Introduction

SEAL S.p.A. is a textile-chemical company, manufacturing material systems for ballistic protection, advanced composites and fuel cells.

Founded over 30 years ago, the company today has achieved a leading position in the ballistic protection and composites industries. Since 2003, Seal is conducting progress and advances of materials linked to fuel cells. SEAL already offers a wide range of traditional and innovative fabrics, such as prepregs with its own resin systems and laminates for marine,

aerospace, automotive, railways, ballistic protection, sporting goods, robotics and the building industry.
SEAL utilizes advanced equipment to ensure the utmost respect for the environment as the material is being manufactured. Along with the research and development department which is supported by a state-of-art laboratory Seal maintains the highest quality of mechanical, physical, chemical and electrochemical properties for fabrics.

These services are performed for all of Seal's products under the certified compliance of UNI EN ISO 9001 since 1996.

SAATIgroup

The Saati Group is a multi-national textile-chemical Group of companies dealing worldwide in high-tech products. The Group employs 700 people around the world, with branches in 8 countries and several manufacturing locations.

SaatiPrint is the division specialised in precision industrial fabric production and distribution, continuously developing its range of products for the screen-printing industry. SaatiPrint has a leadership position as manufacturer of a wide differentiated range of fabrics and chemicals for all prepress needs in many specific applications.

SaatiTech is the division specialised in high technology fabrics for demanding industrial applications. The products are used in medical, diagnostic, filtration, automotive, chemical, acoustic, electronic, appliance, sifting, milling industries and wherever there is a demand for filtration media.

Seal is the division of the Group dealing with ballistic protection, composites and fuel cell.

The fabrics produced by Saati Group are technical precision fabrics made of high performance polymeric monofilaments like high modulus polyester, nylon, polypropylene, peek, carbon, fibres and glass fibres among the others.

Saati has also developed a number of surface treatments to add functionality and value to its fabrics. These include high vacuum plasma treatments, conventional baths to obtain hydrophilic, hydrophobic and oleophobic properties, and new sol-gel treatments.

Saati holds innovation as a strong company value and seeks all opportunities to jointly develop with external partners new products and technologies to broaden its product range or improve the existing ones.

SEAL

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SEAL

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What is a Fuel Cell

A *Fuel Cell* is an electrochemical device that continuously converts the chemical energy of the fuel (hydrogen) and an oxidant to DC electrical energy, heat and other reaction products (water). This reaction occurs inside the *Membrane Electrode Assembly* (MEA), which is an electrolyte membrane sandwiched between two-gas diffusion electrodes.

...We offer a wide range of materials in rolls and sheets for making your best MEA components...

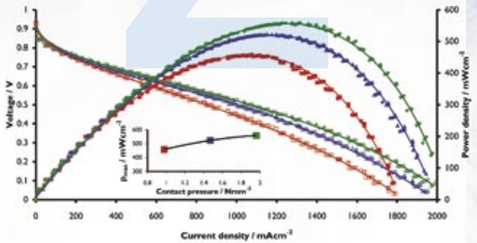
Catalyst Coated Membrane

We can provide a wide range of catalyst-coated membranes with a different active area, ionomers, Pt, PtRu-loading on high surface area carbon, differentiated for hydrogen and reformate use.

Main Features

- 25, 50, 100, 225 cm^2 and customised design
- ionomer: < 50 micron PFSA
- Pt-loading (cathode/anode): < 0,6 mg/cm^2
- PtRu-loading (only for anode reformat use) < 0,3 mg/cm^2

Proton Exchange Membrane Fuel Cells (PEMFC's) are suitable for stationary, transport and portable energy applications.
In hydrogen-based energy systems, *Fuel Cells* are the technology of choice to maximize the potential benefits in terms of energy efficiency, improved energy security and zero-emission.



Gas Diffusion Layer

The Gas Diffusion Layer (GDL) is a fabric of woven spun carbon fibers, which is manufactured by Seal and co-designed with the users to optimize the overall throughput of the MEA. In addition GDL materials can be designed with controlled properties in mind.

Seal laboratories are constantly performing intensive character tests with different MEA configurations to simulate mechanical and fluid dynamic, as well as the electrical and electrochemical properties of GDL. At this time several users have used these materials for PEMFC and DMFC applications.

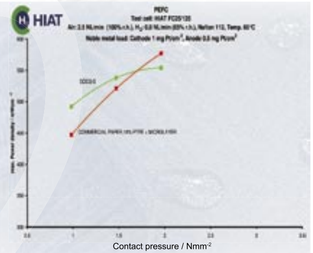
Main Features

- Low weight
- Low thickness
- High chemical resistance
- High electrical conductivity
- High thermal conductivity
- Good gas permeability
- Good water handling
- High mechanical strength and compressibility
- Economical manufacturing

Conductive micro porous layers and surface treatments

Seal can engineer the surface of the GDL with an *innovative hydrophobic plasma based treatment* (patent pending PTC/IT2005/000297), jointly designed with the Centre of Excellence Plasma Prometeo of the University Milano-Bicocca. Traditional coatings based on PTFE from 5% to 30% loading are alternatively offered for hydrophobic treatments.

In addition, Seal designs custom tailored solution for Gas Diffusion Medium (GDM) by combining different GDL substrates and surface treatments with a *Conductive Micro Porous Layer* (MPL). This further layer ensures a better electrical contact with the adjacent catalyst substrate and allows an effective two phase flow management between the cathode catalyst layer and the gas diffusion layer.

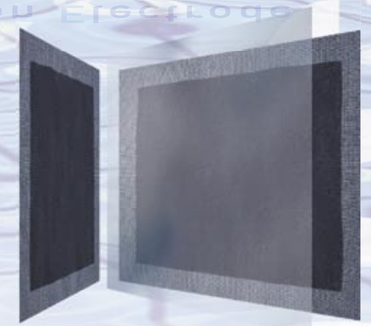


DATASHEETS of GDL materials

	Weave	Weave Count	Weight	Thickness @ 20 KPa	Thickness @ 200 KPa	Density	Electrical Resistivity Through plane @ 200KPa	Electrical Resistivity In plane	Air Permeability @ 100 Pa Through plane	Air Permeability @ 100 Pa In plane	Contact Angle Static	Contact Angle Dynamic
		(warp-weft/cm)	(g/m^2)	(μm)	(μm)	(kg/m^3)	(Ωcm)	(mΩcm)	(mm/s)	(mm/s)		
SCCG 1	PW	15.1 - 13.9	44,2	315	190	140	4,14	51,5	3690	0,94	119	71,8
SCCG 3	PW	13.9 - 12.9	56	370	180	151	5,74	48,5	3180	0,99	123	75
SCCG 5N	PW	22.2 - 25.0	113	370	275	305	3,31	26,7	1197	1,33	123	144
SCCG 7	PW	23.0 - 22.3	122	400	255	305	3,25	28,9	1009	1,32	121	135
SCCG 8	REPS	30.4 - 32.0	149	425	310	350	3,13	24,3	812	1,26	120	136
SCCG 9	PW	17.1 - 17.9	118	505	265	235	3,05	36,5	1800	2,45	125	135
SCCG 10	PW	26.0 - 24.2	109	305	285	355	3,39	24,5	1270	0,85	125	131

Gas Diffusion Electrode

Seal produces Gas Diffusion Electrode by depositing into the gas diffusion media novel electro-catalysts for use in PEMFC and DMFC. Pt and Pt/Ru catalysts on high surface area carbon supports are used to produce highly active electrodes.
The catalyst is deposited into the gas diffusion cloth, producing an highly flexible and rollable gas diffusion electrode.

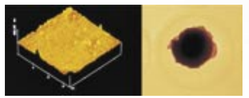


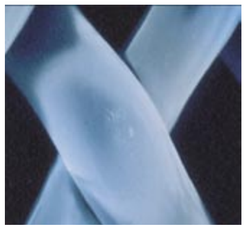
Main Features

- Rollable Gas Diffusion Electrodes
- Flexible configuration of the MEA size
- Substantial reduction of noble metal content
- High specific electrical conductivity of carbon support
- High noble metal surface area
- High carbon support surface area

Membrane Support Layer

Seal has engineered an innovative fabric support layer based on PET and PEEK monofilament yarns; the fabric is treated by plasma to activate and etch the surface of the material; this process allows to modify uniformly and permanently the wetability and the bonding strength between the support layer and the ionomer resin. This micro reinforcement improves the mechanical properties of ion exchange membrane films.





Main Features

- Wide open area (> 50%)
- Low thickness (< 52 micron)
- High Mechanical strength (tension to break > 114 N/5cm, elongation to break > 13%)
- High chemical stability (Peek fabric)
- Thermal resistance up to 200°C (Peek fabric)
- High bonding strength with ionomer resin

Datasheet of membrane support layers

Properties	90/60.27 PET HT	90/70 .27 PET HT	90/80.27 PET HT	90.27 PET HT	90.31 PET HT
Weaving structure	PW	PW	PW	PW	PW
N° thread-warp/cm:	89	90	90	90	90
N°thread-weft/cm:	60	69	79	92	92
Thread diameter (micron)					
Warp:	29	29	29	29	31
Weft:	28	28	28	29	32
Open Area (micron):	114	103	91	84	78
Free surface (%):	65	64	58	58	51
Thickness (micron):	42	43	44	44	52
Weight (g/m^2):	12	13	15	17	19
Tension to break (N/5cm)					
Warp:	195,9	187,2	198,4	188,4	194,2
Weft:	114,8	138,9	160,2	176,3	198,0
Elongation to break (%)					
Warp:	13,6	14,1	15,1	13,4	17,0
Weft:	13,9	16,0	15,0	13,6	25,5
ModSec5%(N/5cm)					
Warp:	20,8	18,5	19,7	18,3	18,0
Weft:	7,8	8,4	10,3	12,8	10,7