Application Profile

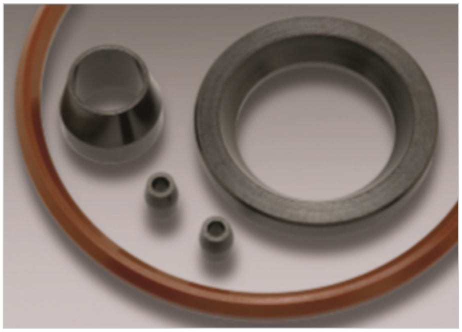
DuPont™ Vespel® Parts and Shapes: Sealing Solutions

Replacing metal-to-metal seals with Vespel® SP and SCP grades

Challenges

Seals are essential to prevent leakage in critical components, such as valves, pumps, and piping. They must endure challenging environments for sustained reliability.

- Metal-to-metal seals are expensive to fabricate requiring hard facing and multiple lapping steps in order to achieve low leak rates
- Increasingly demanding environments such as high temperature and pressure while maintaining sufficient compression strength and creep resistance necessary for seal longevity
- Most engineering plastics deteriorate quickly at high temperatures or cannot withstand thermal cycling



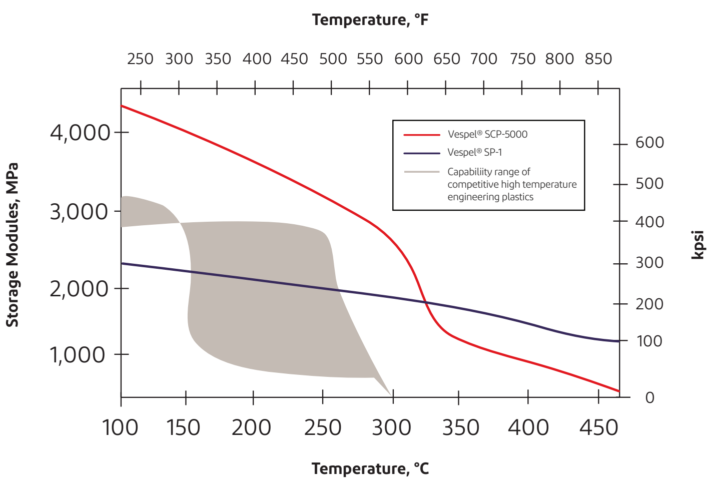
Vespel® SP and SCP parts and shapes can be used for sealing components like valve seals, ferrules, and gaskets to achieve bubble-tight closure at high temperatures.

Solutions

Sealing components made from the Vespel® SP and SCP families of products enable the combination of capabilities to meet demanding applications.

- Vespel® SP and SCP parts offer consistent properties maintaining tight seals across a wide range of temperatures
- High compressive strength and low creep rate enable higher operating pressures for long durations
- Low coefficient of friction and low wear rates between mating surfaces generate longer part life and clean environments (bearing grades)
- Vespel® SP and SCP parts and shapes can be machined to tight tolerances and sealing surface finishes using conventional machining techniques

Flexural Stiffness by Dynamic Mechanical Analysis: DuPont™ Vespel® SP-1 and SCP-5000 versus Competitive High-Temperature Engineering Plastics Used for Seals



Key Take-Away:

The science of Vespel® parts and shapes help jet engines run reliably and efficiently; keeps transmissions shifting longer; helps snowmobiles run smoother; keeps tractors working longer; and helps parts endure extreme environments from reactor chambers to deep space.

Vespel® polyimide polymers are superb material solutions for dynamic and static sealing applications. Vespel® polymers provide long life and sealing in extreme environments where other engineering plastics fail, and where metal-to-metal seals were previously considered the only option.

Benefits of Vespel® Parts and Shapes

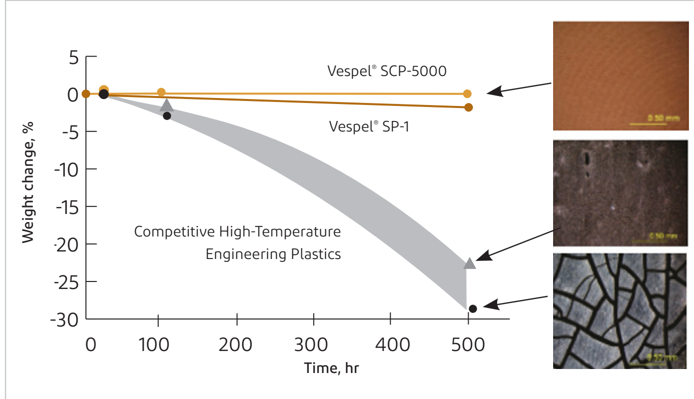
- Reduce total cost of ownership versus metal-to-metal seals
- Thermal degradation resistance can reduce life cycle cost via longer component life
- Lower coefficient of friction leads to smaller, lighter, and less expensive actuator components

Properties

Ability to withstand harsh environments. Temperature up to 550˚F for extended periods of time and excursions to 900˚F.

- High vacuum compatible
- Broad chemical compatibility
- Plasma and radiation resistant
- Self lubricating
- Oxygen service compatible

Weight Loss Test Results – Exposure to Air at 662 °F DuPont™ Vespel® Retains Its Weight and Shape



All samples were solid cylinders 10 mm diameter by 20 mm long. All samples dryed at 248 ° F for 4 hours prior to test.

Typical Properties – DuPont™ Vespel® Isostatic Shape Grades

	ASTM Method	Units	Vespel® SP					Vespel® SCP		
			SP-1 Unfilled	SP-21 Enhanced wear resistance	SP-22 Maximum creep resistance	SP-211 Lowest static friction	SP-3 Vacuum Bearing Grade	SCP-5000 Unfilled	SCP-50094 Highest PV limit grade	SCP-5050 Lowest CTE
Mechanical										
Tensile Strength, 23 °C (73 °F)	D1708/D638	MPa (kpsi)	86.2 (12.5)	65.5 (9.5)	61.7 (7.5)	44.8 (6.5)	56.5 (8.2)	1603 (23.6)	47 (26)	72 (10.5)
Tensile Strength, 260 °C (500 °F)	D1708/D638	MPa (kpsi)	41.4 (6.0)	37.9 (5.5)	23.4 (3.4)	24.1 (3.5)		62 (9)	95	39 (5.6)
Elongation at Break, 23 °C (73 °F)	D1708/D638	%	7.5	4.5	3.0	3.5	4.0	7.5	0.08	2.5
Elongation at Break, 260 °C (500 °F)	D1708/D638	%	6.0	3.0	2.0	3.0		49.0	13.0	5.3
Flexural Modules, 23 °C (73 °F)	D790	MPa (kpsi)	3100 (450)	3790 (550)	4830 (700)	3100 (450)	3280 (475)	5760 (836)	6360 (923)	7790 (1,130)
Flexural Modules, 260 °C (500 °F)	D790	MPa (kpsi)	1720 (250)	2550 (370)	2760 (400)	1380 (200)	1860 (270)	3010 (436)	3540 (514)	5100 (740)
Compressive Stress at 10% stain, 23 °C (73 °F)	D695	MPa (kpsi)	133 (19.3)	133 (19.3)	112 (16.3)	102 (14.8)	128 (18.5)	230 (33.4)	220 (31.9)	172 (25)
Deformation Under 13.8 MPa (2,000 psi) load	D621	%	0.14	0.10	0.08	0.13	0.12	0.05	0.05	0.03
Friction										
Coeff. of Friction at PV = .875 MPa m/s (25,000 psi-ft/min)*			0.29	0.24	0.20	0.12	0.25	0.26	0.25	
Coeff. of Friction at PV = 3.5 MPa m/s (100,000 psi-ft/min)*				0.12	0.09	0.08	0.17	0.15	0.07	
Static Coeff. of Friction in Air*			0.35	0.30	0.27	0.20				
PV Limit (unlubricated)**		MPa-m/s (kpsi ft/min)		12.3 (350)	12.3 (350)	3.5 (100)			17.5 (500)	
Other Properties										
Coeff. of Thermal Expansion, 23-300 °C (73-572 °F)	E831	µm/m/K (10-6 in/in °F)	54 (30)	49 (27)	38 (21)	54 (30)	52 (29)	47 (26)	43 (24)	29 (16)
Hardness	D785	Rockwell E	45-60	25-45	5-25	1-20	40-55	95	91	63
Water Absorption, 24 hr at 23 °C (73°F)	D570	%	0.24	0.19	0.14	0.21	0.23	0.08	0.06	0.04

* Versus carbon steel, steady state, unlubricated, in air, thrust bearing.
** PV limits for any material vary with different combinations of pressure and velocity as well as other conditions.

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