

PLEXIGLAS® FOR AVIATION

DISCOVER
INFINITE
SPACE



PLEXIGLAS® 
The Original.

Aircraft glazing
was one
of the first
applications
for cast
acrylic sheet.





REACH FOR THE SKY WITH EVONIK!

EVONIK PERFORMANCE MATERIALS GMBH

which is part of the Evonik Industries AG group, occupies a leading global position in the international methacrylate chemistry market. Our strengths are creativity, specialization, continuous self-renewal, and reliability. Having spearheaded the development and expansion of continuously manufactured and specialty cell cast sheet products, we have earned a reputation as a leader in innovative technology in the plastics industry.

Aircraft glazing was one of the first applications for cast acrylic sheet. Acrylic is lightweight, resistant to thermal shock, and has excellent optical clarity and mechanical properties. Therefore, **PLEXIGLAS®** acrylic sheets have been used in the most varied types of aircraft glazing for many years. In the 1960's, the German Röhm GmbH, now Evonik, introduced its special aircraft grade acrylic sheet.

PLEXIGLAS® LIGHTWEIGHT MATERIALS FOR A CLEAR VIEW

PROPERTIES AND APPLICATIONS

Cast aviation grade sheets are used for glazing, edge-lit panels, wing tip lenses, and other transparent applications in the aviation industry. PLEXIGLAS® aviation grade sheet possesses the following properties:

- Excellent light transmission and brilliance
- Outstanding weather resistance
- 100 % recycling ability
- Easy to fabricate
- High surface hardness
- Light weight – half the weight of glass
- 11 times more break resistant than glass

Applications of PLEXIGLAS® in Aviation Transparency



SALES RANGE

SPECIALIZED MATERIALS THAT ARE RELIABLE AND DURABLE

PLEXIGLAS® GS 241

PLEXIGLAS® GS 241 sheet is a cell cast acrylic sheet designed for general aviation and helicopter window applications and is superior to standard cell cast acrylics in both optical quality and thickness tolerance. The material is used for applications that do not specify material which is certified to any particular aviation standard. It is manufactured and certified to meet the requirements of AMS-LP-391, Type I, Grade C.

APPLICATION

PLEXIGLAS® GS 241 sheet is used for aviation applications where military specifications are not required at an economical cost.

FABRICATION

Fabrication techniques used on standard cell cast acrylic sheet will be appropriate for PLEXIGLAS® GS 241 sheet. When drape forming this sheet, excellent results can be achieved if the sheet is heated evenly between 150 °C and 160 °C. For pressure forming or vacuum forming operations temperature of 170 °C to 190 °C are recommended.

PROPERTIES

- UV transmittance < 1 % (UV range of 290–330 nm)
- PLEXIGLAS® GS 241 sheet is tested to high optical standards for glazing that does not specify require a specification. We do certify it to MS-LP-391, Item A, Type I, Grade C.

GRADES

The aviation acrylic sheet products include: PLEXIGLAS® GS 249 aviation grade, which is a cross-linked acrylic sheet. PLEXIGLAS® GS 249 meets prEN 4365. Furthermore it is qualified by the US Navy to meet Military Specification MIL-PRF-8184 as a Type I, Class 2 material. As such, it is also suitable for Type II and Class 1 applications. PLEXIGLAS® GS 245 aviation acrylic sheet meets prEN 4364 and is qualified by the US Navy to meet the requirements of Military Specification MIL-PRF-5425. Furthermore, PLEXIGLAS® Stretched is qualified to prEN 4366 as well as MIL-PRF-25690. Together with our products we offer our customers competent application-oriented advice, custom-tailored solutions and compliance with all relevant standards and specifications.

AIRCRAFT COCKPIT
WINDOWS



PLEXIGLAS® GS 245

PLEXIGLAS® GS 245 acrylic sheet meets and is qualified to prEN 4364 and MIL-PRF-5425 for use in the aviation industry in applications where exacting standards are established for aircraft applications. It has premium optical quality, dimensional stability, and extraordinary flatness and tolerance control.

APPLICATION

Current applications include instrument panels, wing tip lenses, dust covers,

helicopter bubbles, and aircraft canopies. PLEXIGLAS® GS 245 sheet is used in aerospace transparent enclosures in monolithic or laminated form.

FABRICATION

Fabrication techniques used on standard cell cast acrylic sheet will be appropriate for PLEXIGLAS® GS 245 sheet. When drape forming this sheet, excellent results can be achieved if the sheet is heated evenly between 150 °C and 160 °C. For pressure forming or vacuum forming operations

temperature of 170 °C to 190 °C are recommended.

PROPERTIES

- UV transmittance < 1 % (UV range of 290–330 nm)
- Certified to aviation standard prEN 4364 and MIL-PRF-5425 and listed on the US Navy's QPL
- Is a cell-cast acrylic with excellent weather resistance specially developed to meet the high optical requirements of the aviation industry





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PLEXIGLAS® GS 249

PLEXIGLAS® GS 249 acrylic sheet meets and is qualified to prEN 4365 and MIL-PRF-8184 (Type I, Class 2). PLEXIGLAS® GS 249 is a cross-linked cast acrylic sheet with increased resistance to crazing and solvent attack, as well as improved dimensional stability after heating.

APPLICATION

PLEXIGLAS® GS 249 sheet is used in a wide variety of commercial, military and rotary wing transparencies in monolithic or laminated form.

FABRICATION

Most fabrication techniques used with other acrylic sheet materials can also be followed when fabricating PLEXIGLAS® GS 249 sheet. Forming techniques may vary slightly.

PROPERTIES

- UV transmittance < 1 % (UV range of 290–330 nm)
- Certified to aviation prEN 4365 and Mil-PRF-8184
- Cross-linked acrylic sheet developed to withstand craze and weathering
- Offers higher resistance to media that cause stress cracking and a higher heat deflection temperature
- Excellent suited for stretching, which makes it possible to improve its properties even further over the unstretched state
- As MIL-PRF-8184 Type I, Class 2 material, it is also suitable for use in Type II and /or Class 1 applications

PLEXIGLAS® STRETCHED

PLEXIGLAS® Stretched acrylic sheet meets and is certified to prEN 4366 and MIL-PRF-25690. PLEXIGLAS® Stretched is an advanced form of Evonik's PLEXIGLAS® GS 249 cross-linked material. The stretched acrylic increases the resistance to crazing and solvent attack, as well as improves mechanical behavior.

APPLICATION

PLEXIGLAS® Stretched is used in a wide variety of commercial, military and rotary wing applications in monolithic or laminated form.

FABRICATION

Most fabrication techniques used with conventional acrylic sheet materials can also be followed when fabricating PLEXIGLAS® Stretched sheet. Forming of stretched acrylic sheet requires unique and more sophisticated processing parameters. Forming temperatures should not exceed 110 °C and forming times are much longer than with unstretched acrylic.

PROPERTIES

- UV transmittance < 1 % (UV range of 290–330 nm)
- Certified to aviation prEN 4366 and MIL-PRF-25690
- Offers higher resistance to environmental conditions
- Is produced from Evonik PLEXIGLAS® GS 249, prEN 4365 and Mil-PRF- 8184
- Superior optical quality as well as thickness tolerances due to grinding and polishing of the material
- MIL-PRF-25690 Class 2 material, it is also suitable for Class 1 applications

ADDITIONAL FEATURES

Colors

PLEXIGLAS® aircraft grade acrylic sheet is available in a variety of transparent, translucent, and opaque colors. Please contact our sales department for further information.

Evonik Cast	Evonik Cast UV IR	Industry Standard	Color	Light Transmission* in %
2422			Green	74
2585			Grey	23
2830			Grey	52
2928			Blue	76
2929	7YS15	2515	Grey	74
2930			Grey	48
5Y23		5527	Blue	46
5Y48		2069	Blue	58
5Y50		2454	Blue	78
655			Blue	76
6Y24		2019	Green	83
6Y32	6YS11	2111	Green	76
6Y86		2082	Green	65
7X03			Grey	24
7X05			Grey	51
7Y00			Grey	27
7Y08			Grey	62
7Y12			Grey	67
7Y17	7YS17	2074	Grey	14
7Y18	7YS18	2094	Grey	46
7Y25	7YS25	2256	Grey	67
7Y35		2539	Grey	58
7Y38		2537	Grey	33
7Y43	7YS64	2064	Grey	27
7Y52		2412	Grey	26
7Y70			Grey	74

* The light transmission is independent of the nominal sheet thickness. Every color can be matched as UV IR version.

UV IR ABSORBING FEATURE

PLEXIGLAS® aviation products are now available with UV and IR radiation absorbing features. The special color technology provides design flexibility to aircraft cockpits and cabin interiors by filtering out unwanted ultraviolet (UV) and infrared (IR) radiation. This feature works in both ends of the solar spectrum outside the visible range. The reduction of UV and IR radiation exposure, helps minimize the weathering of interior fabrics and components, and prevents heat build-up in the aircraft enclosure. The UV and IR absorbing technology is available in all standard and custom colors. Additionally, these colors are available across our range of aviation glazing products: PLEXIGLAS® GS 241 (AMS-LP-391), PLEXIGLAS® GS 245 (prEN 4364 / MIL-PRF-5425) and PLEXIGLAS® GS 249 (prEN 4365 / MIL-PRF-8184) and in PLEXIGLAS® Stretched (prEN 4366 / MIL-PRF-25690).

FABRICATION

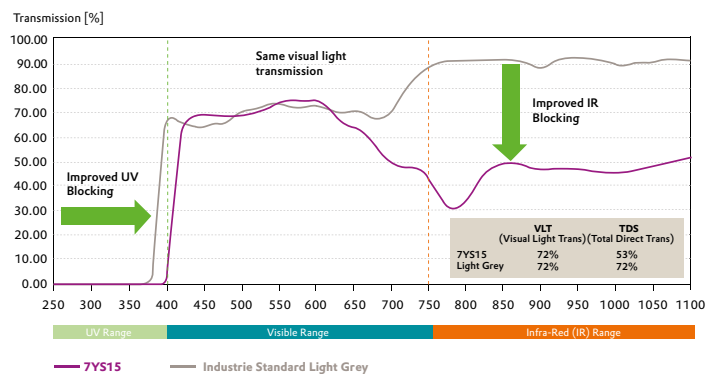
Our products with UV and IR radiation absorbing features can be formed, cut and processed the same as our PLEXIGLAS® GS 241, GS 245 and GS 249 products. In addition, the sheet sizes (up to and including 3050 mm x 2030 mm as cast) allow for greater yields and larger formed parts.

PROPERTIES

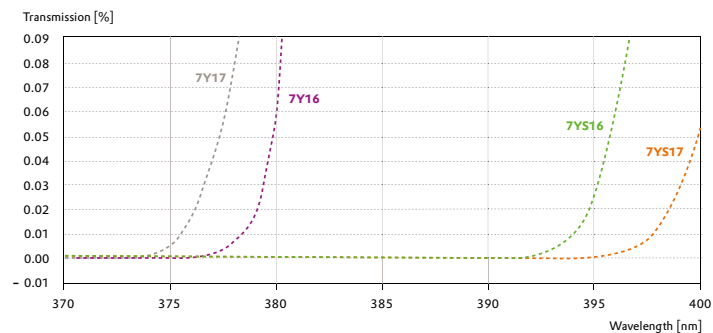
The UV and IR radiation absorbing material has the same physical properties as the corresponding PLEXIGLAS® product into which the features are included. The UV filtering is improved and the IR radiation is blocked even though the color impression in the visible range is maintained. The UV IR absorbing feature improves UV blocking up to 99.9%.



PLEXIGLAS® Grey 7YS15 Solar vs Industry Standard Light Grey



Comparison UV Block Colors with and without UV IR Absorbing Feature



TECHNICAL DATA

Certification

Evonik Cast	AECMA	Germany	UK	France	US	Russia
PLEXIGLAS® GS 241					AMS-LP-391, ASTM-D-4802	
PLEXIGLAS® GS 245	prEN 4364	WL 5.1412	DTD 5592 A	AIR9106/A Type I	MIL-PRF-5425	GOST 10667-90
PLEXIGLAS® GS 249	prEN 4365	WL 5.1415	DTD 5592 A	AIR9106/A Type II	MIL-PRF-8184 Type I, Class 2	GOST 10667-90
PLEXIGLAS® Stretched	prEN 4366	WL 5.1416		AIR9106/ Type III	MIL-PRF-25690, Class 2*	

*(automatically qualified for Class 1)



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TOLERANCE AND DIMENSIONS

PLEXIGLAS® aircraft grade acrylic sheets, blocks and billets are supplied within the tolerance limits of the applicable specification. Custom thicknesses and dimensions are available. Please contact our sales department for further information. Our process allows tight tolerances across a larger sheet size than is shown in the MIL specifications.

Thickness Tolerances EN4367 and LN 9130

Standard Thickness	Sheets < 2.4 m ² (2000 mm x 1200 mm)	Sheets > 2.4 m ² (3000 mm x 2000 mm)
mm	Specification (in %)	Specification (in %)
1.5	± 25	–
2.0		
2.5	± 20	
3.0	± 18	± 20
4.0	± 15	± 20
5.0	± 13	± 17
6.0	± 12	± 15
8.0	± 11	± 13
10.0	± 10	± 12.5
12.0	± 9.5	± 11.5
15.0	± 9.0	± 10.6
20.0	± 8.0	± 10.5
25.0	± 7.5	± 10.0
30.0	± 7.0	–
35.0		
40.0		
45.0		
50.0		
55.0		
60.0		
70.0		
80.0		

Thickness Tolerances MIL-PRF-8184/5425

Standard Thickness		Tolerance A (Up to 914 x 1525 mm & 1016 x 1270 mm)		Tolerance B (Up to 1346 x 2030 mm & 1524 x 1829 mm)		Tolerance C	
inch	mm	Specification (mm)	We offer in sizes up to (mm)	Specification (mm)	We offer in sizes up to (mm)	Specifica- tion (mm)	We offer in sizes up to (mm)
.060"	1.50	±0.30	1930 x 1630	±0.51	2540 x 1625		
.080"	2.00	±0.30	2235 x 1778	±0.51	2844 x 1828		
.100"	2.54	±0.30	2438 x 1778	±0.51	2844 x 1828		
.125"	3.18	±0.38	2160 x 1630	±0.51	2160 x 1830	±0.76	
.150"	3.80	±0.43	2844 x 1828	±0.51		±0.76	
.187"	4.75	±0.51	2844 x 2030	±0.58		±0.76	
.220"	5.60	±0.58		±0.64		±0.76	
.250"	6.35	±0.64		±0.76		±0.89	
.312"	7.90	±0.76		±0.89		±1.02	
.375"	9.50	±0.89		±1.02		±1.14	
.417"	10.60	±1.02		±1.14		±1.14	
.500"	12.70	±1.02	3050 x 2030	±1.14	3050 x 2030	±1.27	3050 x 2030
.625"	15.90	±1.27		±1.27		±1.40	
.750"	19.10	±1.27		±1.27		±1.65	
.875"	22.20	±1.27		±1.27		±1.78	
1.000"	25.40	±1.27		±1.27		±1.91	
1.250"	31.80	±1.60		±1.60		±2.39	
1.500"	38.10	±1.91		±1.91		±2.84	
1.750"	44.50	±2.24		±2.24		±3.33	
2.000"	50.80	±2.54		±2.54		±3.81	
2.500"	63.50	±2.97		±2.97		±4.45	
3.000	76.20	±3.05		±3.05		±4.83	
3.500"	88.90	±3.56		±3.56		±5.33	

Product Properties of cast PLEXIGLAS® Sheet

Property	Test Method	Unit	Typical Value*		
			PLEXIGLAS® GS 241	PLEXIGLAS® GS 245	PLEXIGLAS® GS 249
Specific Gravity	ISO 1183; (ASTM D-792)	g/cm ³	1.19	1.19	1.19
Tensile Strength	ISO 527-2/1B/5; (ASTM D-638)	MPa; (psi)	80; (10,000)	80; (11,000)	80; (11,650)
Tensile Elongation	ISO 527-2/1B/5; (ASTM D-638)	%	4.2	5.5	5
Internal Strain	MIL-P-8184F	%		< 1	< 1
Refractive Index	ISO 489; (ASTM D 542)			1.49	1.49
Light Transmittance • Initial • After accelerated weathering	EN 2155-5; (ASTM D-1003)	%		91 89	91 89
Haze • Initial • After accelerated weathering	EN 2155-5; (ASTM D-1003) EN 2155-5; (ASTM D-1003)	%		0.5 1.0	1.5 2.2
Ultraviolet Transmittance	(l = 290 – 330 nm)	%	<1	<1	<1
Angular Deviation	EN 2155-7; (ASTM D-637)	Minutes		< 4	<4
Thermal Expansion	EN 2155-12 ASTM D-696	1/K in./°F		7 x 10 ⁻⁵ 3.9 x 10 ⁻⁵	7 x 10 ⁻⁵ 3.9 x 10 ⁻⁵
Heat Deflection Temperature	ISO 75-2Ae; (ASTM D-648)	°C °F	105 222	105 222	113 236
Vicat Softening Temperature	ISO 305-B 50	°C		115	118
Flammability	EN 3844-2; (ASTM D-635)	mm/min in./min.		36 1.4	20 0.6
Water Absorption • Standard • Long term	MIL-P-8184 MIL-P-8184	%			0.2 2.1
Craze Resistance Dry • Isopropyl alcohol • Lacquer thinner Wet • Isopropyl alcohol • Lacquer thinner	MIL-P-8184F MIL-P-8184F MIL-P-8184F MIL-P-8184F EN 2155-19	psi psi psi psi MPa			2880 2328 2486 1925 16

* some values may vary with thickness

Product Properties of PLEXIGLAS® Stretched Sheet

Property	Test Method	Unit	PLEXIGLAS® Stretched
Tensile Strength	ISO 527-2/1B/5; (ASTM D-638)	MPa; (psi)	80; (11,600)
Tensile Elongation	ISO 527-2/1B/5; (ASTM D-638)	%	30
Resistance to Crack Propagation			
• At 23 °C	EN 2155-21 MIL-P-25690	N/mm _{3/2} (lbs./in _{3/2})	118 (3400)
• At 73 °F	EN 2155-21 MIL-P-25690	N/mm _{3/2} (lbs./in _{3/2})	56 (1600)
• At -17.8 °C	EN 2155-21 MIL-P-25690	N/mm _{3/2} (lbs./in _{3/2})	56 (1600)
• At 0 °F	MIL-P-25690	lbs./in _{3/2}	3350
• After Weathering			
Shear Strength	MIL-P-25690	psi	4500
Thermal Relaxation			
At 110 °C (230 °F)	EN 2155-22; (MIL-P-25690)	%	5
At 145 °C (293 °F)	EN 2155-22; (MIL-P-25690)	%	42
Crazing Resistance			
Dry			
• Isopropyl alcohol	MIL-P-25690	psi	3700
• Lacquer thinner	MIL-P-25690	psi	3350
Wet			
• Isopropyl alcohol	MIL-P-25690	psi	3550
• Lacquer thinner	MIL-P-25690	psi	2850



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FABRICATION

PLEXIGLAS® aviation grade sheet offers excellent optical characteristics, industry leading thickness tolerances, light stability, and low internal stress levels for consistent performance. **PLEXIGLAS®** acrylic sheet can be easily cut, sawed, machined, thermoformed and cemented. **PLEXIGLAS® GS 249** prEN 4365 and Mil-P-8184 requires special two part solvents. Fabrication techniques used on standard cell cast acrylic sheet are appropriate for **PLEXIGLAS® GS 245** and **PLEXIGLAS® GS 241** sheet. When drape forming, excellent results can be achieved if the sheet is heated evenly

between 150 °C and 160 °C. For pressure forming or vacuum forming operation, temperatures of 170 °C and 190 °C are recommended. Most fabrication techniques used with conventional acrylic sheet can also be followed when fabricating **PLEXIGLAS® GS 249** sheet. Slight technique modification is required.

OVERAGES

All sheets are supplied net trim (no overage). Untrimmed sheets are available. No guarantee is given as to the additional area obtained by ordering untrimmed sheet. For information on custom thicknesses and sizes please contact our sales department.

EDGE PREPARATION

Edge preparation billets are available upon request.

COMPATIBILITY

Like other plastic materials, **PLEXIGLAS®** sheet is subject to crazing, cracking or discoloration if brought into contact with incompatible materials. These materials may include cleaners, polishes, adhesives, sealants, gasketing or packaging materials, cutting emulsions, etc. Contact your **PLEXIGLAS®** sheet distributor for information on a specific product.

® = registered trademark

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Certified to DIN EN ISO 9001 (quality) and DIN EN ISO 14001 (environment)

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