

# TECHNICAL BULLETIN: PTFE ETCHING

The chemical, heat, and weather resistance, durability, flexibility, and dielectric properties, make fluoropolymers an ideal choice for applications in chemical processing, pharmaceutical, and electronics industries. However, these outstanding physical properties, also make them resistant to most bonding agents. Their smooth atomic structures do not provide a surface conducive to adhesion.

IPM-TEK offers etching services, for whole or partial surfaces, of Rings, Bushings, and other virgin PTFE and filled PTFE products that we produce. In general, etching changes the physical structure of the top layer of the fluoropolymer through a chemical reaction, which extracts fluorine atoms, only affecting it to a depth of a few angstroms. This chemical reaction forms a layer (identifiable by its brown color), which readily accepts most adhesives, making the fluoropolymer bondable to itself, or other materials.

**Sheets and skived tapes, etched on one or two sides, are available in the following standard sizes.**

#### Sheets

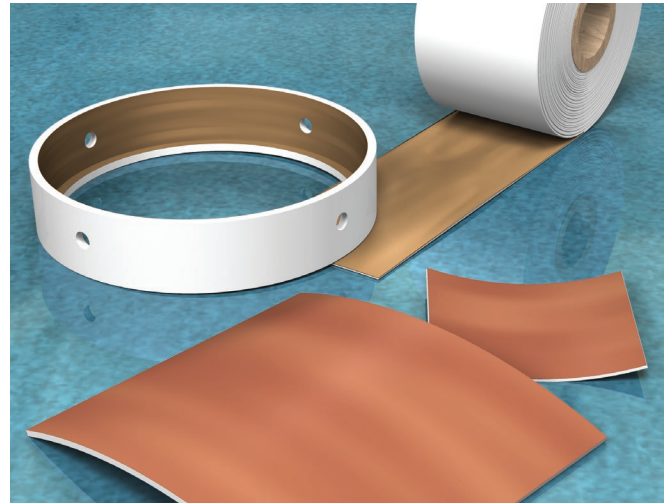
Thickness: 1.5 mm (min.) - 100 mm (max.)  
 Sizes (mm): 600 x 600      1000 x 1000  
 1200 x 1200      1500 x 1500

#### Skived Tapes

Thickness: 0.020 mm (min.) - 4 mm (max.)  
 Width: 300 mm (min.) - 1500 mm (max.)

#### Etching Quality

IPM-TEK is able to guarantee the quality of the etching by maintaining strict control over the etching process and through evaluation of the etching itself through wettability testing (Contact Angle Method), and an adhesion test (ref. ASTM D903).



**Both Virgin PTFE and Filled PTFE products can be etched in preparation for bonding.**

**Contact Angle Method:** Based on the measure of the angle between the tangent to a distilled water drop and the PTFE surface (i.e. the contact angle).

**Figure 1** shows two examples of the contact angle method, one on an unetched surface (poor wetting) and one on an etched surface (good wetting).

**Figure 2** shows how the contact angle can determine the effectiveness of the etching.

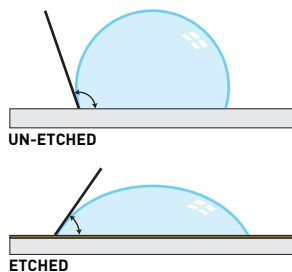
**Figure 3** shows contact angle vs. surface energy. Contact angle and surface energy of etched PTFE are related by the following formula:

$$E_s = 72 = \frac{\cos \theta - 1}{0.025}$$

$E_s$  = Surface Energy (dynes/cm)

$\theta$  = Contact Angle (degrees)

**Figure 1**



**Figure 2**

Contact Angle	Degree of Etching
20° - 45°	Excellent
46° - 60°	Fair
>60°	Poor

**Figure 3**

**CONTACT ANGLE vs. SURFACE ENERGY**

