Gas Permeability

All plastics have some permeability to gases. In the case of Teflon™ FEP Encapsulated O-Rings, however, gases and vapors will permeate at a considerably lower rate than for most other plastics. The primary permeation mechanism is intermolecular migration. This migration rate depends on the type of gas, pressure, temperature, size of contact areas, and thickness of encapsulation. While highly corrosive gases do not attack the Teflon™FEP Encapsulation of the o-ring, they may eventually permeate through and damage the elastomer core and hence affect the mechanical properties. Thus, in addition to chemical resistance, these permeability effects must be considered in gas sealing systems.

Permeability of Teflon™ FEP Resins

(gm/100in²/24 hrs-1mil)[1] TABLE 1

GASES[2]	23°C/73°F	35°C/95°F	50°C/122°F
Carbon Dioxide			
Helium			
Hydrogen Chloride			
Nitrogen	0.18		
Oxygen	0.39		
VAPORS[3]			
Acetic Acid		0.42	
Acetone	0.13	0.95	3.29
Acetophenone	0.47		
Benzene	0.15	0.64	
N-Butyl Ether	0.08		0.65
Carbon Tetrachloride	0.11	0.31	
Decane	0.72		1.03
Dipentene	0.17		0.35
Ethyl Acetate	0.06	0.77	2.90
Ethyl Alcohol	0.11	0.69	
Hexane		0.57	
Hydrochloric Acid (20%)	<0.01		
Methanol			5.61
Piperdine	0.04		
Skydrol Hydraulic Fluid	0.05		
Sodium Hydroxide (50%)	$4x10^{-5}$		
Sulfuric Acid (98%)	$8x10^{-6}$		
Toluene	0.37		2.93
Water	0.09	0.45	0.89

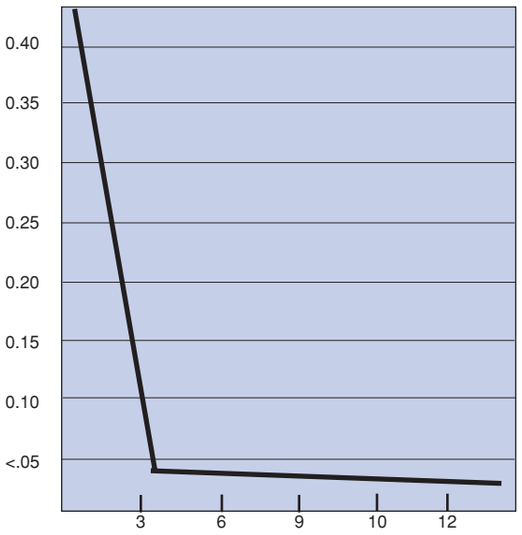
1. Note that the permeation data listed in Table 1 is based on 0.001" thickness of Teflon™ FEP encapsulation. ***The transmission rate significantly decreases when the thickness of encapsulation is increased. See water vapor transmission rate chart.***
2. Test method: ASTM D-790-59 (at 1atm).
3. Test method: ASTM E-96-53T (vapor Pressure).

Absorption

Teflon™ FEP Encapsulated O-Rings absorb practically no common acids or bases at temperatures as high as 200°C/329°F with exposures up to one year. Even the absorption of solvents is surprisingly small; weight increases are generally less than 1% at elevated temperatures and exposure times. Due to the Teflon™ FEP encapsulation, the effects of volume swell (one of the principal causes of seal failure) can be virtually ignored.

Water Vapor Transmission Rate of Teflon™FEP Resins @ 40°C/104°F

Transmission Rate = gm/100in²/24hrs



Please note that the vapor transmission rate significantly decreases when the thickness of encapsulation is increased

Thickness of Encapsulation

As discussed earlier, the thickness of encapsulation must be considered in determining migration rates. The thickness of the encapsulation varies with the cross section of the o-ring.

Cross Section (mm/inches)	Wall Section (mm/inches)	Cross Section (mm/inches)	Wall Section (mm/inches)
1.50mm/.059	0.203mm/.008	7.50mm/.295	0.508mm/.020
1.60mm/.063	0.203mm/.008	8.00mm/.312	0.508mm/.020
1.78mm/.070	0.254mm/.010	8.40mm/.330	0.508mm/.020
2.00mm/.079	0.254mm/.010	9.00mm/.354	0.508mm/.020
2.40mm/.094	0.254mm/.010	9.50mm/.374	0.508mm/.020
2.62mm/.103	0.279mm/.011	10.00mm/.393	0.508mm/.020
3.00mm/.118	0.279mm/.011	11.00mm/.433	0.762mm/.030
3.53mm/.139	0.305mm/.012	12.00mm/.472	0.762mm/.030
4.00mm/.157	0.305mm/.012	12.70mm/.500	0.762mm/.030
4.50mm/.177	0.381mm/.015	14.00mm/.551	0.762mm/.030
5.00mm/.196	0.381mm/.015	15.00mm/.591	0.762mm/.030
5.33mm/.210	0.381mm/.015	16.00mm/.625	0.762mm/.030
5.70mm/.225	0.381mm/.015	18.00mm/.708	0.762mm/.030
6.00mm/.236	0.381mm/.015	19.00mm/.750	0.762mm/.030
7.00mm/.275	0.508mm/.020	20.00mm/.787	0.762mm/.030

Final selection of applications must be based on functional evaluations or experience under actual end use conditions. This has become industry practice dictated by the many complex aspects of performance in severe conditions. The end user should thoroughly test any application, and independently conclude satisfactory performance of the product for his intended use, and shall assume all risk and liability whatsoever in connection therewith.