cathodic protection			●	●			●	●				
Photovoltaic						●		●				
Consumer electronics		●		●		●					●	
Heating cables	●		●	●		●	●	●			●	
Power cables						●	●	●				
Appliance wire	●		●	●				●			●	
Signal cables		●				●	●	●				



Hyflon® PFA and MFA®

Hyflon® PFA and MFA® resins are a unique family of semi-crystalline melt processable perfluoropolymers combining exceptional properties such:

- Retention of mechanical properties from –200°C to 260°C
- Universal chemical resistance
- Exceptional thermal stress-crack resistance
- Excellent electrical properties
- Outstanding fire resistance (NFPA 90A)
- Intrinsic UV resistance
- High flex life

The Hyflon® PFA range consists of two product series: the P series and the M series. Both can be used in Wire & Cable specialty applications as primary insulation, such as high-temperature hook-up wires or heating cables.

Hyflon® MFA® Technology

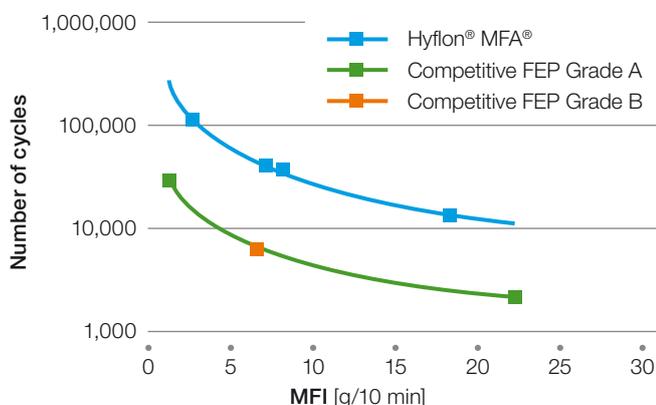
Hyflon® MFA® is a low temperature PFA type (according to ASTM D3307) produced using Solvay Specialty Polymers' proprietary MFA® technology; this grants exceptional properties to the material such as thermo-mechanical properties up to 225 °C and intrinsic thermal stress-cracking resistance, making it suitable for highly demanding wiring systems.

Hyflon® MFA® Outperforms FEP

Hyflon® MFA® is able to provide a very competitive cost/performance ratio versus FEP; in particular MFA® resins are well-suited to meet industry requirements for tough, flexible automotive wiring. According to ISO6722/LV112, standard MFA® is able to pass Class F and G requirements for thermal and stress-cracking resistance.

Flex life test

[0.3 mm, 90 cycles/min]



Hyflon® MFA® 1041 for Thin-Wall Primary Insulation

Hyflon® MFA® 1041 is a high melt-flow rate resin specifically designed for primary insulation.

In particular, thanks to its combination of outstanding electrical properties, flame and thermal resistance, Hyflon® MFA® 1041 resin is the material of choice for the high-speed extrusion of insulation for plenum rated LAN, thin-walled cables and automotive wiring systems.

Hyflon® PFA and MFA® Foam

Hyflon® PFA and MFA® physically foamed compounds offer extremely low attenuation properties and can be used for high-performance coaxial cables, superior cross-webs, and primary insulation for shielded twisted pairs. Typical foaming levels of 50–60 % can be achieved with closed cell voids.

Hyflon® PFA and MFA® typical applications include:

- Telecom cables
- Heating cables
- Avionics and military
- Automotive
- Magnet wire/winding wire
- Consumer electronics
- Appliances
- Sensor cables
- Downhole cables



Photo courtesy of Pentair Thermal Management LLC

Halar® ECTFE

Halar® ECTFE partially fluorinated resins combine high electrical properties and abrasion resistance over a broad range of temperatures, together with a very good chemical resistance to a wide variety of acids, bases, and organic solvents.

Halar® ECTFE typical properties:

- Continuous service from -60°C to 150°C
- High electrical properties
- Very good abrasion resistance
- High performance under radiation
- Excellent fire resistance performance
- Good chemical resistance

Halar® ECTFE grades can be used for jacketing, thin- and very-thin wall applications for high line speeds telecommunication, signal cables, coaxial and other applications requiring excellent weatherability and/or chemical resistance.

Halar® XPH 800 ECTFE for High Thermal Stress-Crack Resistance

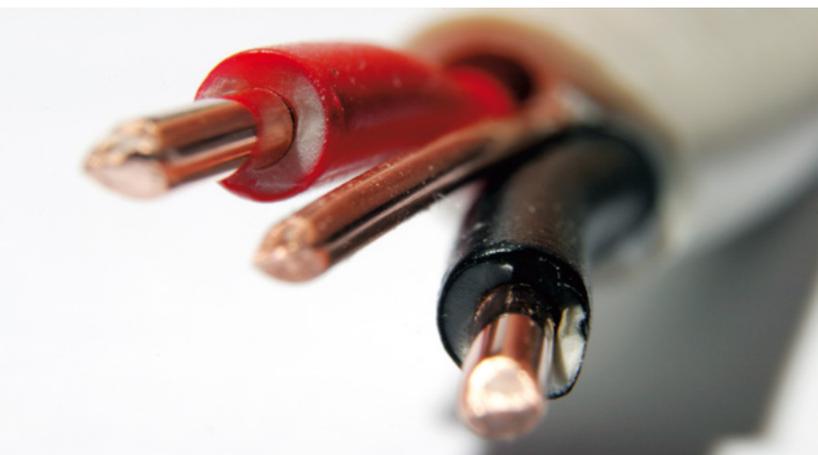
Thanks to Solvay Specialty Polymers' patented polymerization technology, Halar® XPH 800 presents itself as a unique extrusion grade specifically designed for improved thermal stress crack resistance, elevated temperature rating and excellent processability. According to the automotive cabling standard ISO 6722/LV112, Halar® XPH 800 attains a class D rating (150°C continuous service temperature).

Halar® ECTFE Foam

Halar® 558 ECTFE foamed compound can be used for cross-webs and coaxial cable core insulation. It is a completely pre-compounded chemically foamed grade which provides similar performance to FEP with an even lower dielectric constant. Where reduction cost and/or lighter weight may be desired, Halar® ECTFE foam is a sound choice. Cables made from 558 meet the fire performance requirements in NFPA 90A and have been tested according to NFPA 262.

Halar® ECTFE typical applications include:

- Automotive
- Control lines and downhole cables
- Industrial and residential heating cables
- Appliances wires (UL-758, IEC60811)
- Cathodic protection



Solef® PVDF

Solef® PVDF partially fluorinated grades deliver a good combination of properties such as fire resistance, low-smoke generation, and strong chemical resistance. Solef® PVDF can be cross-linked with ionizing radiation thus offering improved thermo-mechanical properties. In particular, Solef® PVDF 460's branched molecular structure makes it the top performer among Solef® cross-linkable grades.

Solef® PVDF typical properties:

- Continuous service from -40°C to 150°C
- Mechanical resistance
- Excellent fire and smoke performance
- Good chemical resistance

Solef® PVDF for Fiber Optic Cables

Solef® 21508 is a low melting point copolymer with very high flexibility. Its optical properties combine with its excellent mechanical characteristics make this grade the ideal choice for cladding on fiber. In plastics optical fiber (POF) applications, Solef® PVDF delivers very good performance in terms of low attenuation in data transmission.

Solef® PVDF typical applications include:

- Telecom cables
- Industrial cables
- Oil & Gas
- Electronics
- Aerospace
- Raceway cables
- Fiber optic cables



Cogegum® GFR

Cogegum® GFR XLPO-HFFR series consists of silane grafted compounds for Wire & Cable insulation and sheathing; added with catalyst masterbatch (Sioplas® method), the finished cable can be cross-linked by exposure to moisture. No special equipment is normally required to achieve cable cross-linking, and an extrusion line for thermoplastic materials is suitable for their processing.

Cogegum® GFR XLPO-HFFR grades are chemically modified polyolefins and contain a fire retardant system based on light metals hydroxydes (ATH and MDH) that give the cable self-extinguishing properties without halogenidric acids evolution and reduced emissions of toxic and corrosive gases and dark smoke.

Cogegum® GFR XLPO-HFFR grades comply with RoHS requirements.

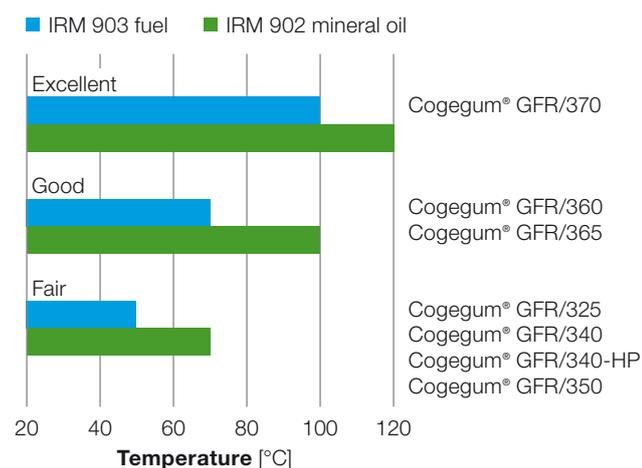
Cogegum® GFR XLPO-HFFR grades are available for a wide range of applications such as low voltage power cable, railway and marine cable, photovoltaic panels connection cable, off-shore cable.

The combination with different grades of Catalyst MBs makes it possible to match material performance with specific cable requirements, such as maximum working temperature (up to 125 °C), long-term aging, UV/VIS resistance.

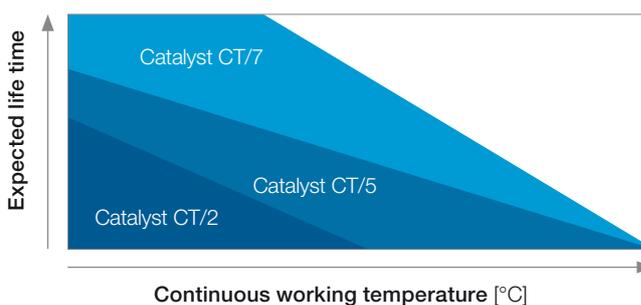
Burning properties

Grade	Limiting Oxygen Index [% O ₂], ASTM D2863	Upper Calorific Potential [MJ/kg], ISO 1716	Halogenidric Acid Emission [% HCl], IEC 60754-1	Corrosivity of Gases Evolved IEC 60754-2
Cogegum® GFR/325	31	18.6		
Cogegum® GFR/340	31	20.3		
Cogegum® GFR/340-HP	31	19.4		
Cogegum® GFR/350	38	18.6	<0.1	pH >4.3 conductivity <10 µS/mm
Cogegum® GFR/360	35	18.5		
Cogegum® GFR/365	38	18.3		
Cogegum® GFR/370	30	15.5		

Resistance to mineral oil and fuel



Long-term thermal performance vs. Catalyst MB grade



Different families of Catalyst MB are available to match standard and special requirements of cable manufacturers in terms of expected life time and continuous working temperature. Special versions of Catalyst MB are also available to optimize processability on different extrusion equipment and to deliver extra protection against UV/VIS radiations.

Cogegum® AFR

Cogegum® AFR HFFR products are thermoplastic compounds for Wire & Cable insulation and sheathing.

These grades are formulated on polyolefins and contain a fire retardant system based on light metals hydroxydes (ATH and MDH) that help to give the cable self-extinguishing properties without halogenidric acids evolution and reduced emissions of toxic and corrosive gases and dark smoke.

Cogegum® AFR HFFR grades comply with RoHS requirements.

Two families of Cogegum® AFR HFFR are offered:

- Cogegum® AFR 700 series: for standard applications
- Cogegum® AFR 900 series: for special applications and enhanced extrusion performances

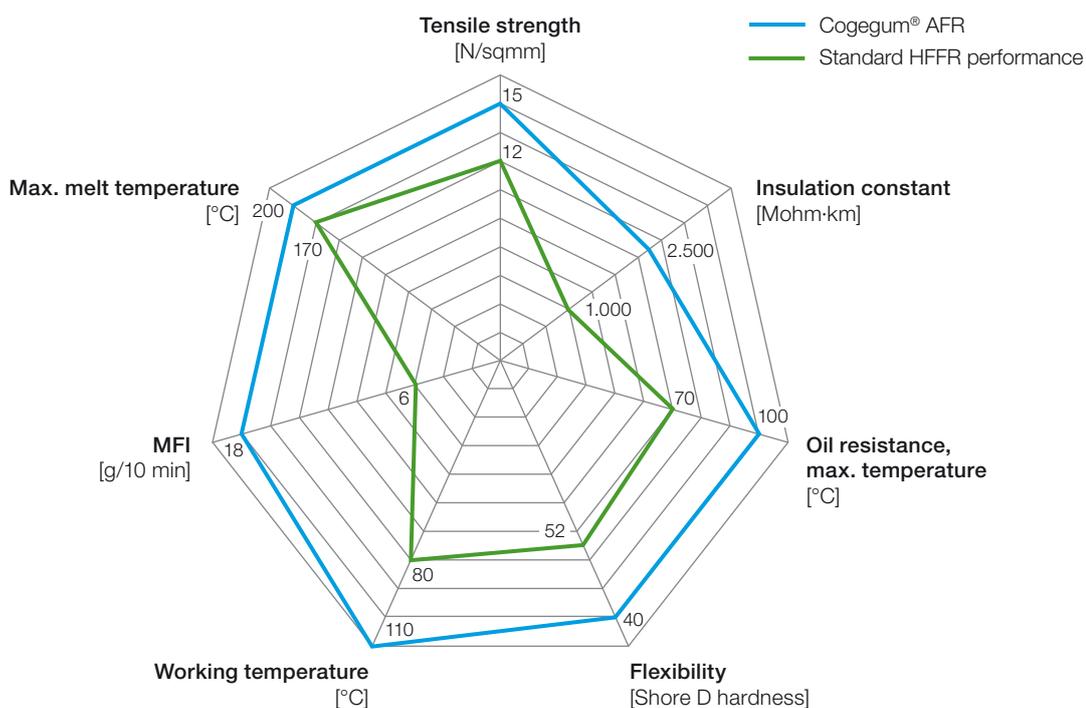
Cogegum® AFR HFFR grades are available for a wide range of applications such as low voltage power cable, control and data cable, signal cable, coaxial cable, optical cable.

Burning properties

Grade	Limiting Oxygen Index [%O ₂], ASTM D-2863	Upper Calorific Potential [MJ/kg], ISO 1716	Halogenidric Acid Emission [% HCl], IEC 60754-1	Corrosivity of Gases Evolved IEC 60754-2
Cogegum® AFR/710	32	18.1		
Cogegum® AFR/720*	39	16.2		
Cogegum® AFR/735	36	16.8		
Cogegum® AFR/760	39	15.6	<0.1	pH >4.3 conductivity <10 µS/mm
Cogegum® AFR/765*	39	15.7		
Cogegum® AFR/920*	37	18.0		
Cogegum® AFR/930	40	16.5		
Cogegum® AFR/960	30	17.5		

* also available as UV/VIS resistant version (ISO 4892-2, method A)

Cogegum® AFR vs. standard thermoplastic HFFR



Polidan® EC and Polidiemme® G

Polidan® EC XLPE series consist of silane grafted compounds based on PE for Wire & Cable insulation; added with catalyst masterbatch (Sioplas® method), the finished cable can be cross-linked by exposure to moisture. No special equipment is normally required to achieve cable cross-linking, and an extrusion line for thermoplastic materials is suitable for their processing.

Polidiemme® G XLPO series consist of flexible silane grafted compounds based on polyolefinic elastomers for Wire & Cable insulation and sheathing; added with catalyst masterbatch (Sioplas® method), the finished cable can be cross-linked by exposure to moisture. No special equipment is normally required to achieve cable cross-linking, and an extrusion line for thermoplastic materials is suitable for their processing.

Polidan® EC and Polidiemme® G typical properties include:

- Polymer system based on unfilled polyolefins
- High electrical properties
- Low density
- High extrusion speed
- Processing with standard PVC screw and tools
- Fast ambient curing
- Low water absorption
- Wide range of Catalyst MB to match with specific applications
- Halogen free and no emission of acid and corrosive gases and dark smoke in case of fire
- Complying with RoHS requirements (EU directive 2002/95/EC)



Polidan® EC and Polidienne® G product range

	Density [g/cm ³]	Shore D Hardness	Working Temperature Range	Description
Polidan® EC/MD	0.94	55	-40°C to 90°C	Medium density grade for signal and power cables up to 10 kV; also suitable for L.V. distribution stranded aerial cable used with Catalyst F/AC
Polidan® EC/110	0.92	51	-40°C to 90°C	Standard grade for signal and power cables up to 3.6 kV; also suitable for L.V. distribution stranded aerial cable used with Catalyst F/AC
Polidan® EC/51	0.90	30	-40°C to 90°C	Low density and flexible grade; for signal and power cables up to 3.6 kV
Polidan® PNT 0553/23	0.90	40	-40°C to 90°C	Flexible grade for insulation and sheathing for potable water contact (submersible pump power cord)
Polidienne® G/420	0.91	32	-40°C to 90°C	Standard grade for high modulus insulation of power and signal cable (hard EPR) and insulation of PV wiring cable (CEI 20-91); very high extrusion speed
Polidienne® G/400	0.90	23	-40°C to 90°C	Flexible grade for insulation and sheathing
Polidienne® G/440	0.88	18	-40°C to 90°C	Extra-flexible grade for insulation and sheathing
Polidienne® G/450	0.87	16	-50°C to 125°C	Ultra-flexible grade for insulation and sheathing; enhanced thermomechanical properties for high temperature rating



KetaSpire® PEEK

KetaSpire® PEEK is a semi-crystalline thermoplastic with excellent mechanical and chemical resistance properties. It provides exceptional performance over a wide range of temperatures and extreme conditions, has very good electrical properties and provides a unique range of high-performance properties in Wire & Cable applications.

Typical properties:

- Continuous service up to 240 °C
- Good electrical performance
- Low smoke and toxic gas emission
- Excellent wear resistance
- Mechanical strength and dimensional stability
- Long-term thermal oxidative stability (UL Relative Thermal Index) up to 240 °C
- Broad chemical resistance and low permeation to chemicals

Solvay Wire & Cable solutions can be specified for applications demanding superior physical performance such as improved flexibility, flex-fatigue performance, fire properties, good abrasion resistance and chemical performance across broad temperature range. All our materials are RoHS compliant and as such lead, plasticizer and halogen free.

KetaSpire® KT-851 PEEK

KetaSpire® KT-851 resin is a deep-filtered grade of PEEK specifically designed for continuous extrusion processes and can be used to manufacture thin insulation coatings onto copper or other conducting wires. The material is lubricated to offer a good balance between properties and ease of processing.

KetaSpire® KT-851 is able to offer the necessary and consistent electrical properties and performance required for wire and cable coatings together with outstanding chemical resistance, excellent wear resistance and higher operating temperature range (continuous 240 °C) whilst maintaining mechanical integrity.

It can be used to produce wire and cable insulation for applications in potential fire risk situations, showing outstanding flame retardant properties and low smoke emissions values. The LOI (Limiting Oxygen Index) is 35 % and even when burning the material has very low smoke generation.

For example, wires and cables used in mass transit systems (rolling stock) and aerospace industries must have extremely low flammability and smoke emission to reduce the hazard to passengers and crew in the event of a fire. Independent testing has shown that KetaSpire® KT-851 has a UL94 rating of V-0 and samples show no appreciable smoke emission after ignition.

KetaSpire® PEEK has been successfully qualified and validated for use at several OEMs in a range of application areas such as:

- Military specification cables
- High temperature cables
- Harsh environment cables for extreme cold and/or heat
- Control and instrumentation cables
- Thermocouple wire (Nuclear Power Plant)
- Magnet wire



AvaSpire® PAEK

AvaSpire® PAEK resins provide a new and unique combination of performance and attractive economics. Cable designers are able to specify AvaSpire® PAEK materials in specific applications or in cases where PEEK may be over-engineered to bridge price and performance characteristics.

The specific grade AV-630 PAEK is well suited for Wire & Cable applications and can be used for ultra thin film thickness (5 microns).

AvaSpire® PAEK typical properties and applications include:

AvaSpire® PAEK provides similar property profile to PEEK with advantages in ductility, improved flexibility and heat resistance performance.

It can be used for niche applications where high temperature, chemical and mechanical performance are required and within target markets such as Rail, Marine, Nuclear and Aerospace. Wires and cables made of PAEK products retain toughness and show good handling characteristics with improved economical manufacture with respect to PEEK.

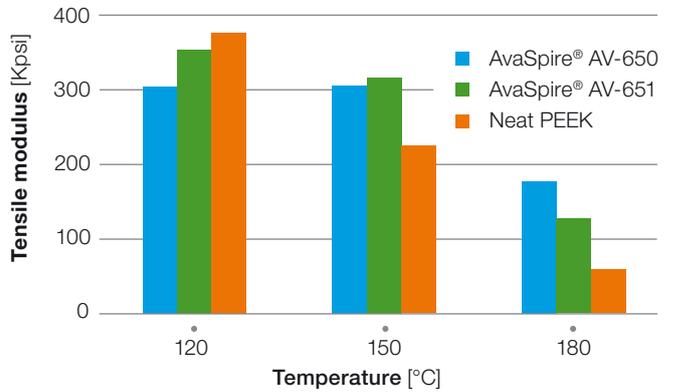
AvaSpire® AV-630 shows:

- Improved flexibility over PEEK
- Improved toughness over PEEK
- Higher HDT
- More attractive economics
- Processed using conventional processing equipment

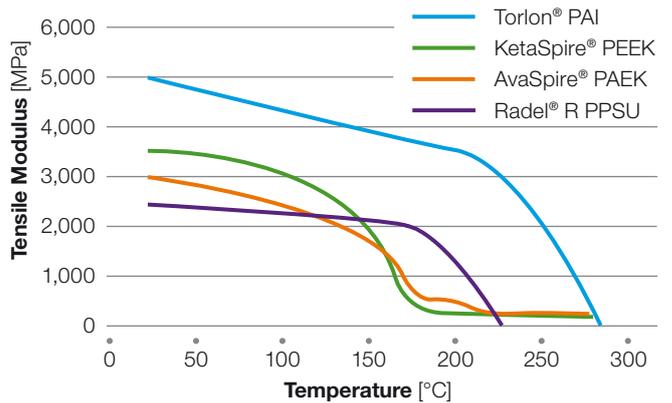
High thermal performance properties:

The thermal performance characteristics and melt stability of PAEK materials allow for ease of processing for Wire & Cable applications and permit high end-use temperatures for long periods of time.

Tensile modulus at high temperature



Tensile modulus vs. temperature



Radel® PPSU

Radel® PPSU resins are amorphous thermoplastic materials which offer an exceptional hydrolytic stability and toughness superior to other commercially-available, high-temperature engineering resins. Ideally suited for durable jacketing and insulation, these resins feature high deflection temperatures and show an outstanding resistance to environmental stress cracking compared to other amorphous materials. The polymer is inherently flame retardant, and also has excellent thermal stability and good electrical properties.

Radel® R-5800 PPSU

Radel® R-5800 is a high melt flow grade that can be processed readily on conventional extrusion equipment. Radel® R-5800 can provide excellent performance and functionality that meet or exceed the demanding requirements of the Wire & Cable industry. These functions include:

- Excellent performance with respect flexibility
- Flame retardancy
- High temperature resistance up to 180°C
- Well-suited for thin wall cable designs
- Good hydrolytic stability
- Lightweight (low specific gravity)
- Good hydrolytic stability, also at high temperatures
- ISO 6722 certified (for automotive applications)
- Transparency

Radel® R-5800 is well-suited for thin wall cable designed for high-temperature Wire & Cable applications in automotive and mass transit systems as possible alternatives to ETFE based on cost and weight reduction parameters. Dual layer systems can also be produced to offer increased flexibility and material design capabilities.

Radel® R-5800 PPSU Conforms to ISO 6722

For automotive applications Radel® R-5800 is ISO 6722 certified and is class E rated (175 °C). Radel® R5800 PPSU material can be used for high-temperature sheathed cables used in the areas of the vehicle exposed to continuous operating temperatures of 150 °C and over. Typical applications can be in engine compartments and for gearbox control, automatic gear transmission and sensor cables for high performance fuel injection.

Torlon® PAI

Torlon® PAI is a thermoplastic amorphous polymer showing exceptional mechanical, thermal and chemical properties. Torlon® polymers provide long lasting performance in severe service environments and provide a distinct combination of properties:

- Outstanding wear resistance
- Resistant to strong acids and organics
- Inherent flame resistance
- Friction and wear properties

Torlon® grades are available for potential application in Wire & Cable as jacketing materials. It is also available in powder form for usage as coating for magnet wire enamel onto copper or aluminium conductor and protective coatings for printed circuit boards.

Torlon® PAI exceptional characteristics make it suitable for usage over polyester wire enamel to achieve higher thermal ratings.

Other Specialty Polymers

Algoflon® PTFE Tecnoflon® FKM

Algoflon® PTFE is used as wire insulation throughout the Aerospace, Architectural, Automotive, Chemical, Electronics, Industrial and Telecom industries where superior material performance is required (i.e., high-temperature and chemical resistance, low flammability).

Algoflon® PTFE has best in class dielectric properties with very low dielectric constant and dissipation factor with both nearly independent of frequency and temperature. In addition it is a very good electrical insulator with high dielectric strength.

Algoflon® PTFE can be directly extruded onto the conductor to provide wire insulation or processed into electrical tapes (both low and high density) for wrapping in order to augment the performance of a variety of cable constructions. It is currently used as an insulator in different wire configurations that include primary conductor insulation in lead wires and coaxial cables.

Tecnoflon® FKM fluorinated elastomer materials are used as jacketing and insulation. These materials combine thermal performance up to 240°C with outstanding resistance to strong acids, bases, steam, and aggressive fuel mixtures. They also offer inherent flame retardancy and reliable long-term aging properties.





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