

Silk-screened Glass

Introduction

Oldcastle BuildingEnvelope™ provides today's design professional with a family of glass products that create that distinctive look—from refreshingly new exterior cladding designs to exciting interior applications. Oldcastle BuildingEnvelope™ silk-screened decorative glass is available in a palette of colors and patterns, allowing the glass to become a critical design element that is not only functional, but also aesthetically important. Silk-screened glass can provide a truly unique architectural statement. The versatile nature of this product allows it to be produced in many colors, thereby making decorative glass an attractive product choice for owners, architects and designers who seek to attain unique features in the structures they create or refine.

Silk-screened glass can be specified for both exterior and interior applications. When used on building exteriors, the painted surface must be protected from direct contact with the environment and is normally found in an insulating glass unit. Combining silk-screened glass with clear, tinted, Low-E, or reflective glass, can control light

transmittance, reduce solar heat gain and provide a desired level of privacy.

Silk-screened decorative glass is fabricated by transferring images or geometric designs to a glass surface. By using the same basic technology as in spandrel glass, the ceramic frit is applied to the glass through a fine mesh screen containing a standard or custom design. More durable than acid-etched or sandblasted surfaces, silk-screened glass is less susceptible to staining, easier to clean and always heat-treated to withstand thermal and/or mechanical stress.

Whether designing for interior or exterior applications, privacy or openness, silk-screened glass is attractive, easy to clean and “more resistant to graffiti” than most building materials. Laminated silk-screened glass can also be used in skylight and canopy applications since it has a significant influence on natural light entering the area. By incorporating silk-screened glass into an insulating glass unit, its aesthetic and performance characteristics are enhanced.

Description

Available in one-piece orders or high-volume runs, silk-screened decorative glass is custom-made by transferring a silk-screen image to the glass and then processing it through a horizontal tempering furnace. Each individual lite is screen-printed with the desired pattern and ceramic enamel frit color. The ceramic frit can be silk-screened onto the glass substrate in one of three common standard patterns—dots, lines, holes—or in a full-coverage application. Additionally, other standard

and custom patterns can be easily duplicated on a range of glass substrates. Depending on the pattern and the color, the glass lite can be made transparent, translucent or opaque. *With a wide range of glass substrate and frit color options, the silk-screen process gives designers exceptional creative flexibility.*

For a list of available glass products/colors, go to the Glass Options Tab.



Silk-screened Glass

Capabilities

Thickness: 1/8" through 1/2".

Size

Maximum size is generally 72" x 120".
Minimum size is 12" x 12".

The maximum glass size will vary with glass thickness and equipment capabilities.

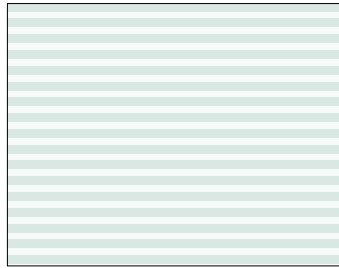
Colors

Oldcastle BuildingEnvelope™ offers ceramic enamel frit in all standard colors as well as simulated sandblast and simulated acid-etched. Custom colors may be utilized to create a unique appearance. Designers can choose from a wide range of glass substrates as well as silk-screened patterns to achieve that special look.

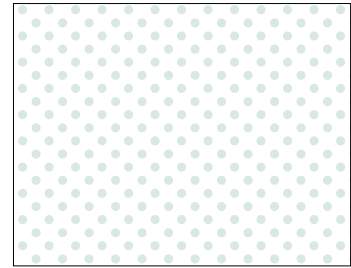
Standard Silk-screened Patterns



Dots—40% coverage;
1/8" dots staggered on 1/4" centers

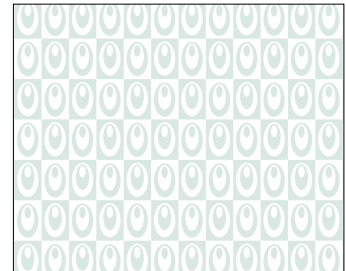
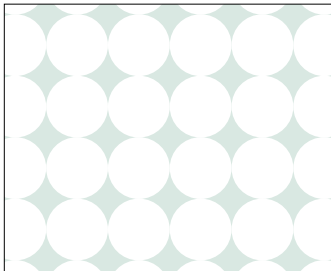


Lines—50% coverage;
1/8" lines on 1/4" centers



Holes—60% coverage;
1/8" holes staggered on 1/4" centers

Custom Silk-screened Pattern Examples



Custom Capabilities: For design assistance with custom silk-screened options, call 1-866-OLDCASTLE(653-2278) or log on to www.oldcastlebe.com.



Silk-screened Glass: Monolithic Glass



#2 Standard Dot Pattern - 40% Coverage - White Frit

Glass Product	Nominal Thickness Inches	Visible Light			Ultraviolet Trans%	Solar		U-Factor/U-Value		SC*	SHGC*	RHG*	LSG*
		Trans %	Refl.* Outside%	Refl.* Inside%		Trans %	Refl.* Outside%	Winter Nighttime	Summer Daytime				
Clear	1/4	61	22	26	NA	52	21	1.01	0.92	0.69	0.60	151	1.02
Green	1/4	53	17	26	NA	32	10	1.01	0.92	0.57	0.49	127	1.08
Gray	1/4	31	8	25	NA	28	9	1.01	0.92	0.55	0.47	122	0.66
Bronze	1/4	37	10	25	NA	33	11	1.01	0.92	0.58	0.50	128	0.74
PPG Solarblue™	.946	35	12	28	NA	25	11	0.47	0.49	0.43	0.37	93	0.95
Pilkington Blue-Green	1/4	52	17	25	NA	33	11	1.01	0.92	0.57	0.49	128	1.06
PPG Azuria™	1/4	47	14	25	NA	22	7	1.01	0.92	0.51	0.44	115	1.07
Pilkington EverGreen™	1/4	45	13	25	NA	23	7	1.01	0.92	0.51	0.44	115	1.02



#2 Standard Line Pattern - 50% Coverage - White Frit

Glass Product	Nominal Thickness Inches	Visible Light			Ultraviolet Trans%	Solar		U-Factor/U-Value		SC*	SHGC*	RHG*	LSG*
		Trans %	Refl.* Outside%	Refl.* Inside%		Trans %	Refl.* Outside%	Winter Nighttime	Summer Daytime				
Clear	1/4	54	25	31	NA	46	25	1.01	0.92	0.63	0.54	138	1.00
Green	1/4	47	20	30	NA	28	12	1.01	0.92	0.54	0.46	120	1.02
Gray	1/4	27	9	30	NA	25	10	1.01	0.92	0.52	0.44	116	0.61
Bronze	1/4	33	11	29	NA	29	12	1.01	0.92	0.54	0.46	121	0.72
PPG Solarblue™	0.946	31	13	32	NA	22	12	0.47	0.49	0.40	0.34	87	0.91
Pilkington Blue-Green	1/4	46	19	30	NA	29	12	1.01	0.92	0.54	0.46	121	1.00
PPG Azuria™	1/4	42	16	30	NA	20	8	1.01	0.92	0.49	0.42	110	1.00
Pilkington EverGreen™	1/4	40	15	30	NA	20	8	1.01	0.92	0.49	0.42	110	0.95



#2 Standard Hole Pattern - 60% Coverage - White Frit

Glass Product	Nominal Thickness Inches	Visible Light			Ultraviolet Trans%	Solar		U-Factor/U-Value		SC*	SHGC*	RHG*	LSG*
		Trans %	Refl.* Outside%	Refl.* Inside%		Trans %	Refl.* Outside%	Winter Nighttime	Summer Daytime				
Clear	1/4	48	28	35	NA	40	28	1.01	0.92	0.57	0.49	126	0.98
Green	1/4	41	22	34	NA	24	13	1.01	0.92	0.50	0.43	113	0.95
Gray	1/4	24	10	34	NA	22	11	1.01	0.92	0.49	0.42	110	0.57
Bronze	1/4	29	12	34	NA	25	13	1.01	0.92	0.51	0.43	114	0.67
PPG Solarblue™	0.946	28	14	36	NA	19	13	0.47	0.49	0.37	0.32	80	0.88
Pilkington Blue-Green	1/4	40	21	35	NA	25	13	1.01	0.92	0.50	0.43	114	0.93
PPG Azuria™	1/4	37	18	34	NA	17	8	1.01	0.92	0.46	0.39	105	0.95
Pilkington EverGreen™	1/4	35	17	34	NA	17	8	1.01	0.92	0.46	0.40	105	0.88

* **Refl.**—Reflectance; **SC**—Shading Coefficient; **SHGC**—Solar Heat Gain Coefficient; **RHG**—Relative Heat Gain; **LSG**—Light to Solar Gain.

For additional information concerning performance, strength or application guidelines see page 10.



Silk-screened Glass: Laminated Glass



#2 Standard Dot Pattern - 40% Coverage - White Frit

Glass Product	Nominal Thickness Inches	Visible Light			Ultraviolet Trans%	Solar		U-Factor/U-Value		SC*	SHGC*	RHG*	LSG*
		Trans %	Refl.* Outside%	Refl.* Inside%		Trans %	Refl.* Outside%	Winter Nighttime	Summer Daytime				
Clear	9/16	54	22	27	<1	37	23	0.95	0.86	0.57	0.49	127	1.10
Green	9/16	47	17	27	<1	23	11	0.95	0.86	0.51	0.44	114	1.07
Gray	9/16	27	8	26	<1	20	9	0.95	0.86	0.50	0.43	112	0.63
Bronze	9/16	33	10	26	<1	23	11	0.95	0.86	0.51	0.44	115	0.75
PPG Solarblue™	9/16	34	11	26	<1	22	11	0.95	0.86	0.51	0.44	114	0.77
Pilkington Blue-Green	9/16	46	17	27	<1	23	11	0.94	0.86	0.51	0.44	115	1.05
PPG Azuria™	9/16	42	14	26	<1	16	7	0.95	0.86	0.47	0.41	107	1.02
Pilkington EverGreen™	9/16	40	13	26	<1	16	7	0.94	0.86	0.47	0.41	107	0.98



#2 Standard Line Pattern - 50% Coverage - White Frit

Glass Product	Nominal Thickness Inches	Visible Light			Ultraviolet Trans%	Solar		U-Factor/U-Value		SC*	SHGC*	RHG*	LSG*
		Trans %	Refl.* Outside%	Refl.* Inside%		Trans %	Refl.* Outside%	Winter Nighttime	Summer Daytime				
Clear	9/16	48	25	31	<1	33	26	0.95	0.86	0.53	0.45	117	1.07
Green	9/16	42	20	31	<1	20	12	0.95	0.86	0.48	0.42	109	1.00
Gray	9/16	24	9	30	<1	18	10	0.95	0.86	0.48	0.41	107	0.59
Bronze	9/16	29	11	30	<1	21	13	0.95	0.86	0.49	0.42	110	0.69
PPG Solarblue™	9/16	31	12	30	<1	20	12	0.95	0.86	0.48	0.41	109	0.76
Pilkington Blue-Green™	9/16	41	19	31	<1	20	12	0.94	0.86	0.49	0.42	110	0.98
PPG Azuria™	9/16	37	16	30	<1	14	8	0.95	0.86	0.46	0.39	104	0.95
Pilkington EverGreen™	9/16	36	15	30	<1	14	8	0.94	0.86	0.46	0.39	104	0.92



#2 Standard Hole Pattern - 60% Coverage - White Frit

Glass Product	Nominal Thickness Inches	Visible Light			Ultraviolet Trans%	Solar		U-Factor/U-Value		SC*	SHGC*	RHG*	LSG*
		Trans %	Refl.* Outside%	Refl.* Inside%		Trans %	Refl.* Outside%	Winter Nighttime	Summer Daytime				
Clear	9/16	42	28	35	<1	28	29	0.95	0.86	0.48	0.41	108	1.02
Green	9/16	37	22	35	<1	17	13	0.95	0.86	0.46	0.39	104	0.95
Gray	9/16	21	10	34	<1	15	11	0.95	0.86	0.45	0.39	103	0.54
Bronze	9/16	25	12	34	<1	18	14	0.95	0.86	0.46	0.40	105	0.63
PPG Solarblue™	9/16	27	13	34	<1	17	13	0.95	0.86	0.46	0.39	104	0.69
Pilkington Blue-Green	9/16	36	21	35	<1	18	14	0.94	0.86	0.46	0.40	104	0.90
PPG Azuria™	9/16	32	18	34	<1	12	9	0.95	0.86	0.44	0.38	100	0.84
Pilkington EverGreen™	9/16	31	17	34	<1	12	9	0.94	0.86	0.44	0.38	100	0.82

* **Refl.**—Reflectance; **SC**—Shading Coefficient; **SHGC**—Solar Heat Gain Coefficient;
RHG—Relative Heat Gain; **LSG**—Light to Solar Gain.

For additional information concerning performance, strength or application guidelines see page 10.



Silk-screened Glass: Insulating Glass Unit



#2 Standard Dot Pattern - 40% Coverage - White Frit

Glass Product	Nominal Thickness inches	Visible Light			Ultraviolet Trans%	Solar		U-Factor/U-Value		SC*	SHGC*	RHG*	LSG*
		Trans %	Refl.* Outside%	Refl.* Inside%		Trans %	Refl.* Outside%	Winter Nighttime	Summer Daytime				
Clear	1	55	25	29	NA	41	23	0.47	0.49	0.58	0.50	123	1.10
Green	1	48	20	29	NA	25	11	0.47	0.49	0.44	0.37	94	1.30
Gray	1	28	9	28	NA	22	10	0.47	0.49	0.41	0.35	89	0.80
Bronze	1	33	11	28	NA	26	11	0.47	0.49	0.44	0.38	95	0.87
PPG Solarblue™	0.233	39	11	25	NA	31	10	1.01	0.92	0.57	0.49	126	0.80
Pilkington Blue-Green	1	47	19	29	NA	26	11	0.47	0.49	0.44	0.38	95	1.24
PPG Azuria™	1	43	16	29	NA	18	8	0.47	0.49	0.36	0.31	80	1.39
Pilkington EverGreen™	1	41	15	29	NA	18	8	0.47	0.49	0.36	0.31	80	1.32



#2 Standard Line Pattern - 50% Coverage - White Frit

Glass Product	Nominal Thickness inches	Visible Light			Ultraviolet Trans%	Solar		U-Factor/U-Value		SC*	SHGC*	RHG*	LSG*
		Trans %	Refl.* Outside%	Refl.* Inside%		Trans %	Refl.* Outside%	Winter Nighttime	Summer Daytime				
Clear	1	49	27	33	NA	36	26	0.47	0.49	0.53	0.45	112	1.09
Green	1	43	22	33	NA	22	12	0.47	0.49	0.40	0.35	87	1.23
Gray	1	25	10	32	NA	20	11	0.47	0.49	0.38	0.33	83	0.76
Bronze	1	30	12	32	NA	23	13	0.47	0.49	0.41	0.35	89	0.86
PPG Solarblue™	0.233	34	12	29	NA	28	11	1.01	0.92	0.53	0.46	120	0.74
Pilkington Blue-Green	1	42	21	33	NA	23	13	0.47	0.49	0.41	0.35	88	1.20
PPG Azuria™	1	38	18	33	NA	16	8	0.47	0.49	0.34	0.29	75	1.31
Pilkington EverGreen™	1	37	17	32	NA	16	8	0.47	0.49	0.34	0.29	75	1.28



#2 Standard Hole Pattern - 60% Coverage - White Frit

Glass Product	Nominal Thickness inches	Visible Light			Ultraviolet Trans%	Solar		U-Factor/U-Value		SC*	SHGC*	RHG*	LSG*
		Trans %	Refl.* Outside%	Refl.* Inside%		Trans %	Refl.* Outside%	Winter Nighttime	Summer Daytime				
Clear	1	43	30	37	NA	31	29	0.47	0.49	0.47	0.41	101	1.05
Green	1	38	23	36	NA	19	13	0.47	0.49	0.37	0.32	81	1.19
Gray	1	22	10	36	NA	17	11	0.47	0.49	0.35	0.30	77	0.73
Bronze	1	26	13	36	NA	20	14	0.47	0.49	0.37	0.32	82	0.81
PPG Solarblue	0.223	30	13	34	NA	24	13	1.01	0.92	0.50	0.43	113	0.70
Pilkington Blue-Green	1	37	22	37	NA	20	14	0.47	0.49	0.37	0.32	81	1.16
PPG Azuria™	1	33	19	36	NA	14	9	0.47	0.49	0.32	0.27	70	1.22
Pilkington EverGreen™	1	32	18	36	NA	14	9	0.47	0.49	0.32	0.27	71	1.19

* **Refl.**—Reflectance; **SC**—Shading Coefficient; **SHGC**—Solar Heat Gain Coefficient; **RHG**—Relative Heat Gain; **LSG**—Light to Solar Gain.

For additional information concerning performance, strength or application guidelines see page 10.



Silk-screened Glass

Capabilities (continued)

Silk-screened Glass Performance Notes

Values are typical for Oldcastle BuildingEnvelope™ products at the time of testing. Data will vary due to manufacturing tolerances as well as glass and ceramic frit variations. All data are Center of Glass (COG) values.

The optical properties for total solar and the visible spectrum were measured following the ASTM E1084 and ASTM E972 standards,

respectively for the white frit coating at 100% coverage on 1/4" clear glass.

Total solar and visible optical properties for a 40%, 50% and 60% frit coating coverage were calculated following standard ASHRAE methodology. The solar heat gain coefficient (SHGC) and U-Values were calculated using the LBNL's Window 5.2 program. The environmental conditions used for the calculations are NFRC 100-2001.

Applications

Oldcastle BuildingEnvelope™ offers a variety of silk-screened decorative glass products to satisfy a wide range of applications. Light frit colors and certain pattern designs can cause enhanced brightness when viewed from indoors under certain daylight and background sky conditions, while dark frit colors will tend to reduce glare. Applications include transparent and translucent silk-screened glass for interior applications, including glass doors, partitions, handrails, glass ceilings, floors, bathrooms, elevator walls, shower enclosures, court walls for racket sports and sneeze guards for food service, curtain walls, canopies and skylights.

See the Glass Selector Tab for some typical applications.

Insulating Glass

When used in an insulating glass (IG) unit, silk-screened decorative glass provides an attractive, easily cleaned building component. The silk-screened pattern can be applied to the #2, #3 or #4 surface of an insulating glass unit to provide the desired aesthetic and performance characteristics. For optimum solar performance, the silk-screened pattern should be applied to the #2 surface. Some glass types may not be available with a second surface frit application. Applications with the silk-screened pattern on the #3 or #4 surface will result in an increase in solar absorption on the interior lite and a higher shading coefficient.

Laminated Glass

When incorporated into laminated glass make-ups, silk-screened decorative glass can be used in interior partitions, handrails, doors, glass art, canopies and skylights. For exterior applications, the silk-screened pattern can be applied to the #2, #3 or #4 surface of a laminated glass assembly providing an element of safety in addition to desirable aesthetics and performance levels. For interior applications, the silk-screened pattern can be applied to the #1, #2, #3 or #4 surface of a laminated glass assembly.

Design Considerations

The correct choice of silk-screened decorative glass for a particular application requires the careful consideration of a number of different properties: color and appearance, thermal and acoustic insulation, strength, deflection under design load and meeting code or safety requirements. Other properties such as flatness and ease of cleaning, which can make silk-screened decorative glass the material-of choice, may also need to be considered.

See the Glass Selector Tab for some typical applications.



Silk-screened Glass

Characteristics

Most heat-treated silk-screened glass is not permanently marked with a logo unless it is specifically requested at the time of placing an order. The design professional is responsible for specifying the use of a logo as required to meet the governing building codes. Heat-treated glass (fully tempered or heat-strengthened) complies with ASTM Standards C1036 and C1048. Tempered glass meets ANSI Z97.1 and CPSC 16 CFR 1201 safety glazing standards. Tempered silk-screened decorative glass supplied in Canada complies with CAN/CGSB-12.1-M90.

Moiré Effect

Moiré is an optical phenomenon that appears as a circular or wavy pattern that may occur with some silk-screened glass conditions. Moiré is formed when two regular spaced patterns overlap but are not aligned.

While moiré may be difficult to predict, the following will increase the probability of it to occur:

- Fine line patterns
- Dots and holes spaced too closely together
- A silk-screened pattern applied to two or more glass surfaces
- Silk-screened patterns combined with a highly reflective glass
- Large insulating units with less than a 2:1 ratio of width to length

Although these guidelines will help, Oldcastle BuildingEnvelope™ recommends full size mock-ups be evaluated when considering silk-screened glass for your project. The mock-up should be viewed under a variety of light and temperature conditions.

Inspection Guidelines

Interior Applications:

Inspect at a distance of 1M (39"), a viewing angle of 90 degrees to the surface being inspected, under incandescent lighting conditions.

Exterior Applications:

Inspect in transmission at a distance of 3M (10 feet), a viewing angle of 90 degrees to the surface being inspected, under indirect daylight conditions, against a uniform background.

The following quality guidelines are to be used for the evaluation of silk-screened decorative architectural glass products when viewed per the inspection guidelines listed above:

- Scattered pinholes and/or fisheyes are allowable
- Screen marks are not allowable
- Slight mottling is allowable within the normal viewing area
- Opaque particles are not allowable within the normal viewing area, but are allowable outside the normal viewing area
- Slight variations in color uniformity are allowable

The 'Normal Viewing Area' is defined as the central 80% of the total area of an individual lite.

Oldcastle BuildingEnvelope™ does not recommend the use of silk-screened decorative glass in backlit applications.

The following criteria also apply:

- On close viewing, 'sawtooth' edges are acceptable in the screen printing process
- A maximum variation of +/- 1/32" (0.8 mm) is acceptable in dot, line or hole location
- Screened patterns may be located up to 1/16" (1.6 mm) off parallel from the locating glass edge. (Locating glass edge must be identified on the PO)
- Due to glass dimension and squareness tolerances, printed patterns may be up to 1/8" (3 mm) off parallel from the edges other than the locating glass edge
- Patterns covering the entire glass surface will require a 1/8" (3 mm) or less border at the edge



Silk-screened Glass

Characteristics (continued)

- For structural silicone glazing applications, the pattern may extend to +/- 1/32" or less but must be specified on the order
- A print image of a 1/32" (0.8 mm) indefinite border is acceptable
- A 1/8" (3 mm) border can be obtained for structural glazing applications. (Structural glazing applications must be specified on the PO)

Additional Important Information

Specifications:

A sample Section 08 81 00 Specification for North America can be found in the last section of this binder titled: Sample Architectural Glass Specifications.

Silk-screen Charts

Contact Oldcastle BuildingEnvelope™ at 1-866-OLDCASTLE (653-2278) for samples or additional information concerning performance, strength, deflection, thermal stress or application guidelines. GlasSelect® calculates center of glass performance data using the Lawrence Berkeley National Laboratory (LBNL) Window 5.2 program (version 5.2.17) with Environmental Conditions set at NFRC 100-2001. Gas Library ID#1 (Air) is used for Insulating Glass units with air. Gas Library ID#9 (10% Air/90% Argon) is used for Insulating Glass units with argon. Monolithic glass data is from the following sources: 1. LBNL International Glazing Database (IGDB) version 15.0; 2. Vendor supplied spectral data files. Laminated glass data is from the following sources: 1. LBNL International Glazing Database (IGDB) version 15.0; 2. LBNL Optics 5 (version 5.1 Maintenance Pack 2); 3. Vendor supplied spectral data files; 4. Vendor supplied data.

Contact Us

For any additional information, including details, technical data, specifications, technical assistance and samples, call 1-866-OLDCASTLE (653-2278).

Visit Us on the Web

Log on to www.oldcastlebe.com for project photos, product colors, general inquiries and project assistance.

To view performance data on a wide range of glass make-ups, or to build your own product specification, log on to www.oldcastlebe.com and choose GlasSelect®.

