

PSS-1000 Optical Sheet



PSS-1000 Optical Sheet | Overview

High Demand Applications

PSS-1000 optical sheet material is one of the toughest optical plastic materials available. Its exceptional impact resistance, superior optical properties, clarity and ultra-lightweight performance make PSS-1000 optical sheet the perfect choice for rugged applications including:

- Ballistic
- Marine
- Heavy Equipment
- Electronic Displays

In addition, PSS-1000 optical sheet material offers outstanding chemical resistance and thermal stability, providing all-around protection, durability and performance in a lightweight plastic sheet material.

Impact Resistance

The strength and toughness of PSS-1000 sheet material make it an outstanding choice for any application that requires impact resistance for enhanced protection and performance.

- General impact resistance exceeds polycarbonate
- Resistance to ballistic threats is more than 40% better than competitive materials
- Ideal for armored vehicles, aircraft windshields, riot shields, banks, check cashing, convenience store locations and more

Precision Optics

One of the most distinctive attributes of PSS-1000 sheet material is its optical performance and clarity, making it perfect for electronic display applications.

- High light transmission value
- Low haze value
- No optical defects resulting from black specs
- Compatible with touchscreen applications

Lightweight Performance

PSS-1000 sheet is ultra-lightweight, providing added convenience and flexibility.

- Lower density than polycarbonate and acrylic
- Half the weight of glass



Extreme Durability

Few other engineered plastics can match the chemical and thermal stability of PSS-1000 sheet material.

- Withstands extreme hot and cold temperatures
- Virtually unaffected by most organic and inorganic chemicals
- Extensive fabrication capabilities – drilled, screwed, notched, grommetted, formed



Ballistic Performance

PSS-1000 optical sheet can be produced as a single monolithic sheet, with no lamination, for applications requiring superior clarity at lower threat levels and/or with lamination to add performance for the highest threat levels.

- Demonstrates >40% improvement vs. polycarbonate
- Ballistic performance remains stable across typical temperature ranges (-40°C to 60°C)



PERFORMANCE COMPARISON

	PSS-1000	POLYCARBONATE	ACRYLIC	GLASS
Impact Resistance	● ● ●	● ●	⊘	⊘
Ballistic Performance	● ● ●	● ●	⊘	●
Optical Quality	● ●	⊘	● ●	● ● ●
Chemical Resistance	● ●	⊘	⊘	● ● ●
Lightweight / Low Density	● ● ●	● ●	● ●	⊘

● ● ● Superior ● ● Excellent ● Good ⊘ Poor

Standard Availability

DIMENSIONS AND THICKNESS

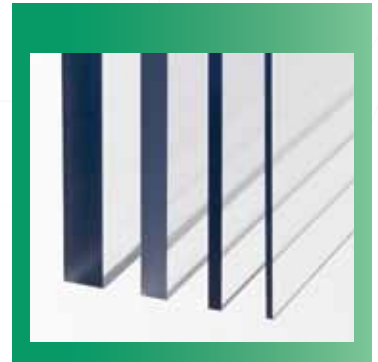
2' x 3' (889 mm x 610 mm)

- 1/8" (3.175 mm)
- 1/4" (6.35 mm)
- 1/2" (12.7 mm)
- 3/4" (19.05 mm)
- 1" (25.4 mm)
- 1-1/4" (31.75 mm)

15" x 18" (390 mm x 450 mm)

- 0.031" (0.8 mm)
- 0.040" (1.0 mm)
- 0.051" (1.3 mm)
- 0.071" (1.8 mm)

*Custom thickness available on request



PROPERTIES

	TEST CONDITIONS	UNITS	STANDARDS	PSS-1000
OPTICAL		Tests conducted on 3.0 mm thick sheet		
Luminous Transmittance		%	ASTM D1003	89
Haze		%	ASTM D1003	0.2
Yellowness Index			ASTM E313	1.22
Refractive Index, n_e	23°C, 546 nm			1.54
Abbe Value				45
MECHANICAL		Tests conducted on 1.0 mm thick sheet		
Tensile Modulus		MPa	ASTM D638-08	1655
Flexural Modulus		MPa	ASTM D790-07	2132
Impact Resistance		4.4 m/s		
Deflection at Peak Load		mm	ASTM D3763-10	24.0
Peak Load		N	ASTM D3763-10	6760
Total Energy		J	ASTM D3763-10	99.4
Taber Abrasion	500g, 100 cycles, 3.00 mm thick	% Haze	ASTM D1044-08	27%
THERMAL		Tests conducted on 1.0 mm thick sheet		
Thermal Expansion Coefficient		$\mu\text{m} / (\text{m } ^\circ\text{C})$	ASTM E831	120
Softening Temperature		$^\circ\text{C}$	ASTM E1545	173
Heat Distortion Temperature	264 psi	$^\circ\text{C}$	ASTM D648	70
UL 94 Flammability Class			ASTM D3801	V-2
ELECTRICAL		Tests conducted on 1.0 mm thick sheet		
Surface Resistivity		Ohms	ASTM 257-99	10×10^{15}
Volume Resistivity		Ohms-cm	ASTM 257-99	9×10^{15}
BASIC		Tests conducted on 1.0 mm thick sheet		
Specific Gravity		g / cm^3		1.11
Water Absorption	7 days, 25°C	%		0.8

PSS-1000 Optical Sheet



Advanced Performance

PSS-1000 optical sheet is one of the toughest optical plastics available. In addition to exceptional impact resistance, PSS-1000 sheet offers superior optical properties, ultra-lightweight performance, outstanding chemical resistance, and thermal stability.

IMPACT RESISTANCE

The impact resistance of PSS-1000 sheet outperforms other transparent plastics. The strength and toughness of the material make PSS-1000 sheet an outstanding choice for any application requiring enhanced protection.

- General impact resistance exceeds polycarbonate
- Resistance to ballistic threats is more than 40% better than the competitive materials

PRECISION OPTICS

One of the most distinctive attributes of PSS-1000 sheet is its optical performance.

- High light transmission value
- Low haze value
- No optical defects resulting from black specks

EXTREME DURABILITY

Few other engineered plastics can match the chemical and thermal stability of PSS-1000 sheet.

- Withstands very hot and cold temperatures
- Virtually unaffected by most organic and inorganic chemicals

LIGHTWEIGHT PERFORMANCE

PSS-1000 sheet is ultra-lightweight for added convenience and flexibility.

- Lower density than polycarbonate & acrylic
- Half the weight of glass

BALLISTIC PERFORMANCE

- Demonstrates >40% improvement vs. polycarbonate
- Ballistic performance remains stable across typical temperature ranges (-40°C to 60°C)

0.22 Caliber, 17 Grain Fragment Simulated Projectile 1/4" Sheet Thickness

	TEMP	UNITS	PSS-1000
V50	-40°C	(ft / s)	1155
	23°C	(ft / s)	1282
	60°C	(ft / s)	1267
V50/AD	-40°C	(ft / s) / (lbs / ft ²)	802
	23°C	(ft / s) / (lbs / ft ²)	890
	60°C	(ft / s) / (lbs / ft ²)	880

PERFORMANCE COMPARISON

	PSS-1000	POLYCARBONATE	ACRYLIC	GLASS
Impact Resistance	● ● ●	● ●	⊘	⊘
Ballistic Performance	● ● ●	● ●	⊘	●
Optical Quality	● ●	⊘	● ●	● ● ●
Chemical Resistance	● ●	⊘	⊘	● ● ●
Lightweight / Low Density	● ● ●	● ●	● ●	⊘

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PROPERTIES

All properties on 3.0 mm sheet except otherwise noted.

	TEST CONDITIONS	UNITS	STANDARDS	PSS-1000
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Luminous Transmittance		%	ASTM D1003	89
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Specific Gravity		g / cm^3		1.11
Water Absorption	7 days, 25°C	%		0.8

PSS Property Comparison

Based on 0.25" sheet thickness.
V-50 test conducted using 0.22-caliber, 17-grain FSP.

	TEST CONDI- TIONS	UNITS	POLYCARBON-			
			PSS-1000	PSS-1400	ATE	ACRYLIC
PHYSICAL						
Specific Gravity	-	-	1.11	1.11	1.20	1.20
Areal Density	0.25" Thickness	lbs / ft ²	1.44	1.44	1.56	1.56
MECHANICAL						
Tensile Modulus	2" / min	MPa	1655	696	2380	3100
Yield Stress	2" / min	MPa	52	44	62	72
Strain at Break	2" / min	%	112	190	100	5
IMPACT						
V50	0.22 cal, 17 gr FSP	(ft / s)	1282	1125	889	775
V50 / AD		(ft / s) / (lbs / ft ²)	890	782	570	497
HARDNESS						
Durometer, Shore D	23°C, 50% RH	-	84	73	84 -86	92 - 93
Taber Abrasion	100 Cycles	Δ% Haze	27%	11%	45%	36%
THERMAL						
Coefficient of Thermal Expansion	-	μm / m ⁰ C	120	-	110	50
OPTICAL						
Light Transmission	-	%	90%	90%	86%	91%
Haze	-	%	0.2	0.3	0.8	1.0
Refractive Index	-	-	1.53	1.52	1.59	1.49

PSS-1000 Optical Sheet



Chemical Stress Crazing Test

PURPOSE

Determine the stress threshold at which the material would craze in contact with unleaded gasoline.

TEST METHOD

ASTM F791-96

TEST PROCEDURES

The specimens were tested in accordance with Procedure A - Craze Stress Iteration per ASTM F791-96. Each specimen was loaded for 10 minutes and visually inspected under load before the addition of the gasoline. The gasoline was in contact with the specimen for 30 minutes for each iteration. The room environment was 72 to 74°F and 20 to 23% R.H. during the test.

RESULTS

The critical crazing stress determined by ASTM F791 Method A:

MATERIAL	CHEMICAL	CRITICAL CRAZING STRESS
PSS-1000 sheet	GASOLINE	2750±250 PSI
Polycarbonate	GASOLINE	1750±250 PSI

Photographs documenting significant observations were taken during the examination:

PSS-1000 Sheet



Polycarbonate



Testing performed February 13, 2012 by Materials Evaluation and Engineering, Inc



PSS-1000 Optical Sheet



Ballistic Performance

PSS-1000 optical sheet can be produced in monolithic or laminated form to stop ballistic threats. In monolithic sheet form, PSS-1000 optical sheet demonstrates superior ballistic performance against fragment simulating projectiles (FSPs).

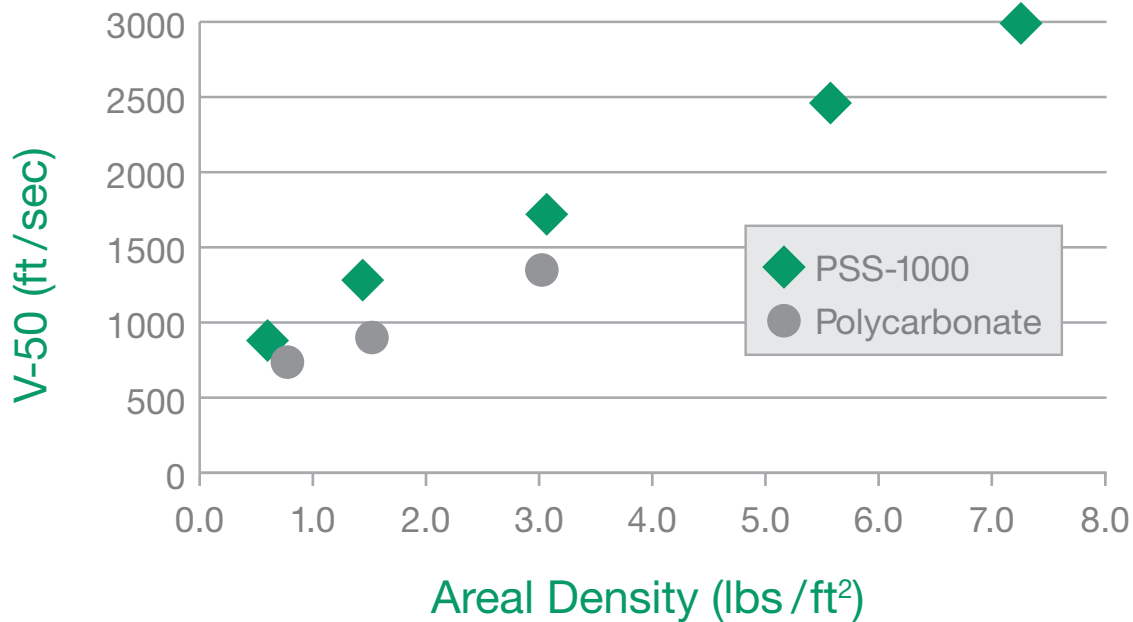
- Against the 0.22 caliber, 17 grain FSP, PSS-1000 optical sheet provides 40% improvement in ballistic protection vs. polycarbonate
- Ballistic performance of PSS-1000 optical sheet remains stable across typical use temperature ranges (-40°C to 60°C)

PSS-1000 optical sheet also laminates well with typical interlayer materials. The excellent solvent and chemical resistance of PSS-1000 optical sheet enable more durable laminated solutions.

The low density of PSS-1000 optical sheet allows for weight savings when replacing polycarbonate, acrylic or glass materials.

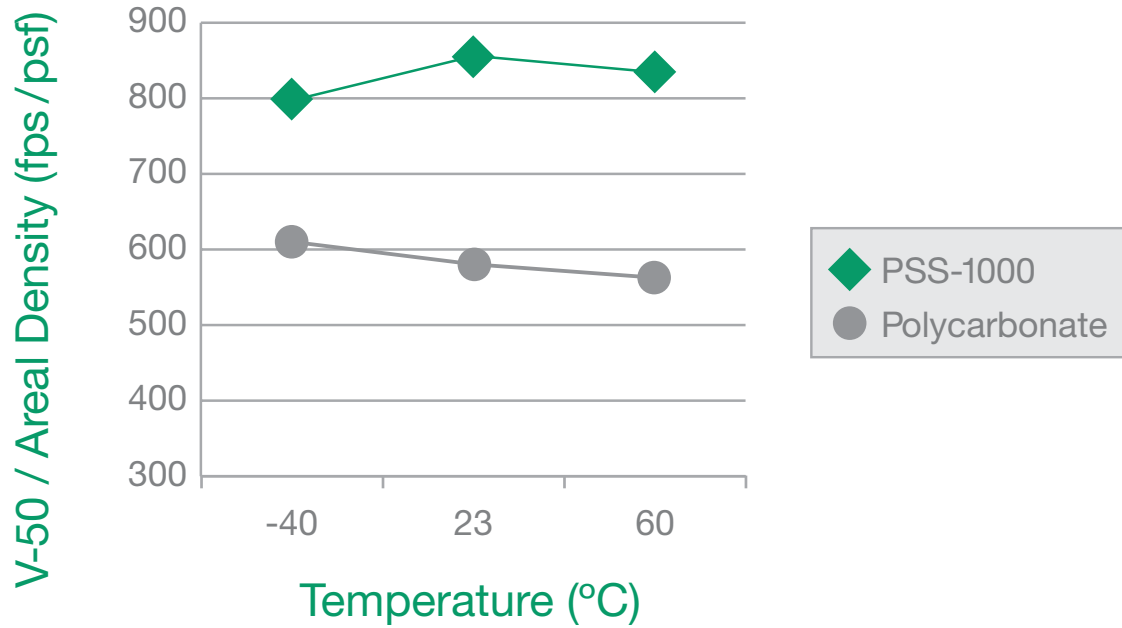
V-50 vs. Areal Density

0.22 cal, 17 gr FSP @ 23°C



V-50 vs. Areal Density vs. Temperature

0.25" Thickness, 0.22 cal, 17 grain FSP



PSS-1000 optical sheet meets NIJ Level III-A protection level defeating the 9-mm FMJ and 0.44-cal MAG projectiles at an areal density of 7.0 lb/ft² and a thickness of 1.23 inches.



