TIMES MICROWAVE SYSTEMS

Regulation (EC) NO. 1907/2006 (REACH)
Proposal for a restriction of Per and Polyfluoroalkyl substances (PFAS)
Submitted by:
Times Microwave Systems, Inc.
Wallingford, CT USA
Date: 19/05/2023

Dear Sir or Madam,

Times Microwave Systems, Inc. (TMS) appreciates the opportunity to contribute to the public consultation regarding the potential restriction of Per and Polyfluoroalkyl substances (PFASs) according to Regulation (EC) No 1907/2006 (REACH).

Times Microwave Systems, a member of Amphenol North America Military group, is a pioneering brand of innovative RF and microwave interconnect assemblies, cables, and connector designs. TMS has over 70 years of industry experience manufacturing high performance coaxial cables, connectors and assemblies and custom solutions for applications in the aerospace, avionics, airframe, medical, military and defense, radars, space, missiles, railway, and wireless infrastructure.

A. Types of Fluoropolymers Used in our Applications:
Coaxial cable dielectric materials: PTFE, FEP, Foamable FEP/PFA resin
Coaxial cable jacket materials: FEP, ETFE, PVDF
Coaxial connector components: Fluoroloy H – Cho-seal 1298, Fluorosilicone Rubbers

B. Performance, Function and Benefits of Fluoropolymers
Polytetrafluoropethylene (PTFE) has an exceptionally low and consistent dissipation factor and dielectric constant across a range of temperatures and frequencies, providing the lowest cable transmission losses of a coaxial cable. The PTFE is critical in applications with an operating temperature ranging from cryogenic temperatures to over 250°C. PTFE has a higher dielectric strength than polyethylene, making it ideal for high power applications. PTFE is used in both coaxial cables and connectors due to these properties.

Fluorinated Ethylene Propylene (FEP) and Perfluoroalkoxy (PFA) resins are blended to create a phase stable product over temperature, where expanded PTFE is insufficiently consistent. Phase matched cable arrays are critical to high performing radar systems. These materials are the only option for phase stable products.

FEP resins are used primarily as cable jackets on any aerospace grade cable that must survive temperatures above +200°C. This material has great chemical resistance (fuel spills) and provides an excellent vapor seal with high resistance to stress cracking, which prevents degradation or outgassing of an installed cable without sacrificing flexibility.

Ethylene tetrafluoropethylene (ETFE) resins are used primarily as cable jackets on any space grade cables that must survive temperatures up to +150°C and radiation exposure. This material has great radiation resistance compared to FEP, allowing use outside of the vehicle's payload.

This material is also an excellent vapor seal with high resistance to stress cracking, which prevents degradation or outgassing of an installed cable without sacrificing flexibility.

Polyvinylidene difluoride (PVDF) is used in UL plenum applications. This material is flame resistant and burns slowly, which creates minimum smoke during a building fire, allowing occupants time to escape.

Fluoroloy H is a ceramic PTFE composite, typically used as a dielectric material in high power rated cable connectors. This PTFE in the dielectric allows for good electrical properties, while the ceramic improves the heat dissipation caused by high power applications.

Conductive Elastomer gaskets are used in coaxial connectors and rely on fluorosilicone binder to resist corrosion without the addition of chromates. Corrosion resistance is ideal for shipboard and aerospace applications.

Fluorosilicone rubber is used as high temperature o-rings in coaxial cable connectors and strain relief on a coaxial cable assembly. These o-rings are capable of withstanding +200C without degradation, which is critical to maintaining a vapor seal in aerospace environments. The strain relief prevents damage to the cable during installation and operational vibrations.

C. Standards Required to Meet Customer Applications

Mil-DTL-87104 Coaxial Assemblies General Specification

- Fungus-inert materials must be used (FEP & PTFE)
- Polytetrafluoroethylene must be used and shall conform to ASTM-D1710
- Reliability, longevity, and service life are requirements per MIL-C-87104 → lends well towards use of fluoropolymer as the dielectric.
- Operating Temperature/Conditions – Range of -62°C to 150°C, which is only attainable with a PTFE dielectric.
- Chemical Resistance – Fluoropolymers are largely resistant to all forms of chemical attack.

Mil-STD-81490 Transmission Lines, Transverse Electromagnetic Mode

- Fungus-inert materials must be used (FEP & PTFE)
- Chemical Resistance – Fluoropolymers are largely resistant to all forms of chemical attack.

Mil-DTL-17 Cables, Radio Frequency, Flexible and Semirigid, General Specification

- *PTFE:*
  - Type F dielectrics
    - Higher maximum power rating than polyethylene. Power handling is the amount of power that a coaxial cable can safely transmit without overheating or developing a dielectric breakdown throughout the usable frequency range.
  - Type FF-2 Barrier Tapes
  - Type VII PTFE Jacket
  - ASTM References to PTFE

- ASTM D4894 - Standard Specification For Polytetrafluoroethylene (PTFE), Granular Molding and Ram Extrusion Materials
- ASTM D4895 - Polytetrafluoroethylene (PTFE), Resins Produced from Dispersion

- *FEP:*
  - Type M dielectric
  - Type IX Jacket
    - High stress-crack resistance
  - ASTM References to FEP
    - ASTM D2116 - Molding and Extrusion Materials, FEP Fluorocarbon
- *E-CTFE & PFA* ASTM References
  - ASTM D3275 - Materials, E-CTFE-Fluoroplastic Molding, Extrusion and Coating
    - Type XI Jacket
  - ASTM D3307 - Perfluoroalkoxy (PFA) – Fluorocarbon Resin Molding and Extrusion Materials
    - Type XIII Jacket

Specifications listed above detail temperature and flexibility requirements for fluoropolymer dielectrics and jackets in coaxial cable and assemblies.

- *UL DUZX.E170516* – UL Specification details smoke requirements for plenum rated cables.
-

D. Available Alternatives or Technologies and Economic Consequences

There are few options for cable dielectric materials and jacket materials that can withstand temperatures above +85C without the use of fluoropolymers. These alternate materials have nowhere near the electrical performance or consistency of fluoropolymers, which would reduce the effectiveness of many defense systems and would require re-designs to account for the significant cable changes.

Foamed polyethylene would have the least change in cable performance (cable loss, phase stability) compared to a PTFE dielectric, however polyethylene cannot operate in the required temperature ranges for aerospace or space applications, due to a low melt point of +85C.

The two most suitable replacements that can withstand the temperature requirements would be polyimide or Polyether ether ketone (PEEK), both of which have significantly worse electrical performance (cable loss, phase stability) compared to PTFE. This reduced performance would require added weight for a cable with comparable insertion loss and would not have the phase stability of the FEP/PFA blends. The increase in weight represents a significant increase in vehicle fuel consumption and increase in material costs.

E. Impact to TMS, our Customers and End Users

The change in fluoropolymer regulation would immediately impact the communication systems (radar, transmission lines, etc.) on aerospace, space, and shipboard systems. Products that are designed on legacy programs would become unavailable, and with no drop-in substitute available would require a system overhaul with a major cost impact. Some of the major programs served (not limited to) are: AH-64, E-2, F-15, F-18, F-35, P-8, Patriot Missiles, STRIKE, Airbus A400, Eurofighter, JAS Gripen, and Panavia Tornado.

F. Derogation Period

We acknowledge the 18-month transition period after the final ECHA ruling; however, the 5-12 year *proposed* derogation period needs to be expanded indefinitely for (Electronics/Wire and Cables). In respect to the markets served, technical properties, critical applications, and the fact that there are no suitable alternatives (at this time), an indefinite extension should be applicable.

We are happy to assist with any questions. Please do not hesitate to contact us for any details that may be considered helpful.

Respectfully submitted,

Sue Reynolds

Sue Reynolds
Compliance Manager
E:sue.reynolds@timesmicro.com