VESPEL®

SF-

0920

0930

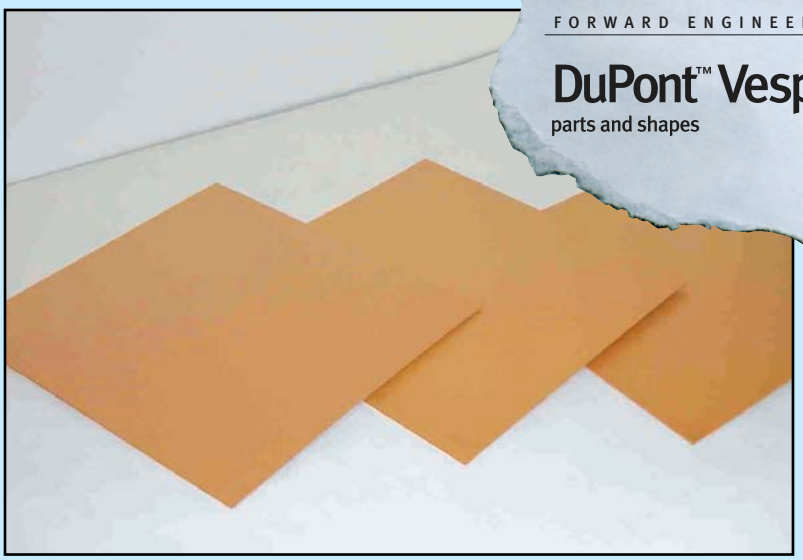
0940

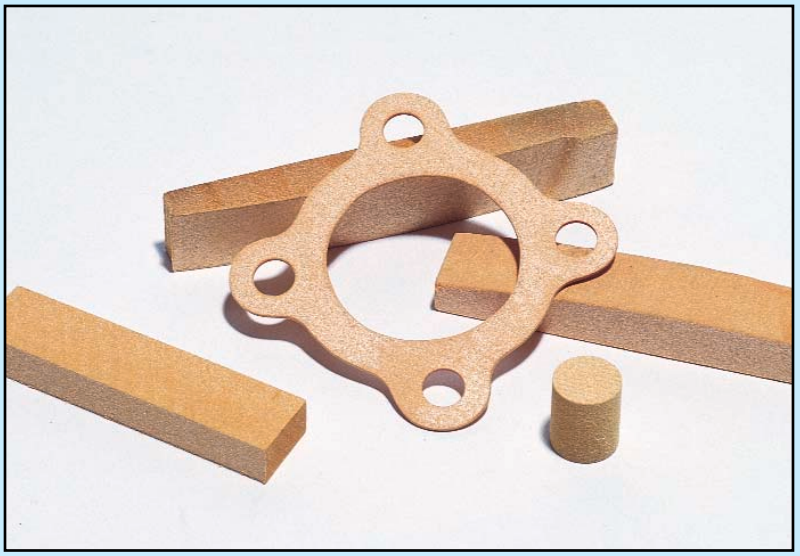
FOR INSULATING, ACOUSTICAL AND SEALING SOLUTIONS AT ELEVATED TEMPERATURES

FORWARD ENGINEERING

DuPont™ Vespel®

parts and shapes





GENERAL MACHINING GUIDE

DUPONT

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VESPEL®

SF- FOR INSULATING, ACOUSTICAL AND SEALING SOLUTIONS AT ELEVATED TEMPERATURES

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DuPont™ Vespel® SF parts are a family of DuPont Proprietary Products which offer insulation, acoustical and sealing properties, particularly at elevated temperatures. The low density offering (SF-0920) does not have enough strength or material integrity to be machined. This offering is produced in sheet form and is blade or hot wire cut to desired perimeter sizes. The medium (SF-0930) to high (SF-0940) density offering can be machined with standard metalworking equipment to produce tolerances once considered too close for foam materials. This is possible due to the material's mechanical strength, stiffness and dimensional stability in the densified state. In most cases, the techniques used in machining metals are directly applicable.

This document is intended to be used as a guide only. The speeds and feeds recommended for specific machining operations are given as a starting point based upon the experience of the DuPont composite parts manufacturing organization.

Special Considerations

- **PROCESSING SAFETY**

  BEFORE MACHINING VESPEL® SF, READ THE MATERIAL SAFETY DATA SHEET.
  - – Machining conditions are correct when no smoke is generated during machining.
  - – Do not allow the material to get so hot that it is uncomfortable to grasp in your bare hands.
  - – A dust removal system is necessary for grinding operations.

- **SUGGESTED TOOLING**

  Grinding is the preferred method of machining contours and/or finished part dimensions.

Sawing and Drilling

Vespel® SF-0940 shapes are easily cut and drilled. Sawing and drilling guidelines typically used for materials such as aluminum can be used for machining Vespel® SF.

Vespel® SF-0930 needs support above and below the work piece to be cut and drilled. Use of acrylic sheeting for support has been successful. Because the SF-0930 offering has a slightly higher density skin form on the top and bottom surface of the molded plate and the material is inherently weaker than the higher density SF-0940, a burr may form at the exit end of the work piece. A light sanding operation may be needed to remove this hanging skin condition.

For cutting large quantities of material with a band saw, a 10 TPI high speed or carbide-tipped blade, with a standard saw set at 800 feet per minute (244 meters per minute) is recommended.

For drilling large quantities of material, a high speed or carbide-tipped drill is recommended to minimize tool wear.

Holding DuPont™ Vespel® SF Shapes

The main precaution in holding Vespel® SF-0930 and SF-0940 shapes for machining is to prevent any deflection caused by the holding fixture, collet or chuck. Unlike metal, foam will deform if held too tight.

- **RELIABLE HOLDING METHODS**
  - – O.D. or I.D. collet: This is the most reliable holding device with sufficient pressure to ensure a good hold.
  - – Chuck: Pie-Jaws that contact approximately 90% of the O.D. surface are recommended for uniform distribution of holding forces when machining thin-walled, tight-tolerance parts.
  - – Fixtures or vises.

Turning

Vespel® SF-0940 and materials at the higher end of the density range of the SF-0930 offering can be machined by using standard lathe, chucker or screw techniques. There may not be enough strength at the lower density range of the SF-0930 to be able to achieve desired results. To produce good machining finishes on turned higher density Vespel® SF pieces, follow these suggestions:

- – Use carbide or diamond-tipped tools for work requiring close tolerances.
- – Tools with a 5° to 15° rake angle at the front face.
- – Feeds and speeds used for turning aluminum can be used as a guideline for Vespel® SF-0930 and SF-0940.

Milling

In general, milling conditions for higher-density Vespel® SF offerings are similar to those used for metals. One should exercise the same precautions previously mentioned regarding heat buildup and care in holding.

- **RECOMMENDED PRACTICES**
  - – Avoid overtightening in fixture to avoid material deflection.
  - – Use 3 or 4 flute carbide end-mills or fly cutters whenever possible.
  - – Cross and down feeds listed below have been demonstrated to produce good results:

	Cross feed		**Down feed**	
	English Units (in./rev.)	SI Units (mm/rev.)	English Units (in./rev.)	SI Units (mm/rev.)
Rough Machining	0.004 - 0.006	0.1 - 0.15	0.002 - 0.004	0.05 - 0.10
Finish Machining	0.003 - 0.005	0.076 - 0.13	0.002 - 0.004	0.05 - 0.10

Grinding

Close tolerance and contour machining can be achieved by grinding and is the preferred method. A diamond dresser as used in steel finishing provides good results. Grinding is typically performed without coolant. There will be dust generation that would require a dust removal system.

Typical operating conditions when using a 1/2-in. wide (12.7 mm), 7-in. wide (178 mm) wheel are:

	English Units	SI Units
Table Surface Velocity	80 ft./min.	2.44 m/min.
Cross Feed	0.020 in./pass	0.51 mm/pass
Down Feed	0.005 - 0.020 in./pass	0.13 - 0.51 mm/pass
Wheel Surface Speed	3000 - 4000 ft./min.	914 - 1219 m/min.

Measuring/Inspecting Parts

Although the same tools used to measure metal parts can be used to measure Vespel® SF parts, techniques differ because the possibility of deflection is greater with polymer matrix parts under the stress applied during measurement.

- **MICROMETER**
  When measuring the O.D. of rings (especially thin walled), do not use the micrometer in the usual fashion (twisting the barrel until it feels snug or until the ratchet slips) as this may actually deform the parts, causing an incorrect reading of the tolerance. Rather, try passing the parts through the gap, using the micrometer as a “no go” gauge. Use the same procedure for the upper tolerance limit, using the micrometer as a “go” gauge. The part should pass through without any pressure applied. To minimize distortion of thin-walled cross-sections, a correctly sized I.D. plug may be inserted into parts.

- **PLUG GAUGE**
  When measuring hole sizes with a plug gauge, avoid forcing the plug into the hole, as it is entirely possible to force a plug gauge into a hole as much as 0.004 in. (0.1 mm) under the plug gauge size, depending on the part design. Generally, plug gauges are better than hole micrometers because of the deformation the micrometers may cause. Air gauges work well for measuring internal diameters.

- **SURFACE FINISH**
  Inspect surface finishes using a visual reference. Measurements obtained using a surface profilometer can be erratic due to differences in hardness between polymer matrix and fiber reinforcement.

General Safety Considerations

– Please read MSDS (Material Safety Data Sheet) before machining.

– Avoid inhaling dust, and wash hands thoroughly before smoking or eating.

Machining Tolerance Guidelines

The following table has been assembled as a quick reference guide outlining some typical machining tolerances achievable using higher density Vespel® SF. This is not meant to represent the product's limitations.

Feature	Standard		Best (Small)		Best (Large)	
	English Units (in.)	SI Units (mm)	English Units (in.)	SI Units (mm)	English Units (in.)	SI Units (mm)
I.D. (Ave.)	±0.010	±0.254	±0.002	±0.010	±0.005	±0.010
O.D. (Ave.)	±0.010	±0.254	±0.002	±0.010	±0.005	±0.010
Length	±0.020	±0.508	±0.005	±0.010	±0.010	±0.254
Counterbore Diameter	±0.010	±0.254	±0.002	±0.010	±0.005	±0.010
Filet Radius	±0.010	±0.254	±0.005	±0.010	±0.005	±0.010
Chamfer Depth	±0.020	±0.508	±0.010	±0.254	±0.010	±0.254
Counterbore Depth	±0.010	±0.254	±0.003	±0.076	±0.005	±0.010
Countersink Diameter	±0.020	±0.508	±0.005	0.010	±0.010	±0.254
Concentricity	0.010	0.254	0.005	0.010	0.010	0.254
Roundness	0.020	0.508	0.005	0.010	0.010	0.254
Run-out (Face)	0.010	0.254	0.003	0.076	0.006	0.152
Squareness	0.010	0.254	0.003	0.076	0.006	0.152
Flatness	0.010	0.254	0.003	0.076	0.006	0.152
Angularity	±5°		±3°		±3°	

Feature	Standard		Best (Small)		Best (Large)	
	English Units (microinches)	SI Units (micrometers)	English Units (microinches)	SI Units (micrometers)	English Units (microinches)	SI Units (micrometers)
Surf. Finish (Machined)	125	3	63	2	63	2
Surf. Finish (Cut)	250	6	250	6	250	6
Surf. Finish (Ground)	32	0.8	32	0.8	32	0.8

Notes: (1) Small implies O.D. < 4 in. (101 mm), Length < 1 in. (25.4 mm), and/or Wall Thk. < 0.1 in. (2.54 mm).
(2) Surface finishes are in RMS/Rg and are based upon comparison with visual equivalents.

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