Table 2 - Permeability Coefficient of Common Polymers (Plastics)

Polymer	Common/Trade Name	Permeability Coeffcients at 25∞C (P × 10^{10}) Oxygen	Moisture
Poly(isoprene)	Natural Rubber	23.3	2290
Poly(chloroprene)	Neoprene G	4.0	910
Poly(isobutene-coisonrene)	Butyl Rubber	1.3	110
Poly(vinyl chloride)	PVC (unplasticized)	0.045	275
Poly(tetrafluoroethylene)	Teflon	4.2	4.8
Poly(tetrafluoroethylene-co)	Teflone FEP	4.9	17
Poly(ethylene), low density (0.914 g/cm^3)	LDPE	2.2	68
Poly(ethylene), high density (0.964 g/cm^3)	HDPE	0.3	9
Poly(propylene) density (0.907 g/cm^3)	PP	1.2	35
Poly(vinyledene chloride)	Saran	0.005	0.5
Poly(trifluoro chloroethylene)	Kel-F81	0.04	0.1
Poly(ethyl methacrylate)	Plexiglas	1.2	3200
Poly(carbonate)	Lexan	1.4	1400
Poly(ethylene terephthalate)	PET	0.035	130

Permeability Coefficient P = (amount of permeate) (film thickness)/(surface area) (time) (pressure-drop across film).
Units of P: [cm^3 cm]/[cm^2 s (cm Hg)].

Table 3 — Effect of Polymer Density/Crystallinity on Permeation

Polymer	Density g/cm^3	Crystallinity %	Permeation Constant P at 30°C (P ×10^{10}) Oxygen	Nitrogen	Carbon Dioxide
Polyethylene	0.922	60	5.5	1.9	25.2
	0.938	69	2.1	0.66	7.4
	0.954	78	1.1	0.33	4.3
	0.96	81	1.06	0.27	3.5
	0.965	83	0.5	—	2.5
Polypropylene	0.907	~50	2.1	0.42	8.4

Peameability Coefficient P = (amount of permeate) (film thickness)/(surface area) (time) (pressure-drop across film).
Units of P: [cm^3 cm]/(cm^2 s (cm Hg)].

coefficients (Table 2). In recent years, PVC tubing has replaced rubber hoses, but even PVC has a fairly high moisture permeability coefficient, at 275. Fluorinated polymers, on the other hand, such as Kel-F 81 and Teflon, have very low oxygen and moisture permeability (Table 2). Indeed, Kel-F 81 has the lowest water vapor permeability of all known plastics (Refs. 3, 7). Unfortunately, Kel-F tubing is only commercially available in very small sizes for medical applications.

Permeation Properties

Permeation through plastics is primarily dependent upon the following properties:

1. *Exposed surface area.* The longer the hose or the bigger the hose diameter, the greater the permeation.

2. *Length of diffusion path.* The longer the path for the impurity to diffuse, the less the permeation. Thick-walled hoses allow less permeation.

3. *Material of construction.* The stiffer the hose, the less the permeation — Fig. 2.

4. *Nature of contaminant.* Except for Teflon, most plastics allow a much higher degree of moisture permeation than oxygen permeation.

5. *Humidity.* The higher the humidity of the surroundings, the greater the moisture permeation. Moisture permeation at 90% relative humidity will be double the permeation at 45% relative humidity (at the same room temperature).

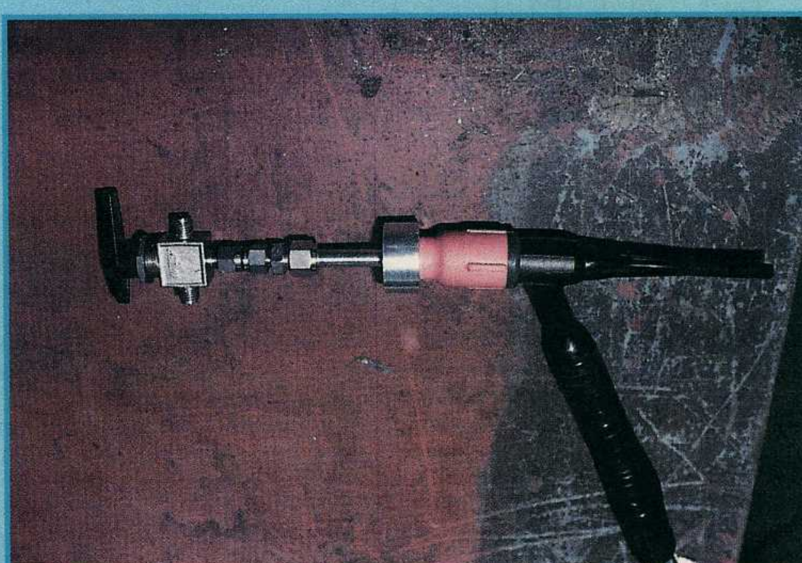

Fig. 3 — Accessory for measuring impurities in shielding gas at weld torch tip.

6. *Temperature.* The higher the room temperature, the higher the moisture permeation (at the same relative humidity). For example, the moisture permeation rate at 95°F (35°C) is approximately double the rate at 75°F (24°C). Welding on hot, humid days may result in more weld defects.