DUPONT®

Vespel®

polyimide parts and shapes

Proven Performers in Semiconductor Manufacture

Semiconductors

Semiconductors

Vespel®: The Right Stuff for Semiconductor Production

DuPont Vespel® polyimide parts come with a documented record of reliability and durability in wafer handling, wafer processing, IC handling and testing and other semiconductor manufacturing operations.

As an alternative to ceramics, quartz and unproven types of plastics, Vespel® parts reduce ownership costs with longer life in the chamber and extended maintenance intervals. And they often cost less right up front.

Super clean to improve die yields

Vespel® gives you the cleanliness needed to deliver consistently high yields. DuPont process research and manufacturing controls have kept pace with the fab's needs for ever cleaner materials. Vespel® parts are exceptionally clean, providing extremely high purity, negligible trace metal content, virtually no particulate shedding in plasma and insignificant outgassing.

To meet ever tightening contamination requirements, DuPont is continuously improving the cleanliness of Vespel® parts. For the latest available test data, contact our nearest customer support site listed on the back page.

Strong, tough to resist damage

Vespel® parts provide a unique combination of strength, toughness and low wear to withstand the rigors of repeated handling, cleaning cycles, mechanical abuse and permanent deformation. And their good compliance allows reliable sealing. Table 1 outlines typical mechanical properties.

Stands up at high temperatures

Vespel® parts serve reliably at temperatures up to 288°C (550°F) in many applications. For limited periods, they can endure temperatures of 482°C (900°F) or more. Elevated temperatures have little effect on mechanical properties such as tensile strength, elongation, flexural modulus and compressive strength.

Low in wear and friction

With low friction and superior wear performance over a broad temperature range, Vespel® parts are a good choice for sliding contact and applications where interfacial temperatures are high.

Holds close tolerances

Compared with other polymer components, Vespel® parts provide superior dimensional stability. Vespel® has no observable softening or melting point, and its coefficient of thermal expansion is low. Creep resistance is high. (For creep and other enginering data, contact our nearest customer support site listed on the back page to obtain a copy of DuPont publication H-15724-1.)

Resists chemical attack

Vespel® parts are compatible with most gases typically used in key semiconductor process vessels, including epitaxial reactors, photoresist developers, dry etchers and ion implanters. Most solvents, etchants, electronic chemicals, vacuum fluids and hydraulic oils have no significant effect on Vespel® parts.

First-class electrical insulators

Vespel® parts provide the excellent dielectric properties required for semiconductor processing components (see Table 2).

TABLE 1: **Typical properties of Vespel® parts (SP-1 Resin)**

Property	Test Method	Test Temp. °F (°C)	Typical Value
Tensile strength, ultimate, psi (MPa)	ASTM D 638	73 (23) 500(260)	12,500 (86.5) 6,000 (41.2)
Elongation, ultimate, %	ASTM D 638	73 (23) 500(260)	7.5 6.0
Flexural modulus, kpsi (MPa)	ASTM D 790	73 (23) 500(260)	450 (3,103) 250 (1,724)
Compressive modulus, kpsi (MPa)	ASTM D 695	73 (23)	350 (2,413)
Coefficient of friction	Unlubricated		
Dynamic*	–	0.29	–
Static	–	0.35	–
Coefficient of linear thermal expansion, 10^{-6} in./in./°F (µm/m/°K)	ASTM D 696	73-572 (23-300)	30 (54)
Thermal conductivity, W/m °K	–	104 (40)	0.35
Underwriters Laboratories flammability rating	UL 94	94 V-0, 94-5V	–

*Steady state, unlubricated in air, PV = 25,000 lbf/in^2·fpm (0.875 MPa·m/s)

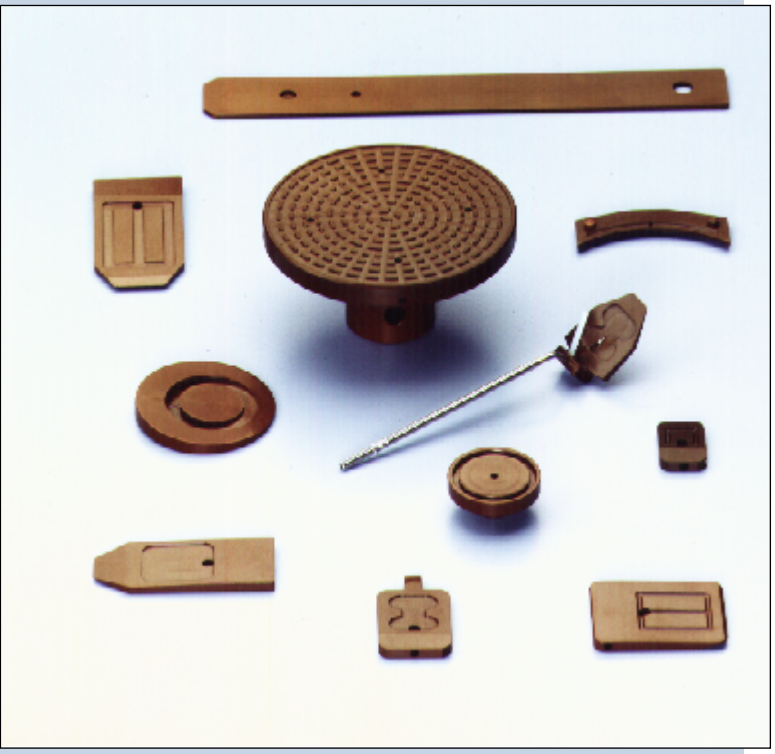
TABLE 2: **Typical electrical properties of Vespel® parts (SP-1 resin)**

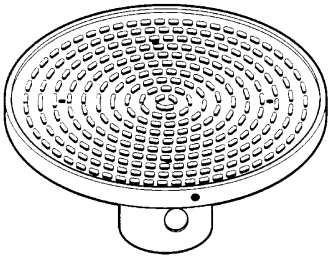
Property	Test Method	Test Temp. °F (°C)	Typical Value
Dielectric constant	ASTM D 150	73 (23)	
@ 10^2 Hz			3.62
@ 10^4 Hz			3.64
@ 10^6 Hz			3.55
Dissipation Factor	ASTM D 150	73 (23)	
@ 10^2 Hz			0.0018
@ 10^4 Hz			0.0036
@ 10^6 Hz			0.0034
Dielectric strength: short term @ 0.080 in. (2 mm) thickness, V/mil (kV/mm)	ASTM D 257	73 (23)	560 (22)
Volume resistivity, Ω-m	ASTM D 257	73 (23)	10^{14} - 10^{15}
Surface resistivity, Ω	ASTM D 257	73 (23)	10^{15} - 10^{16}

Wafer Processing

Wherever a wafer process requires resilient, long-wearing parts to cushion, dampen or isolate, Vespel® usually provides a viable solution.

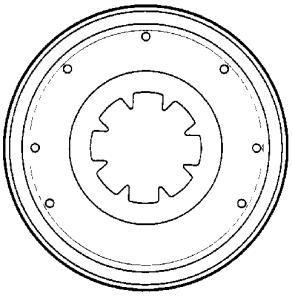
Candidate applications include crystal slicing, photoresist applications, dry etching and ion implantation. Typical Vespel® parts used in such processes are shown here.





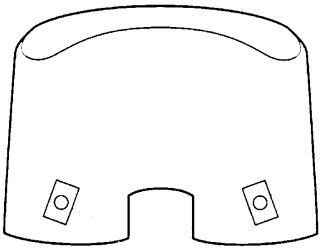
Spin chuck surface

During the application of photoresist, this Vespel® part grips wafers firmly but gently. Its complex surface was easily machined to close tolerances. Vespel® provides long wear and minimum contamination.



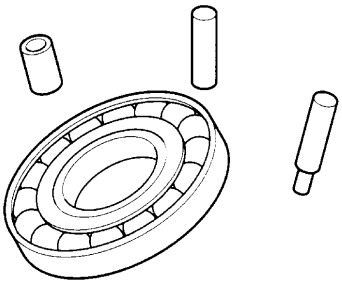
Wafer clamping ring

Used in oxide etching, the Vespel® clamping ring withstands extremely aggressive conditions. It maintains strength, resilience and dimensional stability at operating temperatures of 288°C (550°F), high plasma energy, and vacuum to 10^{-9} torr. Service life depends on chamber conditions, including types of etchant gases.



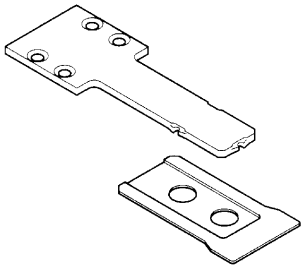
Insulators

Vespel® parts work as both thermal and electrical insulators. The insulators shown separate wafers from a stainless steel pedestal during ion implantation. The use of Vespel® minimizes contamination and extends service life with high process yield and reduced downtime.



Bearings, centering pins

Vespel® parts such as these require no lubrication and exhibit low friction as key parts for implantation of impurity atoms. The bearing retainer is a special composition of Vespel® tailored for superior wear resistance in a vacuum environment.

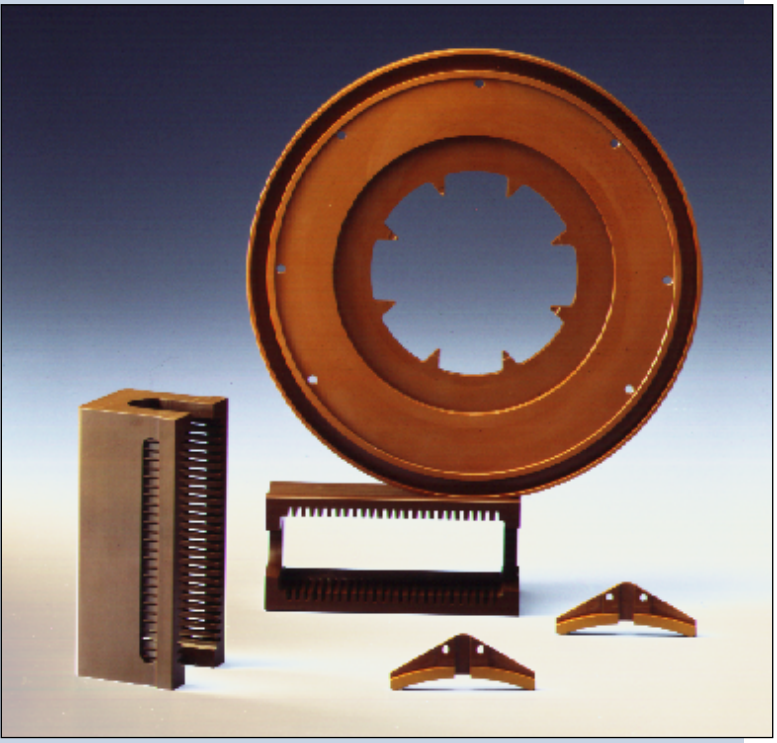


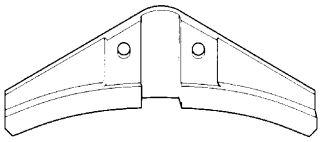
Vacuum pads

Attached to robot arms, Vespel® pads hold wafers while they are removed from various processing setps.

Wafer Handling

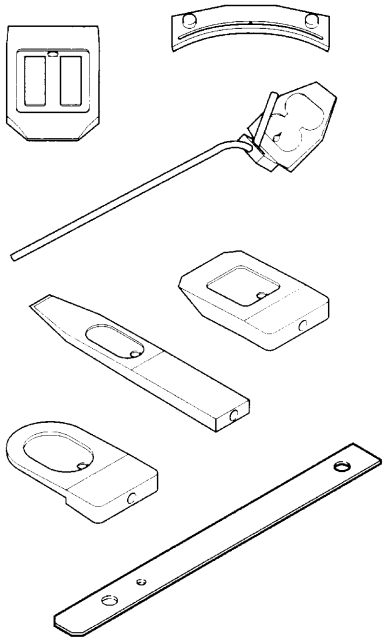
Automated wafer handling systems require contact surfaces that are resilient, long wearing, free of particulate and dimensionally stable. Because Vespel® parts can meet all these requirements, they are widely used in vacuum pickup systems, carrying devices and positioning assemblies.





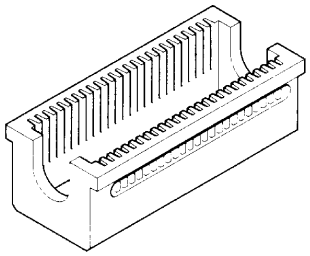
Wafer guides

These Vespel® guides withstand process temperatures up to 288°C (550°F) without damage or deformation. The resilience of Vespel® and its low thermal conductivity help avoid buildup of thermal stresses in wafers. And Vespel® minimizes particulate contamination.



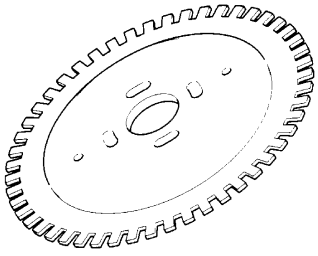
Vacuum pickup strips and tips

Vespel® parts only 1 to 3 mm thick are milled to permit air passages and bonded to stainless steel in such applications. Vespel® meets needs for strength to hold up in such thin sections and resilience to help protect wafers from handling damage.



Wafer carriers

As wafer carriers and wafer contact surfaces in such carriers, Vespel® parts far outperform various other polymer components in resistance to elevated temperatures and process conditions. This Vespel® carrier's intricate design features, including slots and undercuts, were readily machined to close tolerances.

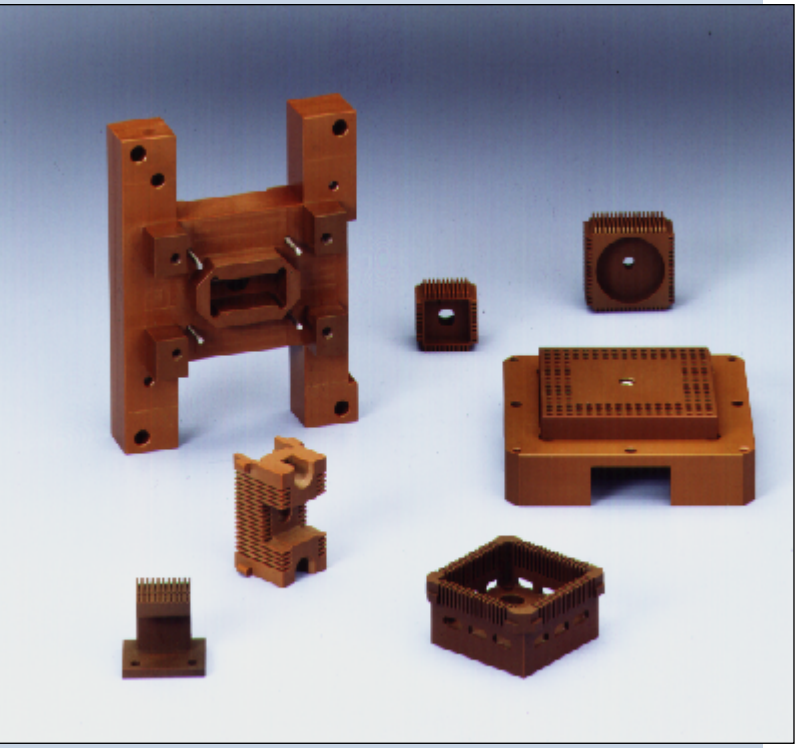


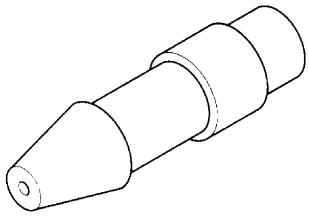
Probe check insulators

In holding wafers during testing of individual circuit chips, these Vespel® components help minimize contamination and hold the close tolerances needed for precise positioning for testing.

IC Handling and Testing

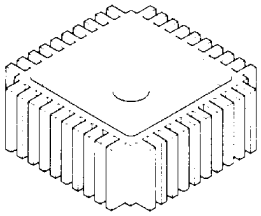
Vespel® gives you the excellent dielectric performance and mechanical properties needed in apparatus for handling and testing integrated circuits in packaging operations.

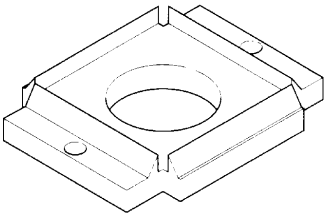


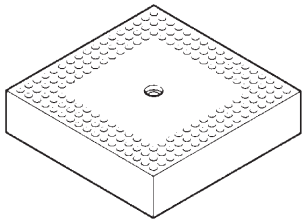


Die-pickup collets

For handling diced chips during packaging, Vespel® collets meet needs for resilience and cleanliness. These parts were easily machined to the precise tolerances required.

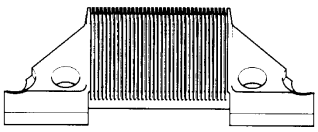






Test sites and holders

In these thin-walled components, Vespel® provides excellent dielectrics and outperforms ceramics in strength, toughness and resilience to protect circuits from damage during testing. In some cases, metal contacts are adhesive-bonded in place. The Vespel® parts also fill the need for dimensional stability over a wide range of test tempertures.



Insulators and wear strips

Used during testing and packaging steps, these Vespel® parts resist wear and have low friction against components made of other materials. Their configuration attests to the feasibility of machining Vespel® with high precision.

How to Obtain Vespel® Parts

DuPont manufactures Vespel® in a wide and growing range of standard and custom shapes. Standard shapes include ring, rod, bar and slab stock. Although the shapes are sometimes used as is, they are usually machined to make complex components with precise dimensions.

DuPont is continually expanding the range of standard Vespel® shapes and sizes to allow production of larger parts and to reduce machining waste and costs. For up-to-date information about sizes and shapes, please contact the nearest customer support site listed here.

A number of specialized component suppliers offer Vespel® parts in their standard product lines and machine them to user specifications. Custom-machined parts can also be obtained through many machine shops or ordered directly from DuPont.

We stand ready to help in meeting your needs for economical high-performance components for semiconductor manufacturing. Give us a call today.

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Start with DuPont

For more information about Vespel® parts, ask for copies of the following literature:

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www.dupont.com/enggpolymers/americas/products/vespel.html

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