Case study: **Use of fluoroelastomers Sealing elements in Gas turbine Engines**

There is no other chemistry available to replace the performance that Fluoropolymers provide for chemical, thermal, plasma and radioactive resistance as seals. By definition any chemical that could withstand those situations would also be considered persistent.

A ban, or a class regulation, of polymeric PFAS materials and their raw materials will have a profound impact on global industry and everyday lives. The following case study is given to showcase just a tiny fraction of the uses of PFAS sealing materials where no alternative technology exists.

Key facts:

- 400% increase in passengers over the past 30 years
- Multiple gas turbine suppliers in Europe (Rolls-Royce, Safran, MTU, …)
- 70% fuel consumption reduction over the past 40 years

Planes are a common means of transportation with a 400% increase in passengers over the past 30 years as it has become affordable thanks to the gain in aircraft efficiencies. [i]
Military planes are also an essential asset for countries defence system.

In both cases, gas turbine engine development have been driven by higher engine efficiencies and higher thrust while reducing emissions.

From the literature it can be found that at constant rpm, maximum thermal efficiency can be obtained by maintaining the highest possible exhaust temperature [ii] and this resulted in turbine entry temperature doubling between 1940 and 2010 [iii]. This has helped to minimize emissions (70% reduction in fuel consumption over the past 40 years [iv]).

In summary, higher engine operating temperature helps increase efficiency and reduce emissions. This has driven temperature in some sealing location well above 200°C which can only be withstood by fluoroelastomers. In order to ensure sealing at elevated temperature the use of fluoroelastomer or perfluoroelastomers is required to meet the combination of lifetime, fluid compatibility and

temperature requirements. [v] Other elastomeric solution would not withstand the thermal / Chemical exposure load.

[i] Air transport, passengers carried | Data (worldbank.org))
[ii] Aircraft Gas Turbine Engine Performance, *aircraftsystemstech.com*
[iii] Future Aero Engine Designs: An Evolving Vision, *Advances in Gas Turbine Technology (pp.3-24)*
[iv] Low Emissions Propulsion Engine Combustor Technology Evolution Past, Present and Future *Hukam Mongia and Willard Dodds - GE Aircraft Engines, Cincinnati, Ohio, U.S.A. ICAS 2004*
[v] *(Thomas, E., "Fluoroelastomer and Perfluoroelastomer Compatibility With Advanced Gas Turbine Lubricants," SAE Technical Paper 2003-01-3029, 2003).*