

# Liquid-Liquid Porometer

Standard & Nanoflow Versions Available

## Application

Designed for pore structure characterization of materials such as membranes, filter media, ceramics, paper, textile, etc., having very small pore sizes. It is capable of measuring pore diameters, pore distribution and liquid flow rate of materials having very low permeability.



Standard Version LLP

## Principle of Porometry

A wetting liquid spontaneously fills the pores of the material. Two immiscible wetting liquids are selected. Liquid 1 with lower surface tension is used to fill the pores of the sample. Liquid 2 is added to the top of the sample and is pressurized to displace the first from the pores and flow through the empty pores. The flow rate of Liquid 2 is also measured without wetting the sample with Liquid 1. The pore diameter is related to the surface tension of the two liquids. The flow rates yield pore distribution and liquid permeability.

$$D = 4 \gamma_1 \cos \theta_1 / p$$

Where:

D = pore diameter

$\gamma_1$  = Interfacial surface tension of liquids

$\cos \theta_1$  = contact angle of liquid 1 on pore surface

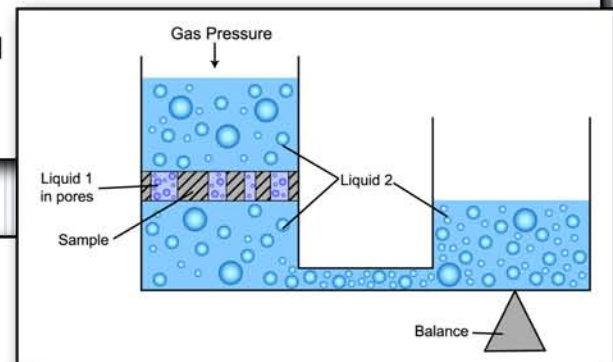
p = differential pressure applied on the sample by liquid 2



Nanoflow Version LLP

## Test Procedure

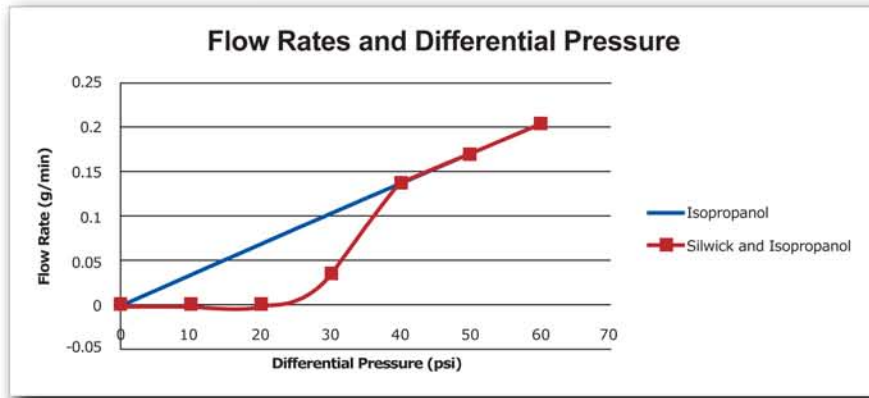
Two immiscible & saturated wetting liquids such as silwick and alcohol are taken. Pores are filled with silwick and alcohol is pressurized to displace the silwick and flow through the pores. The amount of liquid flowing out is measured in balance. Alcohol flow rate and differential pressure are measured. Because surface tension of silwick and alcohol are low, contact angles are taken as zero. Mean flow pore diameter and pore distribution are computed like CFP.



## Unique Measurable Characteristics

1. Pore diameters down to several nanometers are measurable
2. Pressures needed are much less than those for capillary flow porometer
3. Very low liquid permeability measured
4. Fully automated, user friendly operation

# Typical Test Results



caprep v 6.71.38 using PMI/APP Graphics v1.8.7

PERMEABILITY RESULTS  
12-07-2009

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CORNELL INDUSTRY RESEARCH PARK, BLDG. 4  
ITHACA, NY 14850 USA  
PHONE (607)-257-5544 or 1-800-TALK-PMI

FOR: DEFAULT

TESTNUMBER: 1  
OPERATOR: TLM  
LOTNUMBER: MACHINE 1591

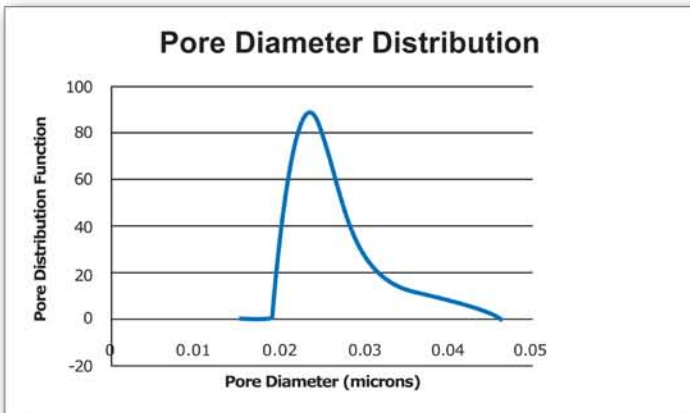
SAMPLE ID: FFI

TIME: 12:17:49  
FILE: C:\Documents and Settings\PMI\lab\Desktop\LEP Data Latest\FFI.CPT

SAMPLE THICKNESS : 1.000 mm  
SAMPLE DIAMETER : 5.248 mm  
FLUID USED : WATER  
FLUID VISCOSITY : 1.900 CP

FLOW RATE COLUMNS:  
A: Flow in CC/SEC.  
B: Specific Flow in LITERS/MIN/CM<sup>2</sup>.  
C: Flow in LITER/PSI/CM<sup>2</sup>/SEC.  
D: Flow in LITER/PSI/CM<sup>2</sup>/MIN.

DIFFERENTIAL PRESSURE PSI	A	B	FLOW RATE C	D	PERMEABILITY DARCYs
.0024137	.0000081	.0000022	.0000155	.0009273	0.043166
2.2096	.0004704	.0001305	9.841E-07	.0000590	.0027487
5.3184	.0003343	.0000927	2.906E-07	.0000174	.0008116
7.8900	.0005099	.0001414	2.988E-07	.0000179	.0008344
11.026	.0007159	.0001986	3.002E-07	.0000180	.0008384
14.143	.0008984	.0002492	2.937E-07	.0000176	.0008202
17.268	.0010517	.0002917	2.816E-07	.0000169	.0007864
20.408	.0011812	.0003276	2.676E-07	.0000161	.0007473
23.524	.0012739	.0003534	2.504E-07	.0000150	.0006992
26.643	.0013755	.0003815	2.387E-07	.0000143	.0006666



# Specifications

**Pressure Range:**  
0 - 500 psi

**Resolution:**  
1 in 60,000

**Sample Size:**  
5mm - 50mm diameter  
foil to 1" Thick  
(Others Available)

**Pore Size Range:**  
0.5 - 0.002 microns

**Flow Resolution:**  
0.0001 cc/min

## Porous Materials, Inc.

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