

## Toray Paper 120

Property	Unit	Value
Thickness	um (microns)	370
Bulk Density	g/cm <sup>3</sup>	0.45
Porosity	%	78
Surface Roughness Ra	um (microns)	8
Gas Permeability	ml•mm/(cm <sup>2</sup> •hr•mmAq)	1500
Electrical Resistivity	Through Plane	80
	In Plane	4.7
Thermal Conductivity	Through Plane (Room Temp)	(1.7)
	In Plane (Room Temp)	21
	In Plane (100°C)	23
Coefficient of Thermal Expansion - In Plane (25 -100°C)	x10 <sup>-6</sup> /°C	-0.8
Flexural Strength	MPa	40
Flexural Modulus	GPa	10
Tensile Strength	N/cm	90

# Gas Diffusion Layers

Gas Diffusion Layers (GDL) are key components in various types of fuel cells, including Proton Exchange Membrane (PEM), Direct Methanol (DMFC) and Phosphoric Acid (PAFC) stacks as well as in other electrochemical devices such as electrolyzers. In fuel cells, this thin, porous sheet must provide high electrical and thermal conductivity and chemical / corrosion resistance, in addition to controlling the proper flow of reactant gases (hydrogen and air) and managing the water transport out of the membrane electrode assembly (MEA). This layer must also have controlled compressibility to support the external forces from the assembly, and not deform into the bi-component plate channels to restrict flow. Other uses require different criteria, for example, electrolyzers require thicker, higher density porous plates, while humidifiers have most of the same requirements as fuel cell stacks, but the GDLs do not need to be electrically conductive. The GDL serves as a connection bridge between the MEA and graphite plate.

## **The main functions of GDL include the following:**

- A gas diffused pathway from flow channels to the catalyst layer
- Help removes by-produced water outside of the catalyst layer and prevent flooding
- Keep some water on surface for conductivity through the membrane
- Heat transfer during cell operation
- Helps provide enough mechanical strength to hold the MEA from extension caused by water absorbency

## **What is the purpose of a Hydrophobic Treatment (AKA Wet Proofing)?**

A hydrophobic treatment to GDL enables improved water transport. In PEM fuel cells, specifically water retention can result in lower power generation. These GDLs are treated with Teflon in order to make the material hydrophobic and improve water transport.

## **What is the purpose of a Micro-porous Layer (MPL)?**

The purpose of the carbon Microporous Layer (MPL) is to minimize the contact resistance between the GDL and catalyst layer, limit the loss of catalyst to the GDL interior and help to improve water management as it provides effective water transport. MPL treatment is especially recommended for use with CCM (Catalyst Coated Membrane).

## Gas Diffusion Layer Comparison Table

Gas Diffusion Layer (GDL)	Type	Thickness (um)	Density (g/cm <sup>3</sup> )	Basic Weight (g/m <sup>2</sup> )	Air Permeability (s)	Through Plane Resistance (mΩcm <sup>2</sup> )	Tensile Strength (N/cm)	Flexural Modulus (MPa)	Porosity	MPL*
Plain Carbon Cloth	Cloth	356	1.5	132	-	-	19.25	7.5	-	No
Carbon Cloth W1S1005	Cloth	410	-	180	< 8	< 13	>10 MD & >5 XMD	-	-	Yes
Sigracet 29 BC	Paper	235	-	90	1 cm <sup>3</sup> /(cm <sup>2</sup> *s)	< 12	-	-	80%	Yes
AvCarb EP40	Paper	200	0.2	36	4.5	8	-	-	-	No
AvCarb P50	Paper	170	0.31	50	35	6.7	-	-	-	No
AvCarb P75	Paper	245	0.29	75	15	7.8	-	-	-	No
AvCarb GDS1120 P50	Paper	184	0.4	79	-	< 14.5	-	-	-	Yes
AvCarb GDS3250 EP40	Paper	225	0.33	75	-	< 14	-	-	-	Yes
AvCarb GDS3260 EP40	Paper	210	0.38	80	-	< 14	-	-	-	Yes
AvCarb GDS2120 P75	Paper	248	0.4	101	-	< 14	-	-	-	Yes
AvCarb GDS2230 P75	Paper	275	0.4	98	-	< 14	-	-	-	Yes
AvCarb MGL 190	Paper	190	0.44	-	2.2	-	65	45	78%	No
AvCarb MGL 280	Paper	280	0.44	-	3.3	-	85	45	78%	No
AvCarb MGL 370	Paper	370	0.46	-	4.4	-	120	45	78%	No
Spectracarb 2050A - 0550	Paper	127	0.5	88	35	18	4.2 MD & 2.6 XMD	37	-	No
Spectracarb 2050A-0850	Paper	203	0.5	88	35 cfm/ft <sup>2</sup>	18	4.2 MD & 2.6 XMD	37	-	No
Spectracarb 2050A - 1050	Paper	254	0.5	88	35	18	4.2 MD & 2.6 XMD	37	-	No
Spectracarb 2050A - 1535	Paper	381	0.35	175	35	15	-	40	-	No
Spectracarb 2050A-1550	Paper	381	0.5	175	35 cfm/ft <sup>2</sup>	15	-	40	78%	No
Toray 030	Paper	110	0.4	-	-	80 mΩcm	-	40	80%	No
Toray 060	Paper	190	0.44	-	-	80 mΩcm	50	40	78%	No
Toray 090	Paper	280	0.44	-	-	80 mΩcm	70	40	78%	No
Toray 120	Paper	370	0.45	-	-	80 mΩcm	90	40	78%	No

\* MPL stands for Microporous Layer