

INNOVATION

EXCELLENCE



Bayer Films Americas

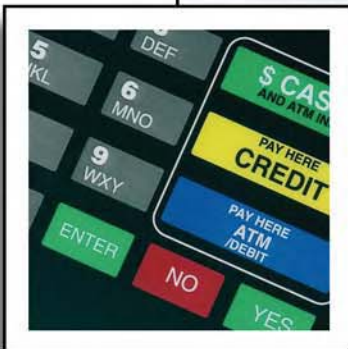
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Bayer Films Americas

Achieving Higher Levels of Innovation and Excellence in Film Applications with Makrofol® and Bayfol® Polycarbonate Films



Makrofol® and Bayfol® polycarbonate films are clearly the right choice when product excellence is your goal. Produced from Bayer's MAKROLON® polycarbonate resins, Makrofol and Bayfol are backed by the worldwide technological leadership of Bayer. Bayer films are manufactured to stringent quality standards in ISO-9001:2000 certified facilities. State-of-the-art extrusion lines provide the flexibility to provide custom colors, widths, lengths, and sheets. These high quality films have the required UL ratings, meet FDA approval, and are available in an assortment of surface textures.

Bayer films offer the stability, consistency, and strength to ensure excellent quality in a wide range of applications. Many times stronger than acrylic, Makrofol and Bayfol can be easily formed and much more dimensionally stable than polyester. These films form easier, deeper, and more consistently than other materials, making the graphics crisper and gloss more consistent from part to part. Lower stress levels allow for tighter registration of printed graphics. The superior strength of polycarbonate allows you to use thinner films and still achieve the results you desire.

Clearly the Right Choice

Makrofol and Bayfol polycarbonate films feature outstanding clarity and transparency. They are produced in a variety of thicknesses, surface textures, grades, and glosses. You can choose from a wide range of options, including transparent, translucent, opaque, and metallic. Custom colors and grades for laser engraving are also available.

Typical applications include:

- ◆ Instrument Panel Overlays
- ◆ Thermoformed Medical Packaging
- ◆ Indoor/Outdoor Labels and Decals
- ◆ Mousepads
- ◆ Automotive Dials
- ◆ Nameplates
- ◆ Exhibit and Display Components
- ◆ Floor Graphics
- ◆ Automotive Control Panels
- ◆ Keypads
- ◆ Chip Packaging
- ◆ Membrane Switch Overlays
- ◆ Menu Boards
- ◆ Film Insert Molding
- ◆ Electrical Insulation



...Clearly the Right Choice

Outstanding Product Line Provides Creative Design Options for New Applications

Bayer polycarbonate films offer the clarity, variety of surface textures, and specific properties you need to meet the most demanding application requirements.

Graphic Arts Quality

Makrofol® DE and PC polycarbonate films are available in a wide variety of surface textures, including glass clear with both sides gloss. These films offer high light transmittance, excellent surface uniformity, and ease of processing. All films use pure Bayer MAKROLON® polycarbonate resin. Most meet FDA approval and have the necessary UL ratings.

Chemical Resistant Blends

Bayfol® CR film is a polycarbonate/polyester blend that provides improved mechanical and chemical resistant properties.

Flame Retardant

Makrofol® FR films have flame retardant properties and can be easily fabricated or printed. They are ideal for electrical insulation and are available in white and clear.

Light Diffusing

Makrofol® LT and BL films have been specially developed to provide light diffusion capability which surpasses the capability of films that rely on surface texturing for light scattering. Makrofol® LT and BL are available in natural color and smoke tint. Smoke tint is suitable for “dead front panels”.

Specialty Films and Composites

Specialty films have been developed to provide increased weatherability and durability under harsh conditions. Makrofol® EPC film is a special composite film that provides excellent first surface chemical and UV resistance. Bayfol® AS-A (black) film is suitable for antistatic packaging of sensitive electronic components.

New Products

A variety of new products have been developed to meet customer special needs. Those products, designated by Makrofol/Bayfol DPF or TP names, offer special features such as unique textures and colors, UV and flame resistance, high Vicat softening temperature, soft feel, metallic look, adhesive coating, low stress, etc.



Bayer Films Americas

Bayer Polycarbonate Films and Advanced Molding Technology

Bayer has developed Film Insert Molding (FIM) technology that can satisfy “a designer’s wish list” for 3-dimensional parts. Bayer’s materials and processes for insert molding polycarbonate-based films provide the features you need for quality parts...at reduced costs.

- ◆ Compound curves
- ◆ Complex geometrics
- ◆ Registered graphics
- ◆ Multiple colors
- ◆ Opaque or transparent
- ◆ Selectively textural
- ◆ Scratch resistant
- ◆ Long lasting finishes

Film insert molding consists of placing a decorated film, either flat or formed into the mold of an injection molding machine. Resin is shot behind the film, bonding the film surface to the molding resin to form a finished integral part. The development of water-based and high heat polycarbonate inks, innovative forming methods, and precision registering equipment provide major advantages in part decoration by FIM.

- ◆ Unlimited decoration possibilities with precisely registered graphics
- ◆ Design flexibility including complex designs and simplified backlighting
- ◆ Cost savings via productivity improvements such as reduction in post-molding operations

Many different film and resin combinations are possible using FIM. Typically, the insert molding process incorporates the use of polycarbonate or polycarbonate blend film substrates, allowing a wide variety of injection molded resins to be used. Key factors to consider in choosing materials are: the need for heat and/or chemical resistance; impact resistance requirements; and aesthetic appearance. Designers must also consider the compatibility of materials with the decoration process and graphic construction with the injection molding resin.

Several different forming methods are being used for insert molding. Each forming process has its own benefits and limitations which must be considered in the design phase.

Thermoforming

The primary advantage offered by thermoforming is the ability to achieve deep draws on the formed appliqué. The process does suffer from registration problems on the graphic appliqué. This can cause problems where critical graphic registration is required.

High Pressure Forming (HPF)

Developed by Bayer AG, high pressure forming offers several advantages. Due to the uniform force applied to the film, very little residual stress remains in the part. The inks used to print the film may be heated prior to forming, allowing the graphic to be formed without cracking the ink. Since the front surface of the film is only contacted by the air injected into the tool, rejects from contaminants are reduced. Automatic presses built for this process can be considerably faster than other processes. They have cycle times of seven to ten seconds, depending on gauge.

Hydroforming

The hydroforming process provides excellent registration of the graphics to the molded part. However, it does not allow the films to be heated to increase the elongation of the graphic inks. It allows for fast tool setup and changeover. Formed parts exhibit relatively low stress. The main drawback is long cycle times.

Match Metal Dies

This process has been used for prototypes and low volume applications. One advantage is that tool halves can be heated to improve ink elongation during the forming process. The primary limitation of the process is that metal tooling contacts the front surface of the formed appliqué. This can result in gloss variations and contaminants being forced into the film’s surface.

Trimming

There are presently three methods being used to pretrim inserts prior to molding. Die-cutting offers high quality, low cost trimming and is primarily used for medium to long production runs. Laser cutting is a low volume prototype method of trimming parts. Hard tooling is the choice for high quality, long run parts.

Other Key Parameters

Other key parameters which affect the insert molding process have to do with design of the injection molding tool, the location of the film appliqué in the mold, and the process conditions related to molding the final assembly.



...Clearly the Right Choice for Molded Part Decoration

Fabrication

Printing Makrofol and Bayfol can be screen printed using acrylic and PVC-based inks. Ink adhesion is excellent and no pretreatment of the film is required. Because of the film's high heat resistance, printing inks can be quickly dried at high temperatures.

Die-Cutting Makrofol can be easily die-cut with a variety of steel rule dies. For the best overall results in terms of clean cuts, precision and die longevity, side-bevel rule is recommended. With this configuration, the long-bevel side should face the scrap material displacement rather than the short side bevel.

Thermoforming Makrofol can be thermoformed at a temperature of 190°C (374°F), with the mold temperature at 110°C (230°F). If the film is to be heated very rapidly, it should first be dried for 3 to 4 hours at 100°C (212°F).

Embossing Except for Makrofol LT and BL films, all Makrofol and Bayfol films are suitable for cold forming and offer dimensional stability at high service temperatures up to 130°C (266°F) for Makrofol and 100°C (212°F) for Bayfol films.

Bonding Substrates carrying printed information can be bonded using transfer adhesives, double-sided adhesive tapes, screen printed adhesives or two-component adhesives. For film-to-film bonding, solvents such as methylene chloride are normally used.

Welding Makrofol and Bayfol can be welded to certain other thermoplastics such as PC and ABS using ultrasonic methods.

Custom Extrusion Capabilities Gauge: .005" to .030"
Width: up to 53"
Surface Finishes: Gloss, velvet, suede, matte, micro-matte, and combinations

Converting Services In-line sheeting is done at the extruder; sheets are stacked flat and delivered flat eliminating roll set. Standard trimmed and squared sheeting is available for tighter dimensional tolerances. Masking of gloss surfaces is available for films 7 mil and thicker. Choices of masking are cling or stick.

Resin	Texture Designations		Products Bayer	Comments
	1st Surface	2nd Surface		
PC	Gloss	Gloss	DE 1-1	Virgin Resin—No Additives
	Gloss	Gloss	DE 1-1	Medical Grades
	Gloss	Fine Matte	DE 1-4	No Masking Required—Low Internal Stress
	Gloss	Fine Matte	DE 1-4 White 3723	White
	Gloss	Micromatte	DE 1-mm	Low Stress for Accurate Registration
	Fine Velvet	VF Matte	DE 6-2	Printable Velvet Surface
	Velvet	Matte	PCVM	Standard Velvet Matte
	Velvet	VF Matte	DE 7-2 CG	Tight Gloss Control—1" Surface
	Velvet	VF Matte	DE 7-2	Minimize Pin Holing
	Velvet	VF Matte	DE 7-2 (6)	Black
	Velvet	Gloss	PCVE	High Color Retention
	Velvet	Gloss	VLG 7-1	Very Low Gloss
	Suede	Matte	PCSM	Standard Suede Matte
	Gloss	Gloss	LS 1-1	Low Stress DE 1-1
	Light Diffusion	Fine Matte	Fine Matte	BL 2-2 820812
Fine Matte		Matte	BL 2-4 820816	Light Diffusing
Fine Velvet		VF Matte	BL 6-2 820812	Light Diffusing
Fine Velvet		VF Matte	BL 6-2 820802	Black Translucent
Fine Velvet		VF Matte	BL 6-2 820803	Minimum Pigment Contact
Fine Matte		Fine Matte	LT 4-4	Antiglare
Fine Matte		Matte	LT 6-4	Antiglare
Fine Velvet		Fine Matte	LT 6-4 900009	Antiglare
PC Blends	Fine Velvet	VF Matte	CR 6-2	Increased Actuation Life
	Gloss	Matte	CR 1-4	Increased Actuation Life
	Gloss	Micromatte	DPF-5023	Increased Actuation Life
	VF Matte	Matte	AS-A 2-4	Anti-Stat
FR Materials	Velvet	Gloss	PCVE 600	FR White—Flame Retardant
	Velvet	Matte	PCVM 600	FR White—Flame Retardant
	Velvet	VF Matte	FR 7-2	FR Clear—Flame Retardant
Weatherable	Velvet	Matte	EPC VT/M	Chemical/UV Resistant
	Velvet	Gloss	EPC VT/E	Chemical/UV Resistant
	Gloss	Gloss	EPC ETE	Chemical/UV Resistant
	Velvet	Matte	UV1 7-2	UV Resistant
Enhanced Films	Velvet	VF Matte	DPF-5014	High Heat
	Gloss	Matte	DPF-5072	Metallic Film
	Velvet	VF Matte	DPF-5073	Soft Feel—Weatherable

Graphic Films

Grade	1st Surface Texture	Color	Standard Thicknesses												Applications						
			mil	3.5	4	5	7	8	10	12	12.5	14	15	16		16.5	17	20	25	30	40
DE 1-1	Gloss	Clear	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Automotive, Labels, Membrane Switches, Nameplates, Packaging
DE 1-mm	Gloss	Clear	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Automotive, Labels, Membrane Switches, Nameplates, Packaging
DE 1-4	Gloss	Clear	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Automotive, Labels, Membrane Switches, Nameplates, Packaging
DE 1-4 3723	Gloss	White	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Trade Show Displays, Signs
DE 6-2	Fine Velvet	Clear	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Automotive, Labels, Membrane Switches, Nameplates, Packaging
DE 7-2	Velvet	Clear	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Automotive, Labels, Membrane Switches, Nameplates, Packaging
DE 7-2 (6)	Velvet	Black	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Trade Show Displays, Spacers
LS 1-1	Gloss	Clear	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Automotive
DE 7-2 CG	Velvet	Clear	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Automotive, Labels, Nameplates
PCVM	Velvet	Clear	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Labels, Nameplates, Signs, Point of Purchase Graphics
PCVE	Velvet	Clear	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Labels, Nameplates, Trade Show Displays
PCSM	Suede	Clear	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Automotive, Labels, Membrane Switches, Nameplates, Packaging
VLG 7-1	Velvet	Clear	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Automotive

Cling (C) or Stick (S) masking can be provided for DE 1-1

Light Diffusing Films

Grade	1st Surface Texture	Color	Standard Thicknesses												Applications						
			mil	3.5	4	5	7	8	10	12	12.5	14	15	16		16.5	17	20	25	30	40
BL 2-2 820812	Gloss	Natural	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Automotive, Other Transportation
BL 2-4 820816	Fine Matte	Natural	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Automotive, Other Transportation
BL 6-2 820812	Fine Velvet	Natural	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Automotive, Other Transportation
BL 6-2 820802	Fine Velvet	Smoke-tinted	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Automotive, Other Transportation
BL 6-2 820803	Fine Velvet	Smoke-tinted	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Automotive, Other Transportation
LT 4-4/6-4	Fine Velvet	Natural	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Automotive, Other Transportation
LT 6-4 900009	Fine Velvet	Smoke-tinted	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Automotive, Other Transportation

Weatherable Films

Grade	1st Surface Texture	Color	Standard Thicknesses												Applications						
			mil	3.5	4	5	7	8	10	12	12.5	14	15	16		16.5	17	20	25	30	40
EPC VT/M	Velvet	Clear	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Gas Pump Graphics, Harsh Environments, Nameplates/Labels
EPC VT/E	Velvet	Clear	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Gas Pump Graphics, Harsh Environments, Nameplates/Labels
EPC ETE	Gloss	Clear	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Gas Pump Graphics, Name Plates, Labels
UV1 7-2	Velvet	Clear	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Gas Pump Graphics, Harsh Environments, Nameplates/Labels

Flame Retardant Films

Grade	1st Surface Texture	Color	Standard Thicknesses												Applications						
			mil	3.5	4	5	7	8	10	12	12.5	14	15	16		16.5	17	20	25	30	40
PCVE 600	Velvet	White	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	UL Rating V-2 ≥ 10 mil
PCVM 600	Velvet	White	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	UL Rating 94VTM-0
FR 7-2	Velvet	Clear	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	UL Rating 94VTM-0

Specialty Films

Grade	1st Surface Texture	Color	Standard Thicknesses												Applications						
			mil	3.5	4	5	7	8	10	12	12.5	14	15	16		16.5	17	20	25	30	40
Bayfol CR 1-4	Matte	Natural	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Automotive, Telecom, Hand Held Electronics
Bayfol CR 6-2	VF Matte	Natural	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Automotive, Telecom, Hand Held Electronics
DPF 5014	Velvet	Clear	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	High Heat
DPF 5023	Gloss	Natural	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Automotive, Telecom, Hand Held Electronics
DPF-5072	Gloss	Metallic	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Automotive
DPF-5073	Velvet	Natural	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Soft Feel
Bayfol AS-A 2-4	Velvet	Black	mm	0.090	0.100	0.125	0.175	0.200	0.250	0.300	0.315	0.350	0.375	0.400	0.420	0.430	0.500	0.635	0.750	1.00	Electronic Packaging

Typical Properties of Makrofol®/Bayfol® Light Diffusion Films

Property*	Test Method	Units	BL 2-2 820812	BL 2-4 820816	BL 6-2 820812	BL 6-2 820802	BL 6-2 820803	LT 4-4	LT 6-4	LT 6-4 900009
Physical										
Specific Gravity	ISO 1183		1.51	1.25	1.51	1.51	1.35	1.41	1.41	1.41
Water Absorption (Saturation value, 23°C)	ISO 62	%	0.35	0.35	0.35	0.35	0.35	0.2	0.2	0.2
First Surface Gloss-60°	ISO 2813	gloss unit	≥ 9.0	75	3	3	3			
Second Surface Gloss-60°	ISO 2813	gloss unit	≥ 2.0	≤ 15	≥ 3.0	7	≥ 10			
First Surface Roughness, R3Z	ISO 4288	microns	≤ 5.0	≤ 5.0	15	15	15			
Second Surface Roughness, R3Z	ISO 4288	microns	≤ 9.0	≤ 11	≤ 9.0	≤ 9.0	≤ 9.0			
Optical										
Luminous Transmittance (clear transparent materials)	ISO 13468-2	%	80	≥ 80	≥ 60	≥ 20	≥ 20	≥ 20	≥ 80	≥ 20
Mechanical										
Tensile Modulus	ASTM D-638	klb/in ²	420.6	304.6	420.6	391.5	348.1	797.7	797.7	797.7
Tensile Stress, Break	ASTM D-638	klb/in ²	5800	8700	5800	5800	7251	8700	9427	8700
Elongation @ Break	ASTM D-638	%	100	≥ 100	70	70	≥ 100	3	3	3
Thermal										
Coefficient of Linear Thermal Expansion	ASTM D-648	in/in/°F	3.9 E-05	3.9 E-05						
Shrinkage, parallel, 130°C, 1 h	IEC 60674	%	≤ 0.2	≤ 0.2	≤ 0.2	≤ 0.2	≤ 0.2	0.15	0.15	0.15
Shrinkage, across, 130°C, 1 h	IEC 60674	%	≤ 0.2	≤ 0.2	≥ 0.2	≤ 0.2	≤ 0.2	0.15	0.15	0.15
Flammability										
UL 94 HB	UL 94	min. thickness (mm)	0.38	0.38	0.38	0.38	0.38			
UL 94 V-2	UL 94	min. thickness (mm)						0.38	0.38	0.38
UL 94 VTM-0	UL 94	min. thickness (mm)						0.38	0.38	0.38
UL 94 VTM-2	UL 94	min. thickness (mm)	0.2	0.2	0.2	0.2	0.2			
Burn Rate	FMVSS302	mm/min.	≤ 100	≤ 100	≤ 100	≤ 100	≤ 100	≤ 100	≤ 100	≤ 100
Features										
			light diffusion, translucent	easy punching, light diffusion, translucent	light diffusion, clear translucent	light diffusion, black translucent	light diffusion, black translucent	light diffusion, high stiffness, clear translucent	light diffusion, clear translucent	light diffusion, high stiffness, black translucent

*These typical properties are provided as general information only. They are approximate values and are not part of the product specifications.



Typical Properties of Makrofol®/Bayfol® Specialty Films

Property*	Test Method	Units	CR 1-4	CR 6-2	DPF 5014	DPF 5023	DPF 5072	DPF 5073	AS-A 2-4
Physical									
Specific Gravity	ASTM D-792		1.23	1.23	1.13	1.23	1.20	1.16	1.30
Conversion Factor		ft ³ /lb-mil	156	156	170	156	160	166	148
Water Absorption (Immersion at 73°F 24 hr.)	ASTM D-570	%	0.33	0.33	0.31	0.33	0.37	0.53	
First Surface Gloss-60° angle, black inked second surface	ASTM D2457	gloss unit	≥ 99	2.5 - 8.0	4.20	≥ 99	≥ 98		
First Surface Roughness, R3Z	ISO 4288	microns	≤ 0.5	11 - 17	10.00	≤ 0.5	≤ 0.5		
Shrinkage, across	IEC 60674	%							0.70
Surface resistivity	IEC 60093	Ohm							100,000
Optical									
Haze	ASTM D-1003	%			0.2	92.0			
Light Transmission	ASTM D-1003	%	88	≥ 80	91	90	1.4		
Yellowness Index	ASTM E313		1	1	1	1			
Mechanical									
Tensile Strength, Yield	ASTM D-882	psi	8,650	8,650	9,193	8,650	8,600	5,290	
Tensile Strength, Break	ASTM D-882	psi	8,100	8,100	8,105	8,100	8,700	5,680	7,980
Elongation @ Break	ASTM D-882	%	160	160	11	160	120	110	15
Tear Strength, Initiation	ASTM D1004	lb/in	960	960	753	960	1,100	630	
Thermal									
Heat Deflection Temperature 264 psi load	ASTM D648	°F			347				
66 psi load		°F			381				
Vicat Softening Temperature, Rate A	ASTM D1525	°F			401				
Flammability									
UL 94 V-0	UL 94	min. thickness (in)							
UL 94 V-2	UL 94	min. thickness (in)							
UL 94 VTM-0	UL 94	min. thickness (in)							
UL 94 VTM-2	UL 94	min. thickness (in)							
Burn Rate	FMVSS302	mm/min.							
Features									
			chemical resistant, cold formable	chemical resistant, cold formable	high Vicat temperature	chemical resistant, cold formable, micro-matte	metallic look	soft feel	low surface resistivity

*These typical properties are provided as general information only. They are approximate values and are not part of the product specifications.



Typical Properties of Makrofol®/Bayfol® Weatherable Films and FR Films

Property*	Test Method	Units	EPC VT/M	EPC VT/E	EPC ETE	UVI 7-2	PCVE 600	PCVM 600	FR 7-2
Physical									
Specific Gravity	ASTM D-792		1.20	1.20	1.20	1.20	1.20	1.20	
Conversion Factor	ft ³ /lb-mil	161	161	161	161	160	160	160	1.30
Water Absorption (Immersion at 73°F 24 hr.)	ASTM D-570	%	0.30	0.30	0.30	0.40	0.25	0.25	0.30
First Surface Gloss--60° angle, black inked second surface	ASTM D2457	gloss unit	15 - 30	15 - 25		4.5 - 8.5			3.0 - 4.5
First Surface Roughness: R3Z	ISO 4288	microns					11 - 21	19 - 23	19 - 23
Optical									
Haze	ASTM D-1003	%				1.0		98.0	
Light Transmission	ASTM D-1003	%	89	89	89	93		90	
Yellowness Index	ASTM E313		2	2	2	1		1	
Mechanical									
Tensile Strength, Yield	ASTM D-882	psi	8,200	8,200	8,200	7,500	8,500	8,500	10,600
Tensile Strength, Break	ASTM D-882	psi	8,200	8,200	8,200	7,400	7,500	7,500	8,530
Elongation @ Break	ASTM D-882	%	110	110	110	110	100	100	5
Tear Strength, Initiation	ASTM D1004	lb/in	1,100	1,100	1,100	1,100			1,100
Thermal									
Heat Deflection Temperature									
264 psi load	ASTM D648	°F							
66 psi load		°F							
Vicat Softening Temperature, Rate A	ASTM D1525	°F							
Flammability									
UL 94 V-0	UL 94	min. thickness (in)		0.019					0.010
UL 94 V-2	UL 94	min. thickness (in)						0.010	
UL 94 VTM-0	UL 94	min. thickness (in)	0.006	0.009	0.008		0.006	0.006	
UL 94 VTM-2	UL 94	min. thickness (in)							
Burn Rate	FMVSS302	mm/min.							
Features									
			chemical and UV resistant	chemical and UV resistant	chemical and UV resistant	UV resistant	flame retardant	flame retardant	flame retardant

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Typical Properties of Makrofol®/Bayfol® Polycarbonate Films

Property*	Test Method	Units	DE 1-1 LS 1-1	DE 1-mm	DE 1-4	DE 1-4 Translucent White 3723	DE 6-2	DE 7-2	DE 7-2 (6)	DE 7-2 CG	VLG 7-1	PCVM	PCVE	PCSM
Physical														
Specific Gravity	ASTM D-792		1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
Conversion Factor		ft ³ /lb-mil	160	160	160	160	160	160	160	160	160	160	160	160
Water Absorption (Immersion at 73°F 24 hr.)	ASTM D-570	%	0.33	0.33	0.33	0.07	0.33	0.33	0.11	0.33	0.33	0.33	0.33	0.33
First Surface Gloss-60° angle, black inked second surface	ASTM D2457	gloss unit	≥ 98	≥ 98	≥ 98	≥ 98	3.0 - 6.2	3.0 - 4.5	3.0 - 4.0	3.0 - 4.0	2.0 - 4.0	3.0 - 4.5	5.0 - 10.0	
First Surface Roughness, R3Z	ISO 4288	microns	≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.5	11 - 17	16 - 23	16 - 23	16 - 23	18 - 27	16 - 23	11 - 21	
Optical														
Haze	ASTM D-1003	%	0.3	20.0		99.0					87.3			
Light Transmission	ASTM D-1003	%	91	91	90	31	90	90	90	90	90.3	90	90	89
Yellowness Index	ASTM E313		1	1	1		1	1	1	1	1.9	1	1	1
Mechanical														
Tensile Strength, Yield	ASTM D-882	psi	8,600	8,600	8,600	8,860	8,600	8,600	8,080	8,600	8,600	8,600	8,600	8,600
Tensile Strength, Break	ASTM D-882	psi	8,700	8,700	8,700	8,360	8,700	8,700	8,100	8,700	8,700	8,700	8,700	8,700
Elongation @ Break	ASTM D-882	%	120	120	120	110	120	120	120	120	120	120	120	120
Tear Strength, Initiation	ASTM D1004	lb/in	1,100	1,100	1,100	645	1,100	1,100	740	1,100	1,100	1,100	1,100	1,100
Thermal														
Heat Deflection Temperature 264 psi load	ASTM D648	°F	270	270	270		270	270		270	270	270	270	270
66 psi load		°F	288	288	288		288	288		288	288	288	288	288
Vicat Softening Temperature, Rate A	ASTM D1525	°F	315	315	315		315	315		315	315	315	315	315
Flammability														
UL 94 V-0	UL 94	min. thickness (in)												
UL 94 V-2	UL 94	min. thickness (in)	0.015	0.015	0.015		0.015	0.015		0.015		0.015	0.015	0.015
UL 94 VTM-0	UL 94	min. thickness (in)												
UL 94 VTM-2	UL 94	min. thickness (in)	0.005	0.005	0.005		0.005	0.005		0.005		0.005	0.005	0.005
Burn Rate	FMVSS302	mm/min.	gloss/gloss, low stress	≤ 100	≤ 100		≤ 100	≤ 100		≤ 100		≤ 100	≤ 100	≤ 100
Features														
				micromatte	gloss/f. matte	translucent white	f. velvet/vf. matte	velvet/vf. matte	black	tight gloss range	f. velvet/ gloss	velvet/matte	velvet/gloss	suede/matte

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