

Opticor™
Advanced Transparencies Material
Technical Data Brochure
Aerospace Transparencies



Description

Opticor™ advanced transparency material is an innovative, high performance transparent plastic that offers excellent material characteristics and final product processing flexibility. This material is designed for use in all aircraft transparency applications, including cabin windows, wing tip lenses, landing light lenses, and cockpit windows. It offers exceptional craze resistance and excellent adhesion of metallic and non-metallic coatings. It has lower specific gravity, less thermal expansion to maintain shape, and significantly improved fire resistance and smoke emission compared to MIL-P-25690 stretched acrylic.

Opticor advanced transparency material allows the ability to create optimized geometries that offer aerodynamic benefits, attractive aesthetics and weight savings. Aircraft designers can select from a wide range of thicknesses.



Mechanical properties	Test method	Value
Tensile properties - initial		
Poisson's ratio, 2 inches/minute; 23°C/73°F; 50% RH	ASTM D638	0.41
Tensile strength at yield, test speed 2 inches/minute 23°C/73°F -54°C/-65°F 66°C/150°F	ASTM D638 ASTM D638 ASTM D638	14,000 psi/96.5 MPa n/a 8,800 psi/60.7 MPa
Tensile strength at break 23°C/73°F -54°C/-65°F 66°C/150°F	ASTM D638 ASTM D638 ASTM D638	12,700 psi/87.6 MPa 19,700 psi/135.8 MPa 7,000 psi/48.3 MPa
Elongation at yield 23°C/73°F -54°C/-65°F 66°C/150°F	ASTM D638 ASTM D638 ASTM D638	9.6% n/a 7.4%
Elongation at break 23°C/73°F -54°C/-65°F 66°C/150°F	ASTM D638 ASTM D638 ASTM D638	16% 6.8% 39%
Modulus of elasticity 23°C/73°F -54°C/-65°F 66°C/150°F	ASTM D638 ASTM D638 ASTM D638	374,000 psi/2578 MPa 500,000 psi/3447 MPa 259,000 psi/1786 MPa

Mechanical properties	Test method	Value
Tensile properties - After 4,000 hours of QUV B313 exposure		
Tensile strength at yield, test speed 2 inches/minute	ASTM D638	14,600 psi/100 MPa
Tensile strength at break, 21°C/70°F	ASTM D638	14,100 psi/97.2 MPa
Elongation at yield, 21°C/70°F	ASTM D638	9%
Elongation at break, 21°C/70°F	ASTM D638	12%
Modulus of elasticity, 21°C/70°F	ASTM D638	366,000 psi/2523 MPa
Flexural properties		
Flexural stress at 5% strain, 23°C/73°F; 50% RH	ASTM D790	15,800 psi/109 MPa
Flexural modulus, 23°C/73°F; 50% RH	ASTM D790	381,000 psi/2627 MPa
Compressive properties		
Maximum compressive strength, 23°C/73°F; 50% RH	ASTM D695	37,200 psi/256 MPa
Compressive yield strength, 23°C/73°F; 50% RH	ASTM D695	18,200 psi/125 MPa
Modulus of elasticity in compression, 23°C/73°F; 50% RH	ASTM D695	370,000 psi/2551 MPa
Shear properties		
Shear strength, 23°C/73°F; 50% RH; 1 inch diameter punch, 0.05 inches/minute cross-head speed	ASTM D732	9,600 psi/66.2 MPa
Resistance to impact and to crack propagation		
Resistance to impact - high speed puncture test Average total energy - initial Average total energy - after 4,000 hours QUV B313	ASTM D3763	88.5 inch•lb/10 Joules 44.3 inch•lb/5 Joules
Resistance to impact - falling dart test (Garner impact) mean failure energy	ASTM D3763	30 inch•lb/3.4 Joule
Notched Izod impact strength, 23°C/73°F; 50% RH	ASTM D256	1.2 ft•lb/in/63.6 Joules
Toughness factor (K-factor), 23°C/73°F; 50% RH	MIL-P-25690	see note (A)

Note A: Opticor advanced transparency material is not a bi-axially stretched material and is not subject to in-plane cracking.

Thermal properties	Test method	Value
Linear coefficient of thermal expansion, 25°C to 70°C/77°F to 158°F	ASTM D696	0.000067 mm/mm/°C
Glass transition temperature, 1 Hz; 3°C/minutes	ASTM D4065	257°F/125°C
Heat deflection temperature, 264 psi (1.8 MPa) stress	ASTM D648	217°F/103°C
Maximum service temperature	Note B*	203-212°F/95-100°C
Thermal conductivity at 23°C/73°F	ASTM E1530	0.12 BTU (int)/ft•hr•°F /0.21 W/m•K

Note B: Maximum service temperature determined based on thermo-mechanical properties.

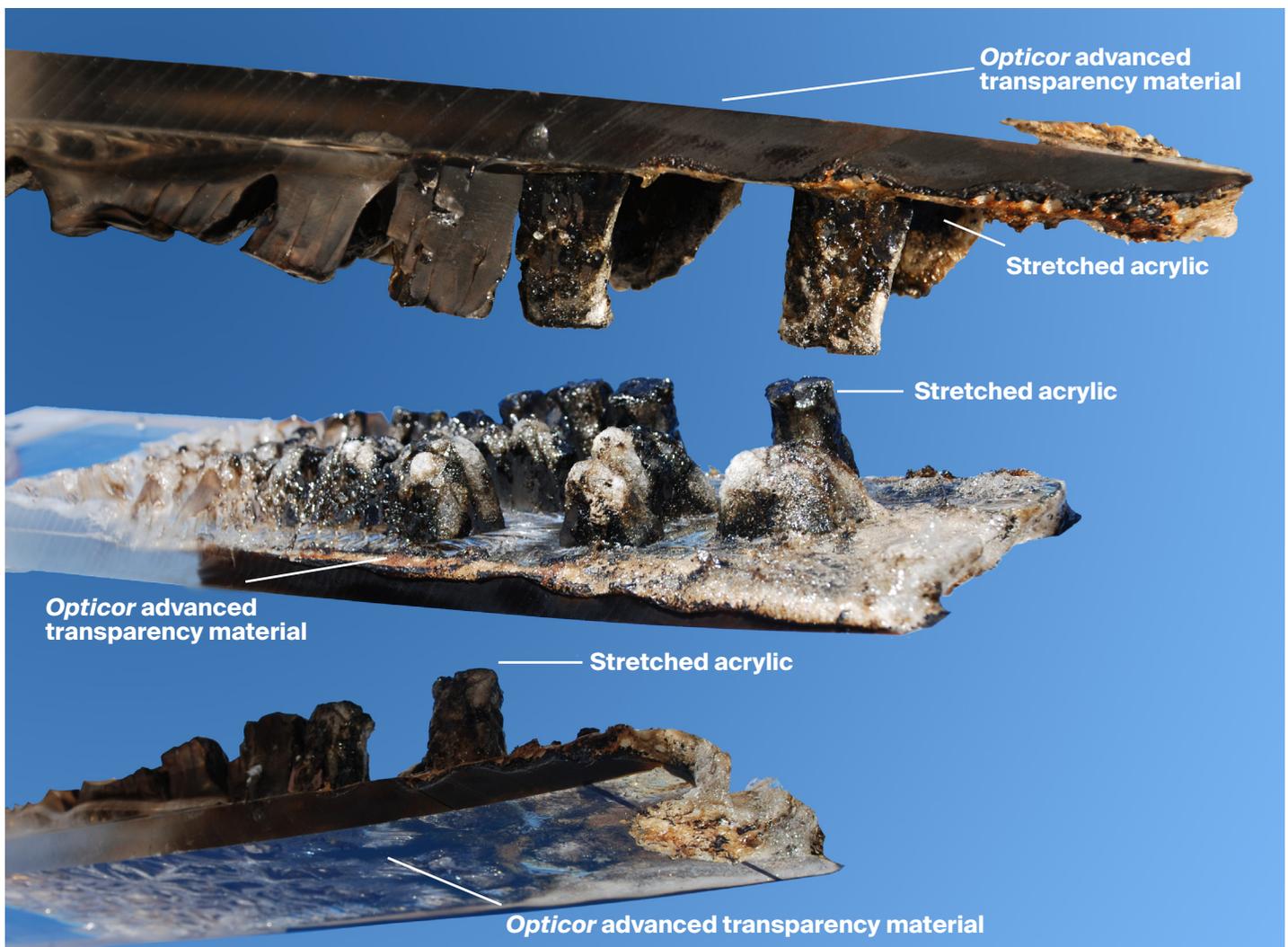
Optical properties	Test method	Value
Visible light transmission Initial 4,000 hours QUV B313 Long term outdoor exposure	ASTM D1003 ASTM D1003 ASTM D1003	91% 90% see note (C)
Haze Initial 4,000 hours QUV B313 Long term outdoor exposure	ASTM D1003 ASTM D1003 ASTM D1003	0.24% 1.89% see note (C)
Refractive index	ASTM D542	1.520

Note C: Long-term outdoor exposure is ongoing in Florida and Arizona, since March 2011.

Physical properties	Test method	Value
Specific gravity	ASTM D792	1.13
Hardness – Rockwell M	ASTM D785	115
Flammability - 15 second flame application Flame time Burn length Burn rate	14CFR Part 25.853 (a) 14CFR Part 25.853 (a) 14CFR Part 25.853 (a)	0 minutes 0 inches 0 inches/minute
Resistance to abrasion Bayer - haze after 100 cycles	ASTM F735	24%

Flammability of *Opticor* advanced transparency material

Flammability testing of a stretched acrylic/*Opticor* laminate was conducted per 14CFR Part 25.853 (a). The effects are shown in the photo below. In the post test inspection, the stretched acrylic shows significant burning. The *Opticor* advanced transparency material did not burn or char, demonstrating the stability of the material in flame conditions. This characteristic is one of the unique benefits for the use of *Opticor* advanced transparency material compared with stretched acrylic.



Flammability characteristics of *Opticor* advanced transparency material

Electrical properties	Test method	Value
Dielectric strength, in air, 0.125 inch/0.32 cm thickness	ASTM D149 method A	426 V/mil
Breakdown voltage, in air, 0.125 inch/0.32 cm thickness	ASTM D149 method A	55 kV
Failure location on electrode, in air, 0.125 inch/0.32 cm thickness	ASTM D149 method A	at electrode
Dielectric constant at 21°C/70°F, 50% RH, 10 Hz at 21°C/70°F, 50% RH, 1 kHz at 21°C/70°F, 50% RH, 1 MHz	ASTM D150	3.17 3.07 2.89
Loss index at 21°C/70°F, 50% RH, 10 Hz at 21°C/70°F, 50% RH, 1 kHz at 21°C/70°F, 50% RH, 1 MHz	ASTM D150	0.045 0.037 0.034
Dissipation factor at 21°C/70°F, 50% RH, 10 Hz at 21°C/70°F, 50% RH, 1 kHz at 21°C/70°F, 50% RH, 1 MHz	ASTM D150	0.014 0.012 0.012
Surface resistivity, 23°C/73°F; 60 seconds electrification time	ASTM D257	3.85E+15 Ω/square
Volume resistivity, 23°C/73°F; 60 seconds electrification time	ASTM D257	6.88E+15 Ω•cm

Chemical resistance	Test method	Value
Weight change after water absorption (24 hours immersion)	ASTM D570	0.20%
Stress craze resistance 75% sulfuric acid 2-propanol isopropanol/water toluene/isobutyl acetate 1:2 (wt) toluene/isobutyl acetate ethylene glycol	ASTM F791 procedure B Critical crazing stress at 30 minutes	3600 psi/24.8 MPa 3500 psi/24.1 MPa 4100 psi/23.3 MPa 3800 psi/26.2 MPa 3600 psi/24.8 MPa No craze
Weight change after 7 day immersion Skydrol LD4 Alkasol 2034 Jet A fuel Deicing fluid Turco 4460-BK CeeBee 280	ASTM D543	-0.13% 0.37% 0.00% -0.04% -0.06% 0.37%

Note: The values above are typical for the material, but not intended for use in specifications or acceptance inspection criteria because of variations in testing methods, conditions, and configurations.

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