

DEFINING EMI SOLUTIONS

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EMI SHIELDED WINDOWS

Think Schlegel EMI for Shielding

As the originator of the fabric-clad foam EMI shielding technology, Schlegel EMI (SEM) is the industry's most trusted name. We continue to set the standard for quality and innovation, designing advanced solutions for a wide range of applications. Our worldwide locations ensure that you get what you need when you need it.

Modern electronic equipment often requires EMI gaskets to avoid radiating EMI/RFI susceptibility to outside sources of EMI/RFI. As a result, maintaining electromagnetic compatibility is an increasing challenge for electronic and electrical product designers. Schlegel is the preeminent fabric over foam EMI shielding products manufacturer for the computer, telecommunications, and electronics industries.

We offer a full range of EMI Shielding products, including gasket I/O backplane shielding gaskets, highly conductive envelopes, tapes, and laminates. SEM is proud to offer a complete line of quality beryllium copper (BeCu) EMI gaskets. With the addition of BeCu gaskets to SEM's extensive portfolio, we can be your exclusive EMI shielding supplier meeting or exceeding global requirements for electromagnetic compatibility.

Design and Consultation

SEM offers design and consultation services to help design filters for your display requirements. Displays are used in all applications, from public information to machine interfaces. This means that the physical properties of a filter will vary to suit its performance needs.

Consideration should be given to several characteristics, such as impact, solvent and abrasion resistance, reflection control, fire specifications, UV protection, RFI shielding, ESD, and anti-static and anti-mist properties. Filters can be designed to incorporate several characteristics in one part, and materials selected from allyl carbonate, acrylic, polycarbonate, polyester, and glass.

A well-designed filter can reduce costs, improve display readability, and enhance product appearance. It's a crucial part of your equipment and can significantly impact your product's performance over time.

Optical Filters and Fascia Panels

SEM supplies high-quality optical filters and fascia panels. These products are manufactured to suit individual customer requirements or specifications and can be made from allyl carbonate, acrylic, polycarbonate, or glass.

All filters can be manufactured to include screen printing and RFI shielding (see technical information "RFI / EMC Filter windows" if necessary).

Filters can be manufactured to include many characteristics, including contrast enhancement, reflection control, impact strength, fire specifications, abrasion and solvent resistance, polarization, and combinations of properties.

RFI / EMC Filter Windows

Shielded filter windows are designed for use with electronic displays and give a high level of shielding from both internally and externally generated electromagnetic emissions. These windows can be designed to incorporate any of the filter characteristics described in the "Optical Filters and Fascia Panels" data sheet.

RFI / EMC shielded windows can be manufactured in allyl carbonate, acrylic, polycarbonate or glass. The shielding element is either a cast in micro - fine mesh (allyl carbonate only), laminated micro - fine mesh or ITO deposition.

Cast Allyl Carbonate Embedded Mesh Windows

These shielded windows offer the superb screening performance of micro - fine mesh, combined with the outstanding characteristics of allyl carbonate (see "Optical Filters and Fascia Panels" for details on allyl carbonate).

The general properties of cast windows are :

- Micro - fine mesh is cast in to a one piece sheet, therefore no delamination problems and higher temperature specification than laminated parts.
- They can be machined to any desired profile, with or without rebates.
- Extremely good abrasion, solvent, impact and heat resistance.
- Lightweight.
- Non-reflective surfaces can be cast in.
- Mesh can be set at any desired angle.
- Silver loaded bus - bar termination.
- Different meshes available to suit the application and mesh is blackened to reduce reflections.

Allyl Carbonate Filter Windows

This product is cast from ADC monomer (allyl diglycol carbonate) and has a series of properties, which makes it ideal for the production of filter windows and fascia panels. This material is equivalent to CR39.

Properties include :

- * Less than half the weight of glass.
- * Bright surfaces and light transmissions close to optical glass.
- * Refractive index close to that of crown glass.
- * High impact strength.
- * Remarkable abrasion resistance (approximately 20 times that of acrylic).
- * Resistance to pitting from hot metal sparks, 30 - 40 times higher than glass and other plastics.
- * Excellent resistance to acids, alkalis and to all solvents including aliphatic and aromatic hydrocarbons.
- * Easy surface dyeing.
- * Better scratch resistance than hard coated plastics.
- * Resistance to distortion by temperatures up to 130 ° C, a temperature at which acrylic resins are melted.
- * U.V. absorbers can be added to help protect LCD displays in strong sunlight.

Allyl carbonate can be cast from 1 mm thick upwards.

Typical properties of polymers cast from A D C "Monomer"

Optical Properties		ASTM test method
Yellowness Index	0.73	D 1925
Haze, %	0.21	D 1003
Refractive Index, n.20	D 1.50	D 542
Dispersion Factor	57	D 542
Visible Transmission, %	93.3	D 1003
Ultraviolet Transmission, % (3 mm thickness)		
at 300 nm.	25.0	
at 340 nm.	77.0	
at 380 nm.	88.0	

Physical and mechanical properties		ASTM test method
Density, g/cc	1.311	D 792
Tensile Modulus, (Mpa)	2.400	D 638
Taber Abrasion, (x P.M.M.A.)	20	D 1044 (modified)
Rockwell Hardness, (M)	97	D 785
IZOD Impact Resistance KJ/mq. Unnotched at 23 C	7.85	D 256 (modified)

Chemical resistance		ASTM test method
7 days immersion at 23 C		
Water :		
absorption, %	0.40	
haze variation, %	+0.07	
Acetone :		
absorption, %	0.78	
haze variation, %	0.00	
Toluene :		
absorption, %	0.40	
haze variation, %	0.00	
Ethyl Alcohol 95% :		
absorption, %	0.10	
haze variation, %	+0.05	
Trichloroethylene :		
absorption, %	0.04	
haze variation, %	+0.06	
H.D.T. 1,82 Mpa, C	69	D 648

Thermal expansion	
Linear coeff./ C	
from -40 to 25 C	0.81 x 10-4
from 25 to 75 C	1.20 x 10-4
from 75 to 125 C	1.43 x 10-4

Laminated Mesh Windows

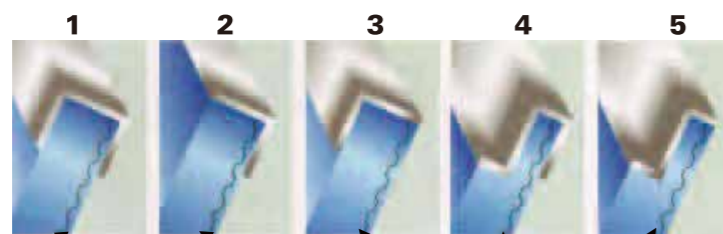
These shielded windows again offer the superb screening performance of micro - fine mesh, which in this version can be left flying for direct termination to the equipment screen. Material and characteristics for the filter can be selected from the full range, (see "Optical Filters and Fascia Panels" for details of the filter range).

The general properties of laminated windows are ;

- * Micro - fine mesh is laminated in between your selected filter medium.
- * Plastic versions can be machined to any desired profile, and glass versions can be constructed with or without rebates.
- * Different meshes available to suit the application and mesh is blackened to reduce reflections.
- * Non-reflective surfaces can be included.
- * Mesh can be set at any desired angle.
- * Various termination methods are available including ; tape edge, mesh over gasket, flying mesh, silver bus - bar.

Shielded Windows

Silver Bus Bar - Options



Wire Mesh – Options – Copper .001 or .002 and Stainless Steel 0.001 or .002

Surface Finish

The finishes available are gloss, fine matte, medium matte and low sparkle matte.

The gloss finish is a shiny surface like a normal window.

The matte finishes are etched matte finishes to reduce reflections. These finishes are a very fine texture designed for use with displays and scatter light from the surface.

Matte finishes do have a slight blurring effect on a display but if the filter is close to the display then this is minimal. As you pull the filter further away from the display the blur becomes worse. With a 3 mm thick filter, if the display is close (within 1mm) of the filter then you should be able to use a low sparkle filter without detriment to the display.

Polycarbonate Filters

Polycarbonate is usually used when impact strength or fire retardance is required. These filters are made from proprietary sheet material and normally coated with a hard coat to give abrasion and solvent resistance.

There are only a few standard tints available for polycarbonate, but others can be produced when necessary, in relatively small volumes. We have several techniques available to enable the production of polycarbonate contrast enhancement filters.

Properties of the polycarbonate will depend on the selected grade.

Glass Filters

Glass filters can be produced plane, matte etched or with multilayer AR coating. These filters can also be strengthened when required. Laminations can be built to include all filtering characteristics already mentioned.

Available Coatings For Acrylic and Polycarbonate

A range of optical coatings are available for the surfaces of acrylic and polycarbonate filters. Coatings can offer a selection of the following characteristics ;

- * Abrasion resistance
- * Solvent resistance
- * Anti - glare (matte coating)
- * Anti - mist
- * Anti - Newton ring
- * Multi - layer anti - reflective (limited to a small range of product)

Acrylic Filters

Acrylic filters are often used for larger displays and also where contrast enhancement is required (due to the large range of tints available). For these filters we use a high grade cast acrylic which can be obtained down to 0.5 mm thick.

The large range of tints available allows specific wavelengths to be transmitted. This can be used to contrast enhance, color correct or produce band pass filters. Infrared filters are also manufactured to block visible light and transmit IR at around 90%.

All acrylic filters can be finished with a hard coat, for abrasion and solvent resistance, which can be applied as a gloss or matte surface.

Typical properties of uncoated acrylic Filters

Optical Properties

Refractive Index nD20	1.492
Light Transmission %	92

Physical and mechanical properties

Density, g/cc	1.18
Tensile Strength N/mm ²	75
Elongation at Break %	4.5
Bending Strength N/mm ²	135
Notched Impact Strength	2
Modulus of Elasticity N/mm ²	3300

Thermal Characteristics

Linear coeff./ C 0 - 50 °C	70 x 10 ⁻⁶
Vicat softening point °C	100
Temp for continuous use °C	70

Mesh Performance

The performance of any RFI / EMC window is dependent on how well it is bonded to the equipment screen. The following tables show the screening capability of the mesh, where the mesh itself is clamped to the screen with no gaskets in between.

The shielding performance will improve as the window size reduces, due to the performance characteristics of the aperture. Mesh selection should be based on required performance and with the way that it interacts with your chosen display.

SHIELDING PERFORMANCE (dB ATTENUATION)

Test Window 300 x 300 mm

	Openings	Wire	E FIELD			PLANE		WAVE		Open
Mesh	per inch	diameter	1 MHz	10 MHz	100 MHz	100 MHz	400 MHz	1 GHz	10 GHz	area %
Copper	100	0.001	90	90	70			50	20	
Copper	100	0.002	107	111	85	70	70	58		64
Stainless	50	0.002	94	90	82		58	55	28	82
Stainless	80	0.001	106	88	82		64	60	34	84
Stainless	100	0.001	128	112	92	77	80	86	74	81
Stainless	80 x 60	0.001	102	105	103		75	60	43	84

Test Window 1000 x 1000 mm for BLK / Cu / 100 opi / 0.002 / 90°

Frequency	Mode	ITO dB	Single Mesh dB	Double Mesh dB
100 KHz	E	-	98	123
1 MHz	E	-	93	152
10 MHz	E	32	78	124
100 MHz	E	28	65	111
400 MHz	P	32	60	115
1 GHz	P	28	50	94
10 GHz	P	24	-	67

Test methods used were consistent with MIL - STD - 285

The above test results are for guidance only

Workable Specification For Cast Filters

Cast allyl carbonate is a high-quality substrate for optical filters. However, since it is a plastic material, there is a possibility of blemishes occurring during production, such as small inclusions and trapped fibers. To accurately measure the quality of products made from allyl carbonate, SEM has established specification and inspection criteria. This specification is achievable and repeatable based on our past performance. If necessary, we can further refine the specification through project discussions, but this may lead to increased inspection and production costs.

Inspection Conditions

The panel should be viewed from the front face under daylight conditions, with normal non-directional lighting. Viewing should take 15 seconds and from a distance of 450 mm.

Blemishes

SIZE	CRITERIA (Window Area)	CRITERIA (Non Window Area)
<0.15 mm	Disregard	Disregard
0.15 - 0.3 mm	1 per 100 x 100 mm	2 per 100 x 100 mm
0.3 - 0.5 mm	0 per panel	1 per panel
0.5 - 0.75	0 per panel	0 per panel

Small Fibers

Small fibers in cast allyl carbonate are not like the surface fibers in coated material. In coatings the fiber creates an inclusion on the surface which is highly visible. With the cast product fibers are very fine and are trapped within the material. These are difficult to see and do not produce a surface defect. These fibers are only visible when illuminated with a direct, bright light and do not effect the quality of a display.

Scratching.

No scratching is allowed on the panels.

Summary.

Please rest assured that we strive to produce the highest quality panels possible. This specification serves as an indication of the worst-case scenario.

Workable Specification For Hard Coatings

Due to the application methods of hard coatings on plastic substrates, blemishes do occur. These blemishes take the form of coating inclusions, trapped fibers and exaggerated material defects.

So that SEM can work with these products, it is important to lay down a specification and inspection criteria. This is a specification which we feel is obtainable and repeatable, when viewed against past performance of coating suppliers. With individual project discussions, it may be possible to tighten up the specification, but this will be done by inspecting out defects and will have obvious implications on price.

Inspection Conditions.

The panel should be viewed from the front face under daylight conditions, with normal non-directional lighting. Viewing should take 15 seconds and from a distance of 450 mm.

Blemishes

SIZE	CRITERIA (Window Area)	CRITERIA (Non Window Area)
<0.15 mm	Disregard	Disregard
0.15 - 0.3 mm	5 per 100 x 100 mm	5 per 100 x 100 mm
0.3 - 0.5 mm	1 per panel	2 per panel
0.5 - 0.75	0 per panel	1 per panel
Small Fiber	1 per panel	3 per panel

Scratching

Where polycarbonate panels are used, fine scratching will be inevitable on the rear surface. These marks can be caused by wiping with the softest of cloths, and even though they are extremely fine, they can look obvious when illuminated.

For panels larger than 100 mm square, only one scratch allowed on the front face if less than 10 mm long.

Summary.

Please rest assured that we strive to produce the highest quality panels possible. This specification serves as an indication of the worst-case scenario.

Fire Specification For Allyl Diglycol Carbonate

SEM supply cast filters from allyl diglycol carbonate (ADC monomer). The following information details the burning characteristics of the cast polymer. These details have been obtained from a variety of sources, including the manufacturer of the monomer, but no certification is available for these results. All details are given for information purposes only and if certification is required an independent test will need to be carried out.

UL Fire Rating

Polymer cast from ADC has been tested in America and has passed UL94 HB at 1 mm and 1.5 mm thickness. This test requires a flame spread of less than 75 mm / minute for less than 3 mm thick, or less than 40 mm / minute for greater than 3 mm. Other flame spread tests back up this result.

Flame Spread

For 1.3 – 2.9 mm thick - to ASTM D 635 - < 25 mm
 For 4 mm thick - result from monomer manufacturer - 25 mm

Limiting Oxygen Index

Any oxygen index below 21 % means that the material will burn in air. This polymer has an index of 18.3 %. This is slightly better than acrylic at about 17 % but worse than polycarbonate at 25 %.

Self Ignition Temperature

Self-ignition temperature is 720 ° F according to ASTM D 1929.

Products of Burning

If the polymer is 100 % burned, the products are CO₂ and H₂O. The products of incomplete combustion will also include some CO, propene and some soot with phenolic end groups on the surface. (OH attached to aromatic ring). Toxic substances are not expected.

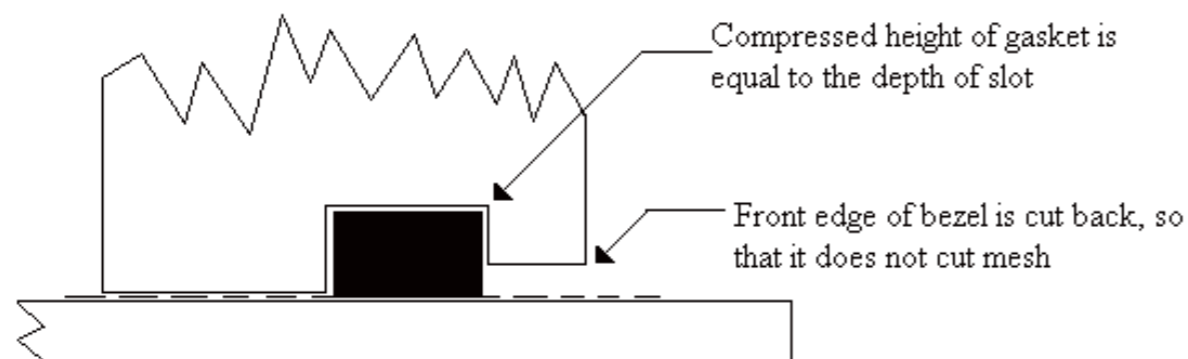
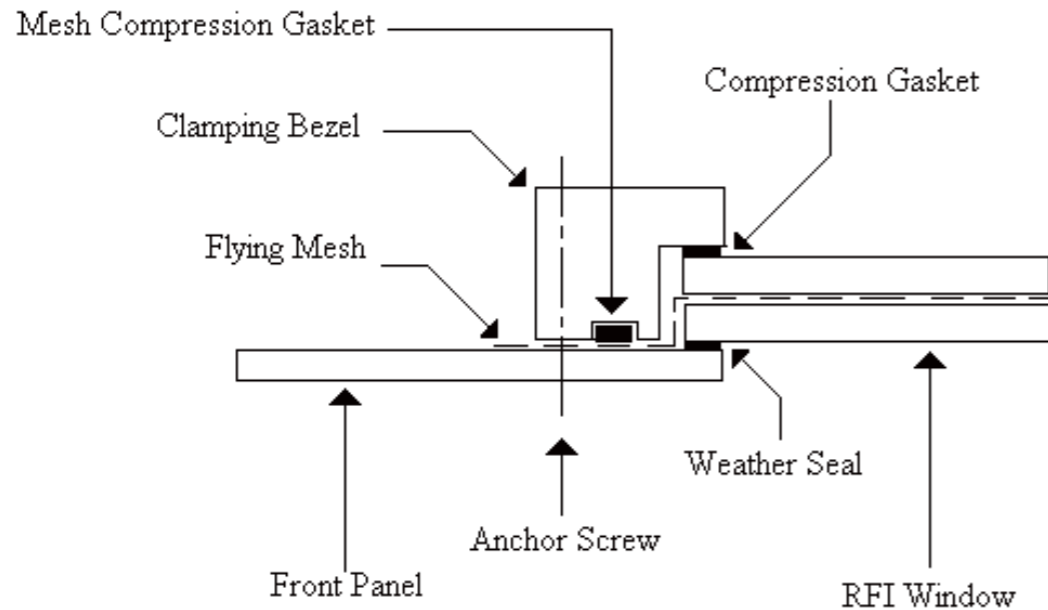
Stability

Unlike some other optical plastics on fire, this polymer does not drip burning material.

Independent Testing

SEM will supply samples to any customer wishing to carry out independent testing.

Tempest Clamping Arrangement For Flying Mesh



The rear surface of the front panel must be free of paint and should have a conductive plating applied for mesh contact

Questions to ask yourself when looking for a Shielded Window

Design & Consultation

General questions:

Is there a drawing? – This is not necessary but is useful.

Is there a Quality spec?

Has a material been selected? – Cast ADC is our preference.

What is the size of the required filter?

What is the thickness of the filter?

Is the edge stepped? – If so how wide and how deep?

Are there any holes or cut outs required? – If so how many, what size and how close to each other.

Is the surface to be gloss, matte or anti reflective?

Is there any printing required?

Is tinting required?

If EMI:

Has a mesh been designed in? – If so what is requested.

Is a mesh angle required? - Fringing / moiré effect.

If no mesh has been chosen then what performance do you require?

How are you proposing to fix the window in?

Do you require bus bar or flying mesh? – Silver bus bar is our preference.

What is the environment and application:

- This is useful to help with the design.
- Is impact resistance required?
- If so how severe?
- Is chemical or solvent resistance required?
- Any specific chemicals?
- What is the temperature requirement?
- What are the lighting conditions? – Daylight readability, indoor, night-time etc.
- What type of display is being used? – LCD, LED, Plasma etc.