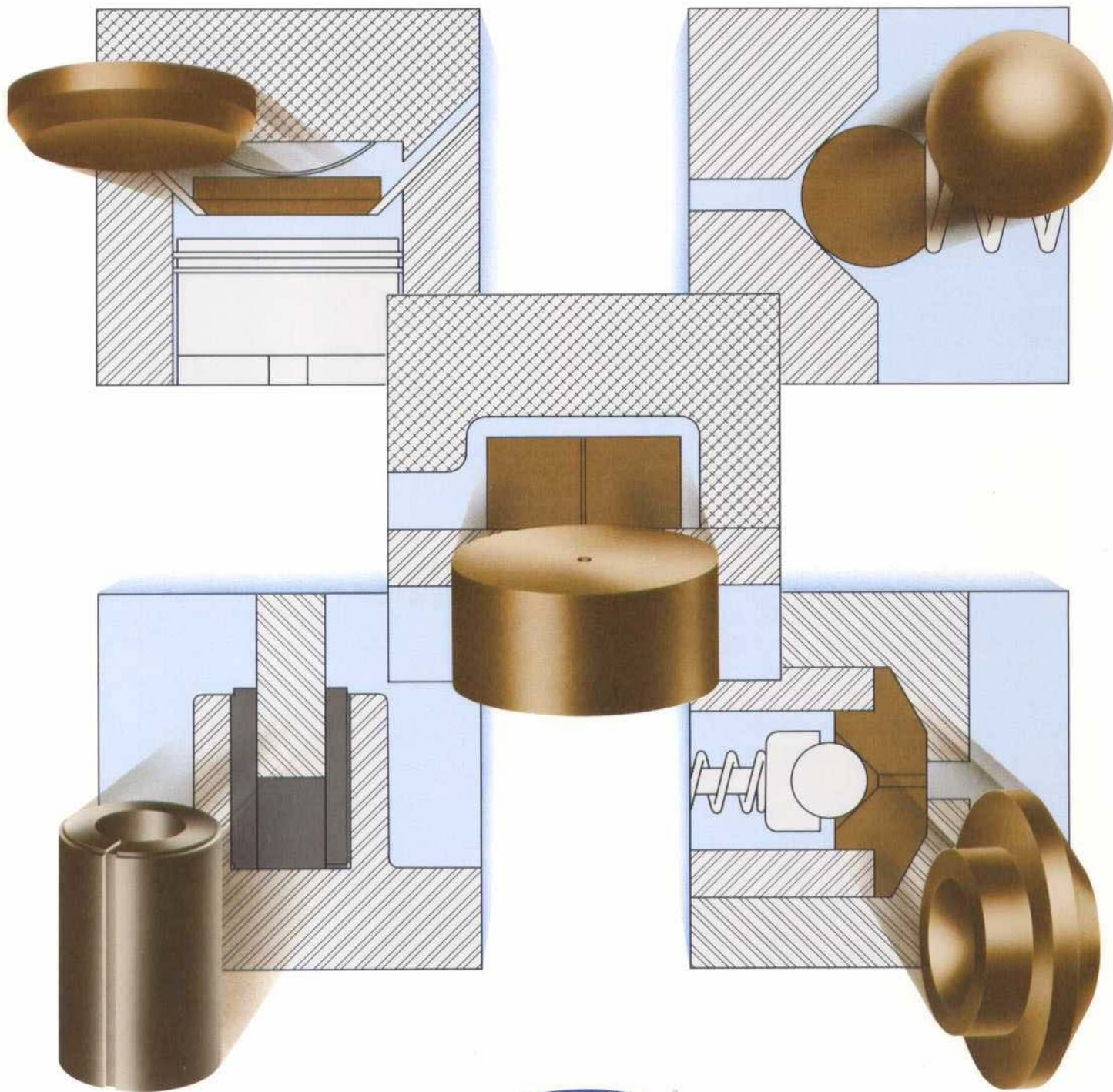


Solve your toughest valve designs
with *VESPEL*[®] polyimide parts:
The toughest parts of all.



Proven performance and reliability for your valve design problems

Over the past two decades VESPEL® polyimide parts have increased reliability, reduced leakage, and extended operating life in a variety of proven valve applications.

These high-performance, compliant parts from DuPont solve difficult sealing problems under the broadest range of temperature, pressure, and vacuum environments.

Not only are VESPEL parts proven in extreme environments, they can also cut manufacturing and maintenance costs, and minimize warranty claims and customer complaints. The result is a valve that saves you — and your customers — plenty of expense and headaches.

Why VESPEL parts perform where all others fail

Engineers rely on VESPEL parts for proven performance and reliability in critical applications because they offer a combination of properties unmatched by any other material. For example,

- VESPEL parts provide a *more reliable seal* than many metal-to-metal seals machined to much tighter tolerances. Their compliant "soft-seal" surface conforms to nicks and irregularities, and contamination in both metal surfaces and fluids.

They uniformly seal without permanent distortion or creep-related problems in extreme environments.

- VESPEL parts *operate reliably* in temperatures from cryogenic to 500°F, with excursions to 900°F. They carry loads at higher temperatures without creep or cold flow compared to other plastics, and do not melt.

- VESPEL parts can *reduce manufacturing costs* by eliminating hand-lapping or secondary grinding operations.

- VESPEL parts have *excellent machinability*. Where needed for complex shapes, they can hold

tolerances like metal.

- VESPEL parts have a *sealing surface not easily abraded* by metal or dirt particles in hydraulic oil.

- VESPEL parts have *extremely good wear resistance* — lubricated or unlubricated. Good in high friction areas — with low coefficient of friction, they resist seize-up even if lubrication fails.

- VESPEL parts are *chemically compatible* with fuels, solvents, industrial and hydraulic fluids, and many other materials.*

- VESPEL parts *seal light gases* like helium, and are oxygen compatible even at high temperature and pressure. VESPEL parts are also radiation resistant, and provide ultra-low outgassing in hard vacuums.

VESPEL parts, balls and machining stock: A form to fit every need

VESPEL performance is available in finished parts, made by DuPont to your specifications; in machining stock for low volume, proprietary, prototype, or complex geometry parts; or in standard size balls. VESPEL parts, balls and machining stock are manufactured in five compositions of SP polyimide resin to optimize the properties needed for a specific application (see below).

SP POLYIMIDE RESIN COMPOSITIONS

RESIN DESIGNATION	DESCRIPTION	CHARACTERISTICS
SP-1	Unfilled base resin	Provides maximum physical properties and best electrical and thermal insulation.
SP-21	*15%, by weight, graphite ⁽¹⁾ filler.	Graphite added to provide low wear and friction for bearings, thrust washers, and dynamic seals.
SP-22	*40%, by weight, graphite ⁽¹⁾ filler.	Same as SP-21 for wear and friction plus improved dimensional stability. It has the lowest coefficient of thermal expansion
SP-211	*15%, by weight, graphite ⁽¹⁾ and 10% by weight Teflon® fluorocarbon resin fillers.	Has lowest coefficient of friction over wide range of operating conditions. Also, has lowest wear rate up to 300°F.
SP-3	*15%, by weight, molybdenum disulfide.	MoS ₂ added to provide lubrication for seals and bearings in vacuum or dry environments.
*Nominal (1) Encapsulated		

*Not recommended for long-term use in steam, acids or strong bases.

VESPEL parts handle the tough applications

In new designs, impossible with lesser materials, or where original components just couldn't hold up — engineers solve all kinds of valve design problems with VESPEL polyimide parts.

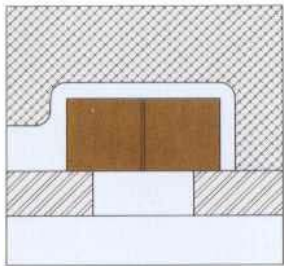
In nearly every case, VESPEL parts pay for themselves many times over by keeping reliability high, maintenance and warranty claims low.

SUMMARY OF TYPICAL PROPERTIES

PROPERTY	(°F) TEMP.	UNITS	SP-1	SP-21	SP-22	SP-211	SP-3
Tensile Strength	73	PSI	12,500	9,500	7,500	6,500	8,200
Ultimate	500	PSI	6,000	5,500	3,400	3,500	—
Elongation	73	%	7.5	4.5	3.0	3.5	4.0
Ultimate	500	%	7.0	2.5	2.5	3.0	—
Flexural Modulus	73	10 ³ PSI	450	550	700	450	—
	500	10 ³ PSI	250	370	400	200	—
Compressive Modulus	73	10 ³ PSI	350	420	475	300	—
Wear Rate		in/1000 hrs.	25-1.2	.09	.06	.07	25-33
Friction Coefficient PV-25,000			.29	.24	.30	.12	.25
Static Coefficient In Air			.35	.30	.27	.20	—
Coefficient of Linear Expansion	73-572	10 ⁻⁶ in/in/°F	30	27	21	30	—

Take a look at how these manufacturers have trusted the tough applications to VESPEL parts.

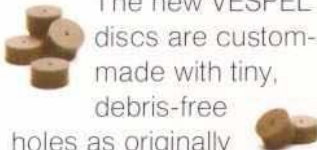
■ A precision .015" diameter hole in the VESPEL disc of a poppet valve is required to control automotive transmission fluid bleedback. Metal could



not be economically drilled at the required hole diameter.

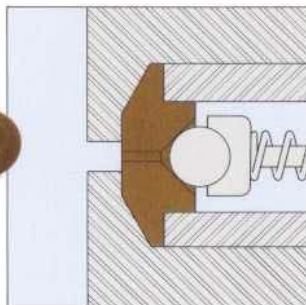
The new VESPEL discs are custom-made with tiny, debris-free

holes as originally specified, and require no



machining. The VESPEL discs reduce wear against the aluminum valve body, and withstand impact without deformation.

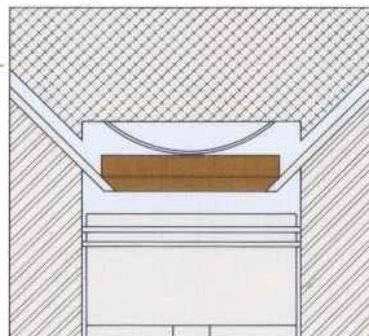
■ In hydraulic pressure relief valves on farm tractors, VESPEL seats provide a mandatory no-leak seal in 275°F hydraulic oil and resist 3,750 psi without creep. The VESPEL seats conform to the ball's



shape and reseal even in the presence of metal or dirt particles. The VESPEL seats increase system reliability and reduce customer complaints.

■ Fifteen years at 1750 cycles per minute — that's how long a VESPEL disc is projected to reliably seal a poppet-type discharge valve in a commercial refrigeration compressor. Using VESPEL parts successfully where all other plastics and

metals had failed



due to fatigue allows a totally new valve design — one that increases compressor efficiency by 15 percent, and capacity by 25 percent, and dramatically reduces operating noise. The VESPEL seal

performs in 350°F, 350 psi FREON® gas systems, and withstands periodic liquid slugging.

■ A VESPEL stem guide allows a maker of pneumatic controls to extend the service tem-



perature and reliability of its top-of-the-line system. Replacing polyurethane, the VESPEL part performs

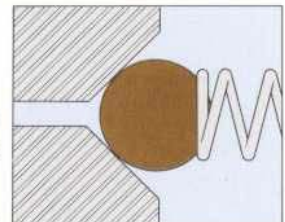
at 500°F without softening. It remains self-lubricating and has low coefficient of friction at high temperatures, and withstands repeated impact without deformation.

■ An aircraft engine subcontractor relies on VESPEL ball checks for critical sealing in its back-up fuel control valves. The VESPEL balls



provide lightweight sealing performance during aircraft maneuvers at pressure ranges from 5

to 250 psi. They operate distortion-free in jet fuel at temperatures up to 300°F, and ensure low wear against the anodized aluminum seat.



VESPEL[®] polyimide parts ... When it absolutely has to work.

For more than 15 years, VESPEL parts have performed critical functions in space vehicles, aircraft engines, automobiles, business machines, off-road vehicles, farm equipment, electronic equipment, and more. Originally used as a "problem solver" in areas where other materials resulted in costly failures, VESPEL parts are increasingly being chosen for newly-designed, high-performance equipment where reliable, long-lasting, quality components are a must.

Despite similar-sounding names of competitive materials, VESPEL parts made from SP polyimide are in a class by themselves. Unlike all other plastics, DuPont's *SP polyimide does not melt* — and no other material offers its

unique combination of properties. To assure consistent quality and supply, DuPont manufactures VESPEL parts and machining stock at plants in the United States and Japan.*

The extraordinary properties of VESPEL parts may not always be required. Initial costs are generally higher than standard materials, and where performance requirements are low, commonplace materials may be used successfully. But in the tough applications, the higher purchase price of VESPEL parts is quickly recovered by savings in manufacturing, reliability and longer component life.

When superior performance and reliability are essential to trim overall costs, the solution is simple — VESPEL polyimide parts.

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*Plant at Utsunomiya, Japan scheduled for start-up in early 1984.

