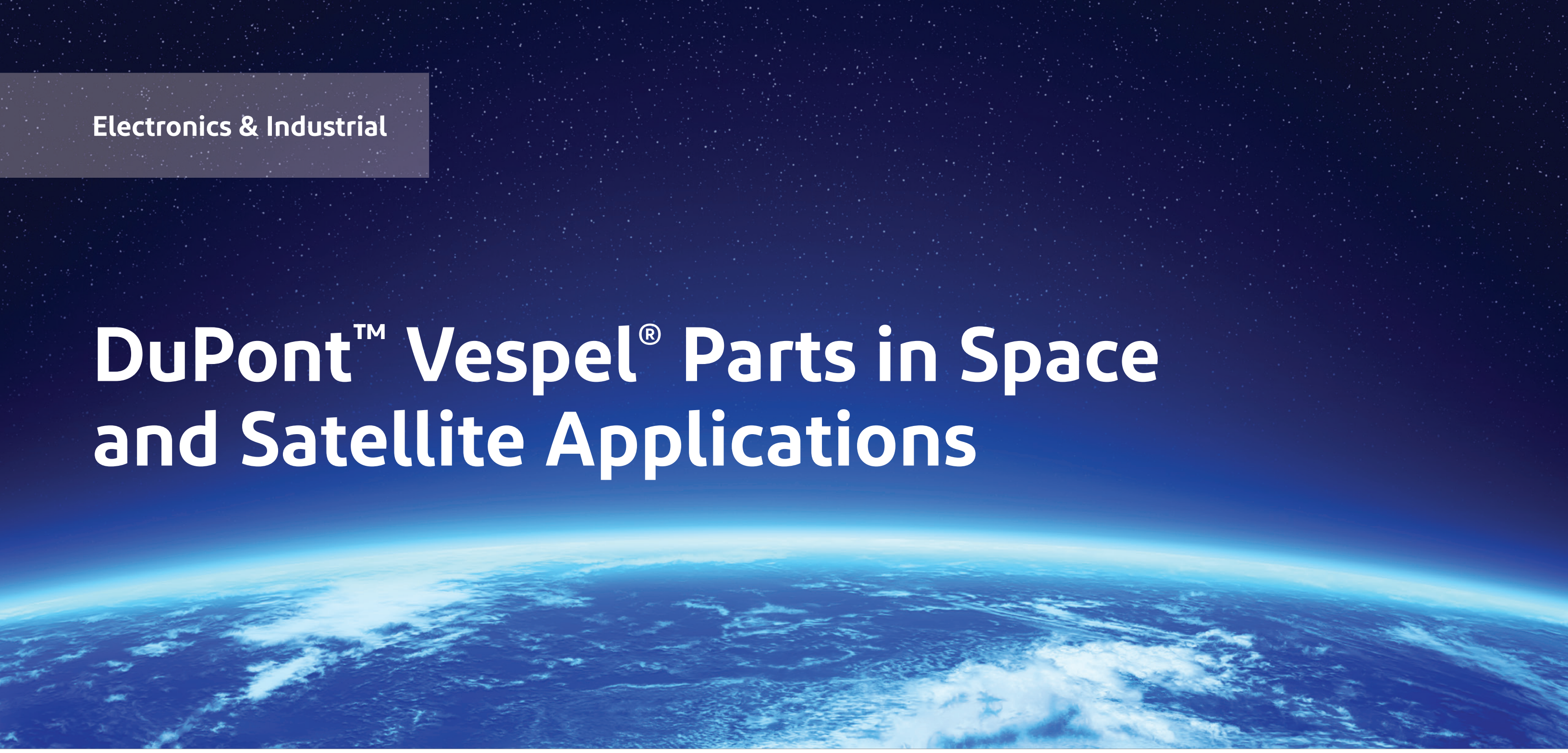
DuPont™ Vespel® Parts in Space and Satellite Applications



Performance and stability at low temperatures, high vacuum and radiation conditions

- Bearings | Bushings
- Transfer vehicle wheels
- Seals
- Locking fasteners
- Camera lens retainers and centering rings
- Space boot components
- Valve components
- Thermal blanket | MLI clips
- Electrical insulators
- Thermal isolators
- Radomes
- Splines

Typical application benefits...

Vespel® parts value in aerospace

- Reduced Weight
- Lower Friction
- Low Outgassing
- Increased Part Wear Life
- Radiation Resistance
- Broad Temperature Range and Cryogenic Performance

Radiation

Torlon®-4203 samples showed ~60x higher wear compared to Vespel® SCP-5050 ISO material at high radiation exposure (10 Mrad). Compared to other polymeric materials in the study, Vespel® parts demonstrated excellent radiation stability. COF, wear properties, and mechanical properties stayed nearly unchanged after exposure to high dosage of radiation.

Figure 1. Average Wear Factor

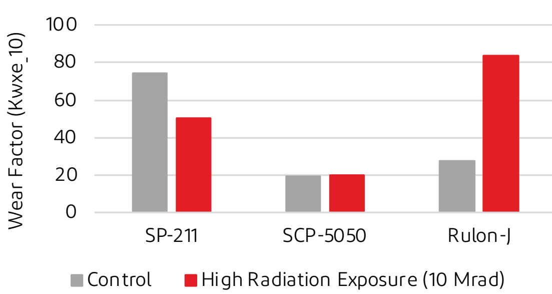


Figure 1. PV testing performed by DuPont, Radiation Exposure performed by Naval Research Lab. Experiment Parameters: 188.55 PSI, 137.80 fpm, 24 hr duration, mating surface 4620 steel. PV: 25,982 lb-ft/in^2-min.

Cryogenic Wear and Friction

- Compared to other unfilled (neat) polymeric materials, DuPont™ Vespel® parts have significantly improved coefficient of friction and wear rate in air, gaseous, and liquid hydrogen compared to PEEK.

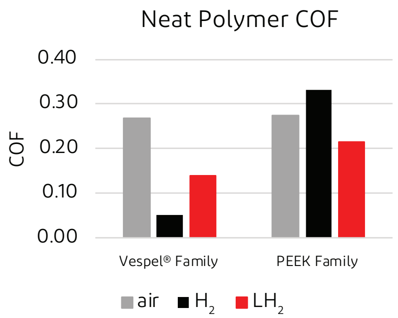


Figure 2. COF for unfilled Vespel® vs. PEEK

- Vespel® filled composite grades have a much lower wear rate compared to PEEK materials at liquid hydrogen temperatures

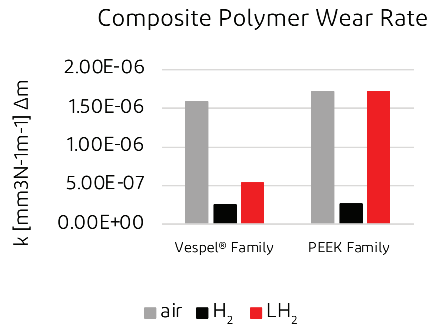
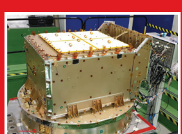


Figure 3. Wear rate for filled Vespel® vs. PEEK

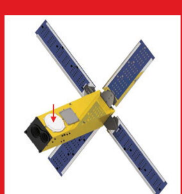
COF and wear and friction for Neat polymers of the Vespel® and PEEK family, data generated by the BAM Bundestanstalt für Materialforschung und – prüfung by Mrs. Theiler, Counterface AISI 304, Ra ~ 0.2 μm, sliding speed v = 0.2 m/s, contact pressure 3 MPa.

Vespel® Parts for Satellite Applications



Thermal Blanket Clips or Multi Layer Insulation (MLI) Clips

Geostationary orbit (GEO) satellites utilize Vespel® SP–1 MLI clips to provide thermal insulation in a wide temperature range (-195 °C to 260 °C) with high thermal gradients and changes.



Radomes

Low earth orbit (LEO) nanosatellites utilize Vespel® SP–1 radomes for S band and X band microwave frequencies. The transparency to microwave frequencies, strong radiation resistance, and thermal stability make Vespel® SP–1 the preferred material selection.

Ion Thrusters Insulation Spacer

Vespel® supports field emission electric propulsion (FEEP) thrusters with Vespel® SCP – 5000 insulation spacers. Vespel® SCP – 5000 parts provides electrical and thermal insulation with low outgassing at -180 °C to 250 °C and higher mechanical strength than Vespel® SP – 1 parts.

- Vespel® materials perform excellently under high vacuum and cryogenic test conditions. There are a wide range of Vespel grades that can provide a variety of wear properties for your specific application needs.

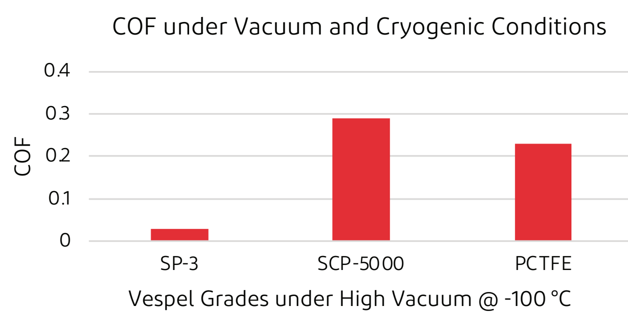


Figure 4. Data generated by the Florida A&M University-Florida State University College of Engineering. Department of Mechanical Engineering. Experiment parameters: 2.5 Mpa, 50mm/s, 20mm stroke, 30k cycles at -100 °C and 10e-6 mbar vacuum.

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