

DuPontTM Kalrez[®] and Vespel[®] Precision Parts for the Aerospace Industry

Solving the toughest sealing, wear and friction challenges in mission-critical applications



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Why DuPont™ Kalrez® and Vespel®?



Recognized leader in responsible business



Core values - safety, sustainability and ethics



World class technical support



Your partner through design, development and production



Proven quality



Culture drives quality and continuous improvement



Solution partner of choice

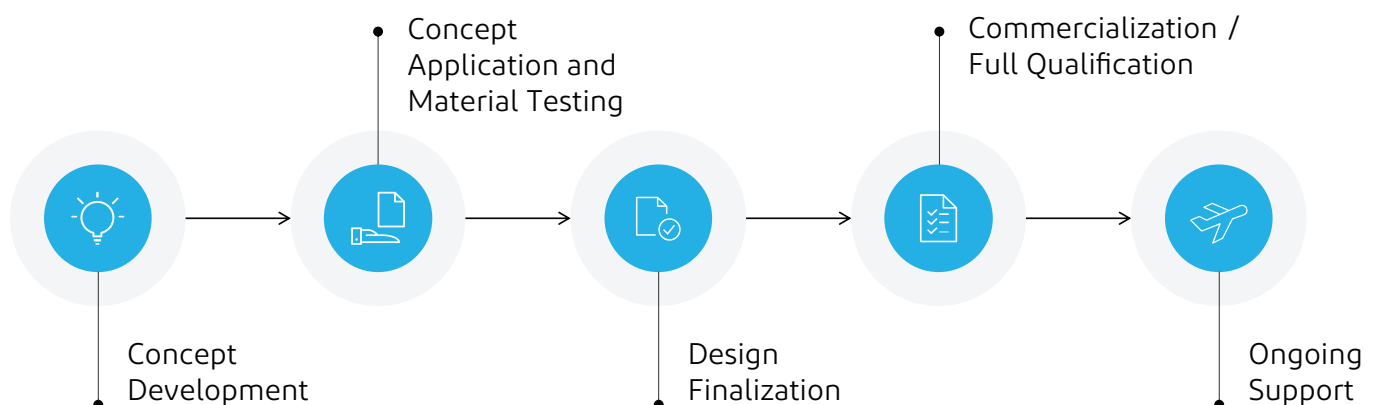


Known for delivering innovative material technologies



Proven service for more than 50 years in aircraft engines and systems

Technical support, every step of the way...



DuPont™ Kalrez® Perfluoroelastomer Seals:

For critical sealing applications in the most challenging conditions

- **Kalrez® 4079AMS – proven performance**
- **Kalrez® Aeroseal™ 7797, and 7800AMS**
 - High thermal stability
 - Low compression set
 - Improved stress relaxation
 - Improved temperature cycling
- **Kalrez® 7745**
 - NASA-approved material (NASA-STD-6001B)

Property	Kalrez® 4079	Kalrez® 7800	Kalrez® 7745	Kalrez® 7797
Hardness (Shore A)	75	75	78	90
Meets AMS 7257E	Yes	Yes	No (Hardness > 75)	No (Hardness > 75)
Max Service Temp, °F (°C)	600 (316)	617 (325)	464 (240)	617 (325)

Vespel Parts in Aerospace Enable

	Reduced Weight		Broad Chemical Resistance		Low Outgassing
	Increased Part Wear Life		Lower Friction		Broad Temperature Range Stability
	Higher Operating Temps		Ability to Run Unlubricated		Cryogenic Performance

DuPont™ Vespel® Parts And Shapes

			
Vespel® S	Vespel® ASB	Vespel® CP	Vespel® CR
Standard	Assemblies	Composites	Chemical
PI Parts & Shapes Direct Formed, Isostatic, Compression	Metal-Backed Polymer Composites Metal-Backed Carbon-Graphites	Fiber Reinforced Resin Composites Fabric Laminates, Sheet Molding Compounds	Chemical Resistant Parts & Shapes Extrusion, Compression

DuPont™ Vespel® Engine Solutions

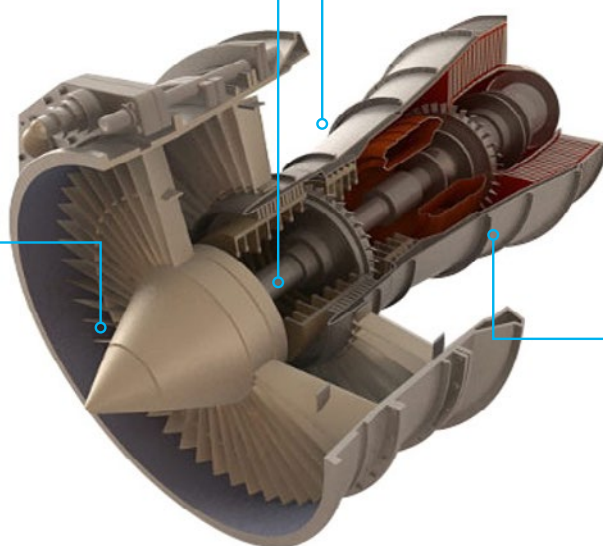
Improving performance, extending life, saving weight & lowering costs

Compressor

- Stator Vane Bushings
- Bumpers & Wear Pads
- Abraidable Seals
- Main Rotor Bumper Bearing
- Composite Shrouds

Fan

- Fan Blade Root Wear Strips
- Abraidable Seals
- Blade Spacers



Externals

- Composite Tube Clamps
- Duct Seals
- Valve Seals
- Bumper & Wear Pads
- Actuation Arm Bearings
- Bellcrank Bushings
- Locking Fasteners
- Insulators
- Spline Adaptors

Combustor & Nozzle

- Augmenter Flaps
- Nozzle Bushings

DuPont™ Vespel® Aircraft Applications

Subsystems

- Thermal & Electrical Insulators/RF Systems
- Bearing Retainers in Avionics
- Wear Pads & Wear Strips
- Oxygen System Seals
- Valve Seats (Various Systems)
- Fuel System Electrical Isolation

Nacelles

- Thrust Reverser Channels
- Slide Blocks
- Actuation System Bearings
- Slider Shoes
- Wear Pads and Wear Strips

Control / Actuation Systems

- Actuation System Bearings
- Control Surface Bearings
- Clutch Brakes
- Bushings & Guides in control linkages

Auxiliary Power Units

- Bushings
- Thrust Washers
- Shaft Bearings
- Seals

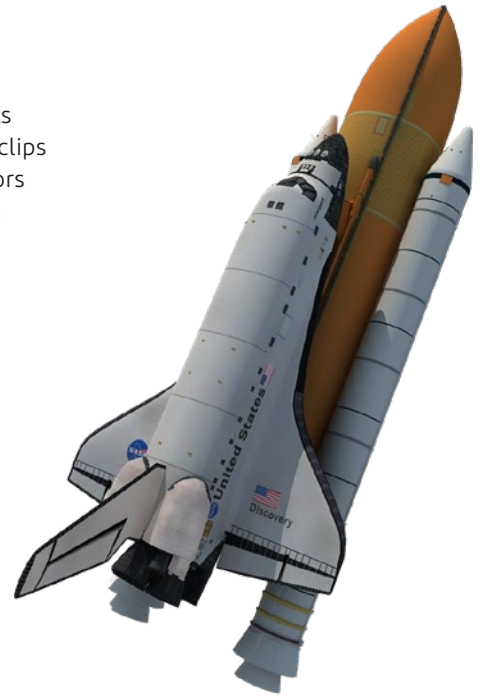


DuPont™ Vespel® Space Applications

Performance and stability at low temperatures with low outgassing and radiation resistance

Satellite and Spacecraft

- Camera lens retainers & centering rings
- Seals
- Locking fasteners
- Bearings
- Bushings
- Splines
- Valve components
- Thermal blanket clips
- Electrical insulators
- Thermal isolators
- Radomes



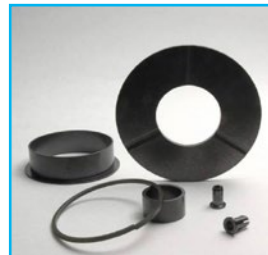
Bushing & Thrust Washers

Low cost, low friction, long life bearing solutions



Application Challenges

- High temperature
- Wear resistance
- Low friction bearing
- Tight sealing



DuPont™ Vespel® Material Solutions:

- Numerous SCP, CP, ASB, and SP grades



Features:

- High thermal oxidative stability
- Low coefficient of friction
- Excellent wear resistance
- CTE well matched to mating metal components



Benefits:

- Weight savings vs. metal bushings
- Protects expensive mating metal vanes and case from wear
- Efficient compressor operation
- Long life



Compressor Shrouds



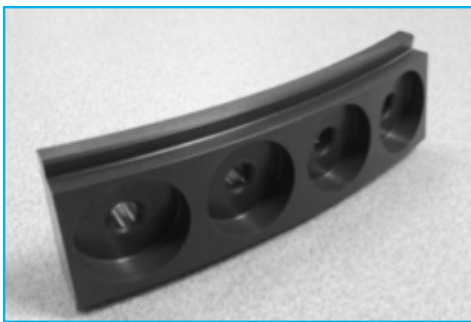
Application Challenges

- High Temperature
- Wear Resistance
- Low Friction Bearing
- Tight Sealing



DuPont™ Vespel® Material Solutions:

- SCP-5050, ASB-0826



Features:

- High Thermal Oxidative Stability
- Low Coefficient of Friction
- Excellent Wear Resistance
- CTE well matched to mating metal parts



Benefits:

- Weight savings vs metal shrouds with bushings
- Protects expensive mating metal vanes and case from wear
- Efficient compressor operation
- Fewer parts to manage and assemble
- Long Life

Abraidable High Temperature Seals



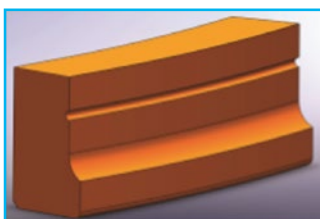
Application Challenges

- Zero clearance seal
- Chemical / environmental compatibility
- Durable in harsh environment
- Capable to 600 °F/315 °C



DuPont™ Vespel® Material Solutions:

- SF-0920, SF-0930, SF-0940



Features:

- Closed cell foam for excellent sealing and compatibility
- Capable of holding close tolerances
- Multiple densities available
- Survives temperatures to over 600 °F/315 °C and will not burn



Benefits:

- Improved compressor/fan efficiency due to near zero clearance seal
- Lower cost than typical honeycomb structures
- No treating required for mating blade tips
- Lightweight, durable designs.

Bumpers, Wear Pads, & Wear Strips

Eliminate metal-to-metal wear



Application Challenges

- Wear resistance
- Low friction
- Strength



DuPont™ Vespel® Material Solutions:

- SP-21, SCP-5050, CP-0301, CP-0664



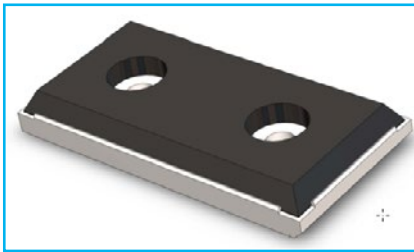
Features:

- High resistance to wear
- Low friction surfaces
- Broad geometry and material options



Benefits:

- Improved component life
- Reduced actuation force requirements
- Design flexibility – assembly options
- System weight savings
- Protects expensive case from wear



Wear Strips for Fan Blade Dovetail Root Surface



Application Challenges

- High loads
- Low friction
- Tight thickness tolerance
- Wear resistance



DuPont™ Vespel® Material Solutions:

- CP-0664, CP-0670



Features:

- High compressive strength
- Coefficient of friction <0.1
- Wear resistance



Benefits:

- Reduces blade stress
- Protects expensive blades from wear
- Controlled, predictable, consistent friction for blade seating
- Corrosion barrier
- Assembly protection



V-Grooves

Eliminate metal-to-metal wear



Application Challenges

- Wear resistance
- Low friction
- Shear strength / impact resistance
- Corrosion resistance
- Field maintenance



Features:

- High resistance to wear
- Low friction surfaces
- Broad geometry options



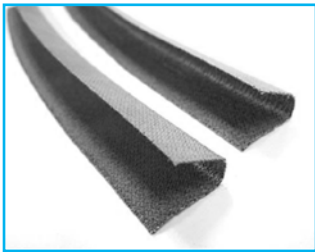
DuPont™ Vespel® Material Solutions:

- CP-0664



Benefits:

- Improved component life
- Design flexibility – assembly options
- Protects expensive components from wear
- Durability



Tube Clamps and Brackets

Save weight over metal alternatives



Application Challenges

- Light weight
- Vibration dampening
- Alignment
- Strength



Features:

- Low density
- High strength
- Meets AS1974 vibratory test requirements



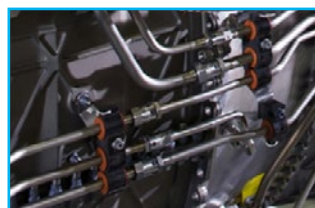
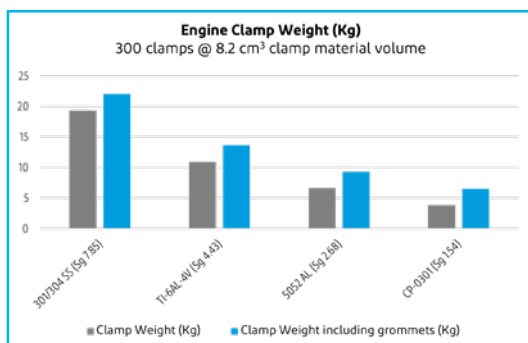
DuPont™ Vespel® Material Solutions:

- CP-0301, CP-2010, CP-2020



Benefits:

- Delivers >40% weight savings over metal clamps
- High strength
- Forgiving to misalignment
- Improved ease of maintenance



Thrust Reverser Components

Low friction, high load capable solutions



Application Challenges

- High loads
- Low friction across operating conditions
- Chemical / environmental compatibility
- Wear resistance



Features:

- High compressive strength
- Coefficient of friction <0.1
- Wear resistance



DuPont™ Vespel® Material Solutions:

- CP-0664 and ASB grades



Benefits:

- Controlled, predictable, low friction from first cycle on and across operating environments
- Reliable, proven performance
- Lightweight, durable designs.



Self Locking Fasteners

Reusable Torque Retention



Application Challenges

- Provide torque retention to threaded fastener
- High temperature capable
- Reusable with same torque retention



Features:

- Strength and toughness
- Thermal endurance
- Creep resistant



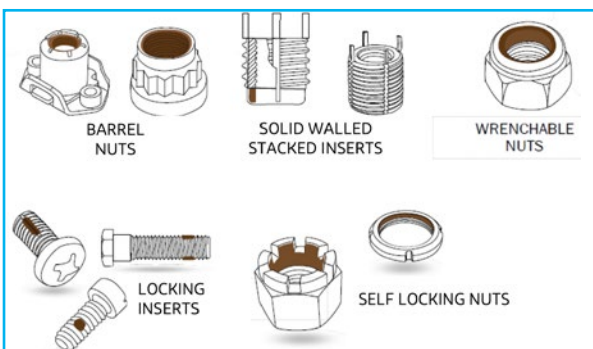
DuPont™ Vespel® Material Solutions:

- SP-1 and SCP-5000



Benefits:

- Meets torque retention requirements
- Reusable with consistent torque retention
- Integrates with metal threads in nuts and bolts
- Proven performance in critical aerospace systems
- Withstands high vibration when placed on external thread



Insulators

Reusable Torque Retention



Application Challenges

- Electrical or thermal insulation
- Loading and vibrational loading
- Environment - temperature



Features:

- Insulative properties
- Fabricate to tight tolerances
- Material toughness
- Lighter than ceramics
- Thermal endurance



DuPont™ Vespel® Material Solutions:

- SP-1, SCP-5000, SF-0920, SF-0930, SF-0940



Benefits:

- Cost savings
- Weight savings
- Thermal endurance versus engineered plastics



Engine Oil System Seals

Preventing Fluid Leakage



Application Challenges

- Thermal cycling from ambient to high temperature
- Suitable for use with rocket fuel such as dinitrogen tetroxide



Features:

- High temperature resistance, durable up to 325 °C
- Low compression set
- Broad chemical compatibility
- Good sealing force retention



DuPont™ Kalrez® Material Solutions:

- Kalrez® 4079AMS, 7745, Aero seal 7797, Aero seal 7800AMS



Benefits:

- Improved reliability of the engine operation
- Durability preventing fluid leakage
- Meets SAE AMS7257E and NASA STD-6001D standards*

*Specific grades



Our primary focus is your success

- The DuPont Support Team assigned to your project is uniquely qualified to understand your design needs
- Dedicated to meeting, and exceeding, your quality requirements
- Experienced with aerospace systems and procedures
- Focused on 100% on-time delivery
- Devoted to unparalleled performance in the field
- Vespel® aerospace-specific US manufacturing sites are AS9100D certified



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