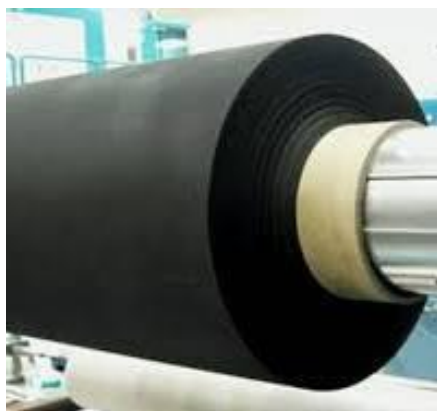




Product Benefits

- ✓ **Value to the customer**
 - Best in Class Product Uniformity
 - High Purity for Enhanced Durability
 - Flexibility in Piece Size for Efficiency
- ✓ **Functionality**
 - Consistent Mechanical Compressibility
 - Low Electrical Resistance
 - High Corrosion Resistance
 - Thermal Stability
- ✓ **Performance Characteristics**
 - High Gas Diffusion & Permeability
 - Controlled Hydrophobicity
 - Smooth Surface

Markets

- ✓ Electrolyzers
- ✓ Fuel Cells
- ✓ Batteries
- ✓ Carbon Capture and Utilization
- ✓ Industrial Electrodes

Applications

- ✓ Redox Flow Battery Electrodes
- ✓ Electrolyzer Cathodes
- ✓ Fuel Cell Electrodes
- ✓ Electrochemical Sensors
- ✓ Separation / Purification
- ✓ Structural EMI Shielding*

Product Overview

Performance

AvCarb's molded graphite laminates offers superior performance in harsh electrochemical environments and fuel cell systems. The high mechanical strength of AvCarb MGLs is ideal for high pressure operation or to span wide channels, and the excellent corrosion resistance allows them to handle harsh operating environments. Their high thermal and electrical conductivity makes them invaluable in attaining high operational efficiency, and they are lightweight making them ideal for portable electrochemical systems. AvCarb MGLs are widely used as an electrode material in hydrogen electrolyzer systems, as they enable high pressure operation, compliant enough to handle stack tolerances, and much lower cost than titanium on the cathode side.

Development History

AvCarb Material Solutions has played a pivotal role in the development and advancement of molded graphite laminate (MGL) production, serving industries that demand high-performance carbon-based materials. With roots tracing back several decades, AvCarb's expertise in engineered carbon materials has evolved alongside technological advancements in fuel cells, energy storage, electrolyzers, and high temperature insulation. AvCarb's commitment to innovation and precision manufacturing has established it as a leader in MGL production, supplying critical components for cutting-edge applications worldwide.

Durability

The production of AvCarb MGLs involves several key stages to ensure high-performance carbon materials suitable for various industrial applications. The process begins with PAN (polyacrylonitrile) fibers that are processed into a continuous non-woven web to create a uniform and porous material. The web is then coated in resin, cut into sheets, and then molded to a target thickness forming a rigid sheet. These sheets are then subjected to a high-temperature heat treatment in an inert atmosphere between 2000 – 3000°C to fully graphitize the panel thereby enhancing conductivity and thermal stability. The high temperatures of this graphitization process enables lower compressibility and improved chemical stability for the highest level of durability.

Product Specifications

Low Density, Low Thickness Options (Nominal Values)

Typical Properties		MGL 190	MGL 280	MGL 370
Nominal Thickness [μm]		195	285	375
Compressed Thickness [μm]	@ 1MPa	165	245	320
	@ 3MPa	110	160	210
Bulk Density [g/cm^3]		0.45	0.43	0.43
Gas Permeability [Gurley-sec]		1.0	1.3	1.4
TP Resistivity [$\text{m}\Omega\text{-cm}^2$]	@ 1MPa	6.0	6.6	7.8
	@ 3MPa	3.1	3.4	4.6
Porosity [%]		78	79	78
Length & Width [mm]		508 x 508	508 x 508	508 x 508

High Density, High Thickness Options (Nominal Values)

Typical Properties		MGL 1000	MGL 1500	MGL 2000	MGL 2200	MGL 2400	MGL 2900
Nominal Thickness [μm]		1000	1500	2000	2200	2400	2900
Compressed Thickness [μm]	@ 1MPa	935	1400	1900	2100	2250	2800
	@ 3MPa	800	1200	1600	1700	1900	2500
Bulk Density [g/cm^3]		0.72	0.72	0.72	0.72	0.72	0.72
Gas Permeability [Gurley-sec]		1.4	1.7	1.8	2.0	2.0	2.0
TP Resistivity [$\text{m}\Omega\text{-cm}^2$]	@ 1MPa	13.2	13.8	14.1	14.3	14.5	15.0
	@ 3MPa	10.5	10.7	11.0	11.0	11.1	11.8
Porosity [%]		69	71	70	70	68	68
Length & Width [mm]		546 x 546	546 x 546	546 x 546	546 x 546	546 x 546	546 x 546

Compressibility

AvCarb Molded Graphite Laminates are designed to allow for a consistent compression within the stack, allowing the thickness to adjust while accounting for other component tolerances within the stack. The total compression is tunable based on the density of the panels with typical compression curves for low and high density MGLs provided in Figure 1.

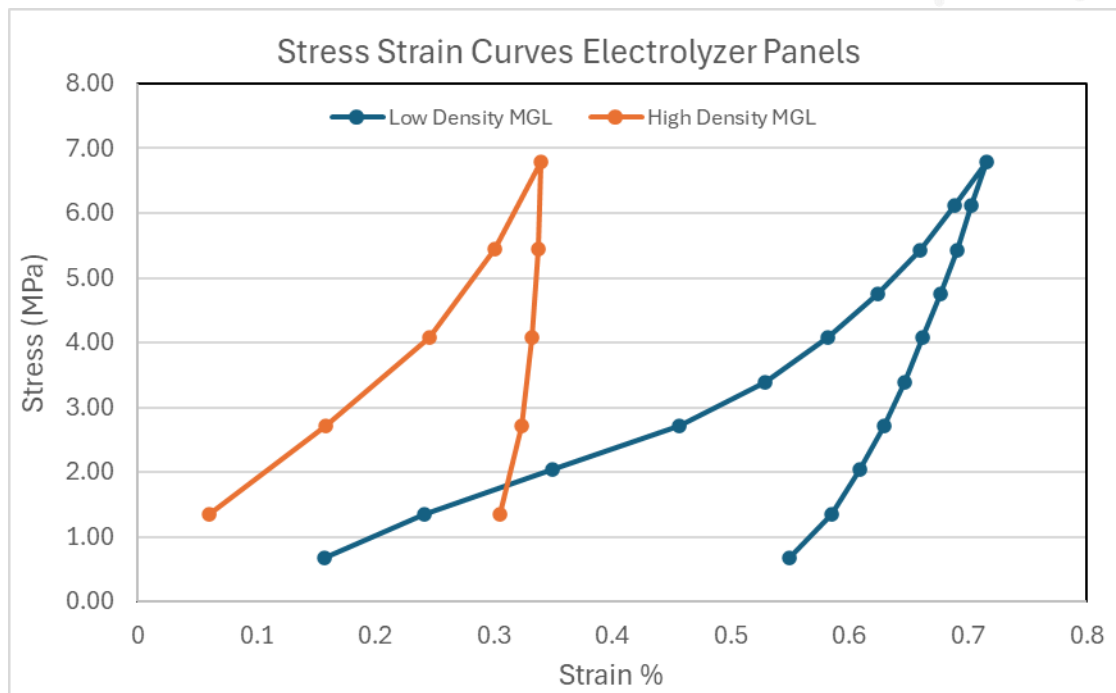


Figure 1. Stress Strain Curves Electrolyzer Panels

Sizing Availability

The AvCarb MGLs are manufactured in a batch process with a standard size of 20"x20" for the low-density materials, and 21.5"x21.5" for the high-density materials. AvCarb will work with customers to cut MGLs down into custom sizes via a laser cutting process upon request. Parts are typically shipped in 26"x26" boxes, with the number of pieces per box varying based on the part thickness. Typical lead times are 12-16 weeks, pending availability of the ordered quantities.